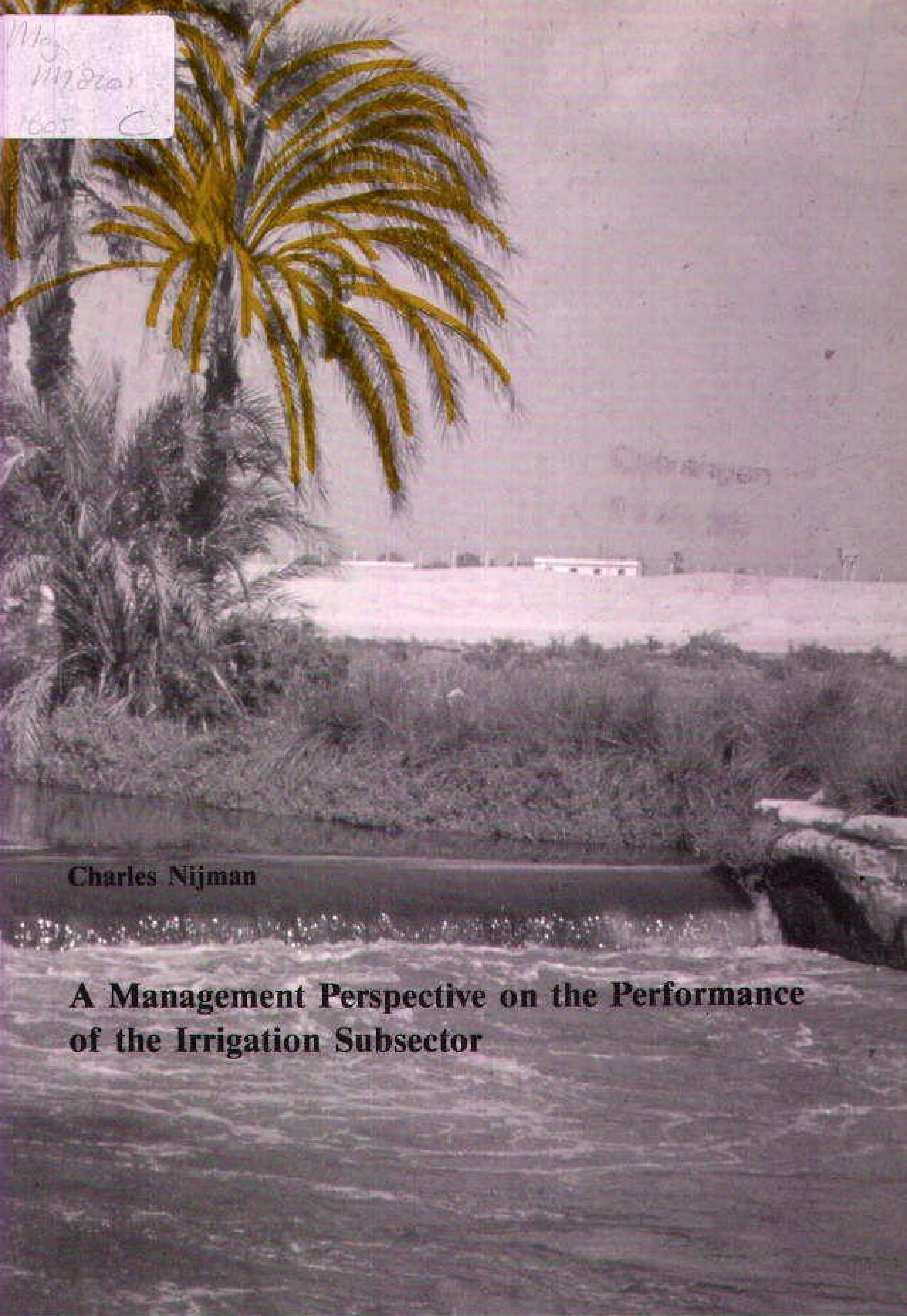


Charles Nijman

A Management Perspective on the Performance of the Irrigation Subsector

Stellingen

1. De Wageningse procesbenadering blijkt een goed referentiekader voor het verschaffen van een integrale kijk op de besturingsproblemen van de slecht presterende irrigatie sector.
   Dit proefschrift

2. Het hanteren van het onderhavige besturingsmodel heeft geleid tot het constateren dat een deel van de bestuurlijke problematiek van het irrigatie management tot dusver niet op zijn waarde wordt geschat. Dit betreft de besturing van de stroomregulering.
   Dit proefschrift

3. Er bestaat een systematische prioriteit in de irrigatie subsector voor het investeringsvolume. Een belangrijk gevolg is een lage gemotiveerdheid tot het leveren van goede kwaliteit van capaciteit scheppende besluiten en tot het leveren van goede prestaties gedurende de capaciteitsbenutting.
   Dit proefschrift

4. Verbeteringen in het benutten van irrigatie capaciteit vereisen een relatie tussen de financiering van een irrigatiedienst en de kwaliteit van zijn dienstverlening.
   Dit proefschrift

5. Tot dusver zijn er geen mechanismen in de financiering van de irrigatie subsector die op effectieve wijze de verantwoordelijkheid voor het oplossen van de kwaliteitsproblemen decentraliseren naar diegenen die er iets aan zouden kunnen doen.
   Dit proefschrift

6. Een niet aan prestaties gerelateerde financiering van investeringen in ontwikkelingshulp versterkt de bestaande centralistische tendensen van de ontvangende overheden.

7. Zowel de irrigatietechnische als de economische technieken gebruikt in de irrigatie gaan impliciet uit van een mechanistisch, maximaliserend mensbeeld.
   Dit proefschrift

8. In tegenstelling tot de meeste andere sectoren heeft het in de irrigatie weinig status om een manager te zijn.
   Dit proefschrift

9. Een officiele omzetting van de term ontwikkelingssamenwerking in zoiets als internationale bijstand --waaronder de opvang van asielzoekers-- zal waarschijnlijk het bewustzijn van de noodzaak, en dus de politieke haalbaarheid, van een GATT overeenkomst doen toenemen.

10. De investeringen in straalvliegtuigen, automatiseringsprojecten en irrigatie systemen hebben tenminste gemeen dat ze ten opzichte van de schattingen ongeveer tweemaal zoveel kosten. Gelukkig wordt dit voor de laatste twee typen van investeringen "gecompenseerd" door het feit dat het effect meestal half zo groot is.

11. Het beheer van de gemeentefinanciën in Den Haag suggereert dat de promovendus dezes zich verder maar beter niet met de ontwikkelingshulp kan bezighouden.

Charles Nijman
"A management perspective on the performance of the irrigation subsector"
Bennekom, 2 april 1993

A MANAGEMENT PERSPECTIVE ON THE PERFORMANCE OF THE IRRIGATION SUBSECTOR

Promotor: *Drs. A.A. Kampfraath, emeritus-hoogleraar in de bedrijfskunde en de organisatieleer.*

A MANAGEMENT PERSPECTIVE ON THE PERFORMANCE OF THE IRRIGATION SUBSECTOR

Charles Nijman

Proefschrift
ter verkrijging van de graad van doctor
in de landbouw- en milieuwetenschappen
op gezag van de rector magnificus,
dr. H.C. van der Plas,
in het openbaar te verdedigen
op 2 april 1993
des namiddags te vier uur in de Aula
van de Landbouwuniversiteit te Wageningen

CIP-GEGEVENS KONINKLIJKE BIBLIOTHEEK, DEN HAAG
ISBN 90-5485-093-0

Cover photograph by M.G.Bos: An Egyptian irrigation canal

CONTENTS

Figures

Tables

Glossary

assolement	Moroccan type of zoning
bethma	sharing of certain irrigated areas during dry seasons
chak	irrigable area under control of farmers, comparable to tertiary system
golongan	Indonesian scheduling system
kharif	the "summer" cultivation season
paddy	rice
pasten	Indonesian scheduling system
rabi	the "winter" cultivation season
subak	Balinese water users' and community group
tank	reservoir

Abbreviations

ADB	Asian Development Bank
AHT/SCG	Agrar- und Hydrotechnik Gmbh/Salzgitter Consult Gmbh.
ANAFID	Association Nationale des Ameliorations Fonciers, de l'Irrigation et du Drainage
CADA	Command Area Development Authority
CGIAR	Consultative Group for International Agricultural Research
DFC	Development Finance Consultants S.A.
DAC	Development Assistance Committee
EEC	European Economic Commission
EIRR	economic internal rate of return
FAO	Food and Agricultural Organization of the United Nations
FSD	full supply depth
FMIS	farmer-management irrigation systems
HRM	human resources management
IAC	International Agricultural Center
IBRD	International Bank for Reconstruction and Development (World Bank)
ICB	International Competitive Bidding
ICID	International Commission for Irrigation and Drainage
IFDP	Institute for Food and Development Policy
IIMI	International Irrigation Management Institute
ILRI	International Institute for Land Reclamation and Improvement
IMD	Irrigation Management Division
IMF	International Monetary Fund
IRR	internal rate of return
LDC	less developed countries
MIS	management information systems
MMP	Sir M. Mac Donald & Partners Ltd.
NEDECO	Netherlands Development Consultants
NIA	National Irrigation Administration
NIC	newly industrializing countries
NPV	net present value
O&M	operation and maintenance
ODI	Overseas Development Institute
OECD	Organization for Economic Cooperation and Development
OED	Operations Evaluation Division
ORMVA	Office Regional de Mise en Valeur Agricole
PPAR	Project Performance Audit Report

PRC	Planning Research Corporation
TAC	Technical Advisory Committee
USAID	United States Agency for International Development
WUG	water users' group

"So how is the "Crisis of Irrigation Management" to be avoided? Here the international development community has a vital role to play. This community has been an active part of the problem through the policy of moving enormous funds into irrigation programs with virtually no attention paid to the results. Indeed there can be little doubt that the policy of benign ignorance --however well intentioned through reluctance to "interfere in internal affairs" of local governments--has been a principal cause of poor management and corruption in irrigation systems. The time is now long past due for this policy to be reversed and for the international development community to play an active role in helping the many talented, honest and dedicated people in the LDCs to resist politicization and corruption of their management systems. A "hands off" policy, confined only to financial disbursements, simply helps the "bad guys" against the "good guys". Insistence of effective management, on results, reverses the balance between the two. Here is the keystone for international irrigation development policy."

Seckler 1982:14.

to Inge and Thijs

Preface

THE MANAGEMENT PERSPECTIVE on the irrigated subsector presented herein is the outcome of four years of related efforts that were initiated in 1987 by the then management of the International Irrigation Management Institute (IIMI), Dr. T. Wickham and Ir. F.E. Schulze. They requested the Dutch Ministry of Foreign Affairs to second a staff member with a background in both management science and irrigation engineering. The Ministry reacted kindly by sending the undersigned.

Developing a management perspective on the irrigated subsector required inputs from practitioners, researchers and specialists of the most important involved disciplines such as engineering, sociology, agronomy and economics. The development of this management perspective was therefore initially done through case studies in Sri Lanka, the Philippines, Morocco and Sudan. Apart from available data in reports, files, and studies in different systems, irrigation agencies and donor organizations, the generalizing picture presented here is based to a large extent on interviews with a wide range of actors involved. It is an attempt to integrate the following multitude of perspectives:

> of farmers and field staff, their superiors, system managers, engineers, design and other support staff of irrigation agencies, as well as most top managers in the involved countries, agricultural agency staff, and individuals of the national planning agencies, several secretaries and undersecretaries of irrigation ministries, external consultants, many staff members of the World Bank and Asian Development Bank, a former Executive Director of the latter, a former Member of Parliament, a Minister of Irrigation as well as a former President of the World Bank. In addition, interaction with many other irrigation and development professionals has contributed to this management perspective.

Many agency documents, files, reports, management control and information systems, as well as loan documents, audit reports and impact evaluation studies were reviewed. The presented management perspective was further validated with an extensive survey of the irrigation management and development literature.

The analysis here is based on this multitude of opinions from interviewees and available written data. Although supported by an analytical framework, and its "unbiased" management perspective, the story represents the author's distillation of the "true" picture of the performance of investments in the irrigated subsector. Thus, only the author is responsible for the analyses and evolving conclusions and recommendations. The views expressed are his own.

It is not the objective of this analysis to blame any individual or any specific agency, government, consultant firm or funding agency regarding the nature of their involvement in irrigation investment. Instead, it is pursued to provide a picture of systematic constraints in irrigation management. Most reviewers of the two initial Sri Lankan case studies have explicitly referred to the much wider validity of this systematic pattern. Many findings and recommendations are likely to apply to a certain degree to other government agencies and other funding agencies involved in investment in irrigation, and in development in general, also in other developing countries. As far as individuals can be identified at all here, they should not be criticized as this analysis is about the performance of the "system" of irrigation development and management in developing countries, and definitely not about individual performance.

The development of the analytical framework, and its application on case studies to obtain a generalized management perspective on the irrigation subsector would not have been possible without the extensive and thoughtful professional guidance of Prof. Drs. A.A. Kampfraath in our frequent encounters during the past four years. I am extremely grateful to him and to IIMI for making possible this type of "overseas" professional guidance. Also, I would like to thank Dr. P.S. Rao for the support and technical supervision provided in an early stage of this study, and Mr. Charles Abernethy and Mr. Khalid Mohtadullah for support and supervision at later stages of my assignment with IIMI.

The majority of data collection and interviews for the two Sri Lankan case studies occurred during 1988 and 1989. The comparative studies in the Philippines, Morocco, and Sudan, as well as the extensive literature survey were done during 1990 and 1991.

Given this study's dependence on the interaction with irrigation practitioners and researchers, I am very grateful to the many people who allowed me time for interviews, often iteratively. I hope that most of these interviewees can find themselves in the presented analysis and recommendations. Moreover, I am very grateful for the cooperation and assistance I received from the staff of the Sri Lankan Mahaweli Economic Agency, Irrigation Department and Ministry of Irrigation, Lands and Land Development, the Moroccan irrigation authorities of Gharb and Moulouya, the Philippine National Irrigation Administration, and the Sudanese Rahad Corporation and Ministry of Irrigation. I am also grateful to involved staff members of several consultant companies, research institutes, the World Bank and Asian Development Bank for their cooperation with this research.

Interaction with IIMI colleagues and some of its visitors was crucial for this study. Indeed this study would not have been possible without it. In particular, I would like to thank the following for the discussions we had on irrigation management:

Dr. P.S. Rao, Dr. Hammond Murray-Rust, Dr. Zenete Franca, Dr. Masao Kikuchi, Mr. K. Jinapala, Mr. P.G. Somaratne, Dr. Douglas J. Merrey, Dr. D. Vermillion, Mr. J. Verdier, Dr. C.M. Wijayaratne, Mr. D. Berthery, Dr. H. Sally, Mr. Charles Abernethy, Ir. F.E. Schulze, Mr. Khalid Mohtadullah, Dr. R. Saktivadivel, Dr. M.S. Shafique, Prof. Khin Maung Kyi, Dr. E. VanderVelde, Dr. Jacob Kijne, Dr. Chris Panabokke, Dr. D. Seckler, Dr. D. Constable, Dr. Gil Levine, Dr. M. Svendsen, Dr. Fred Valera, Mr. Jacques Rey, Mr. Ranjith Rathnayake, and Ms. Inge Jungeling

In addition, Prof. Lucas Horst and Dr. Peter Zuurbier of Wageningen University provided thoughtful comments on the paper's final draft version. Though I do not want to implicate any of them in the author's responsibility for the presented analysis and findings.

The research was supported by the Research and Technology Department (DPO/OT) of the Ministry of Foreign Affairs of the Netherlands, through my secondment to IIMI for more than four years. Additional research and publication costs were funded out of IIMI's unrestricted core funds, for which I am very grateful as well. In addition, I am grateful to the Department of Management Studies of the Wageningen Agricultural University for the support given to this research, especially during the last months of finalizing this text.

Special thanks are due to Ms. Charlene Ludowyke for the preparation of parts of this text, and to Ms. Mala Ranawake for assisting in the preparation of most of the figures.

Reading Advice

Readers with very limited time who want to grasp the main messages of this management perspective, are advised to read the Executive Summary and chapter six, that contains the conclusions and recommendations.

Charles Nijman
Bennekom, August 1992

Executive Summary

INVESTMENT IN IRRIGATION has been immense in the past. Estimated average annual investments of US$ 15 billion makes irrigation the largest subsector of the agricultural sector, that is itself by far the largest sector of development investment. Since the mid-1960s the awareness spread that the performance of irrigation investments was far below its potential. The size of this underperformance is well represented by Seckler's alarming conclusion that the average irrigation investment costs twice as much, and delivers no more than half the benefits specified in the plans.

THE PROBLEM DEFINITION

Simultaneously with the increased awareness about underutilization, the awareness increased that the level of management of the systems was backward compared to the construction efforts and expertise. The underutilization was considered not only a technical, but also a managerial problem. Essentially three pilot studies in the late 1970s in the Philippines, Sri Lanka and India have provided the few available data to proof such potential for performance improvement through improved management. Yet, this potential for a sustainable "water revolution" remains to date largely as it was, because the evidence of these three experiments was not repeated nor sustained.

From the perspective of many engineers, the management issue in irrigation has remained therefore, to a large extent, imaginary. There has remained thus a serious disjuncture in the perspectives of many irrigation professionals. Many of them have argued for the need for a more objective perspective on irrigation's performance to reunite the different professional perspectives, and as a prerequisite for the identification of relevant improvements. The topic of this study is such an improved insight in the management of irrigation, and ways to improve its performance.

THE OBJECTIVES

In addressing these issues, this study adopts the following two objectives: 1) the identification of generalized directions of management change for performance improvement in the irrigation subsector; and 2) the testing of an analytical framework for irrigation management.

Addressing these objectives requires firstly an effort to fill the fore mentioned gap toward the concept of irrigation management. Therefore, the concepts of management and control processes and conditions of an existing analytical management framework are translated for irrigation. Together they form this paper's so-called management perspective. Subsequently, this analytical framework is applied to irrigation.

EXISTING IRRIGATION MANAGEMENT CONCEPTS

Few explicit efforts to develop irrigation management concepts appear to exist. Most concepts focus on the formal appearance of the organization, its structure. Of the reviewed concepts, only Diemer's approach was a process-oriented approach. All concepts remained vague about the relation between process and structure. None of them tried to take a management perspective, i.e., to consider all relevant factors for irrigation managers. This study's potential contribution is to fill these gaps by taking an explicit management perspective, and by systematically analyzing the relation between process and structure. Besides, other management conditions than structure only are considered such as financial control systems, human resources, and the provision of information and knowledge.

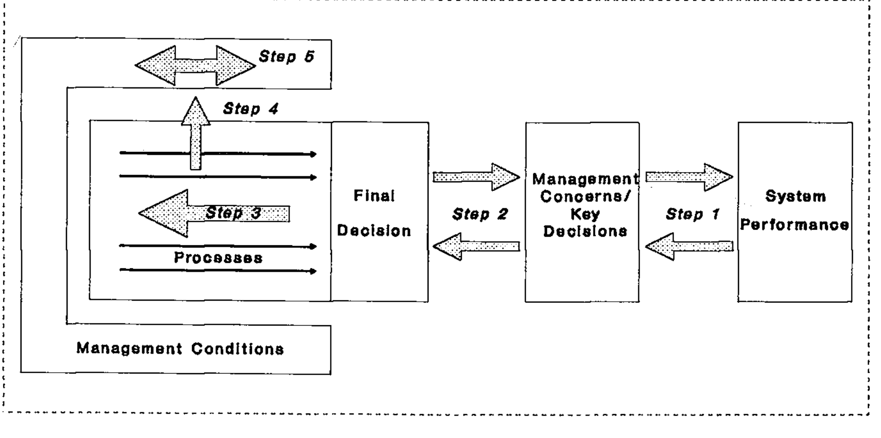
AN INTEGRAL MANAGEMENT PERSPECTIVE

This study's management perspective is based on an integral management framework developed by Kampfraath and his colleagues of the Department of Management Studies of the Wageningen Agricultural University, The Netherlands.

The Figure below is a graphic representation of the different steps of this process-based management analysis. The identification of key decisions in regard to water delivery is the first step in the development of this management perspective on irrigation (step 1 of the Figure below). For irrigation agencies, the management of *water* is considered the primary irrigation activity and measure of performance evaluation. Therefore, to evaluate the internal management processes in any irrigation system, the relevant key decisions for irrigation have to relate to the water delivery.

During the *capacity utilization*, the seasonal allocation plan, in-seasonal allocation, and the flow regulation are considered to be such key decisions. For the *capacity creation*, the desired investment objectives, feasible investment objectives, and the functional requirements for the investment were taken as the most relevant key decisions.

Performance-based management analysis



After the definition of the relevant key decisions, the contribution to the overall performance must be established for each of them (step 2). If this contribution is deemed unsatisfactory, the processes leading to the final decisions are analyzed, and the bottlenecks in these processes are identified. The establishment of the so-called levels of sophistication of the key decisions is part of this analysis (step 3). Based on an analysis of the interaction between the processes and the management conditions, those changes in the management conditions are derived that are likely to lead to improved processes. Apart from the organizational structure and rules, this framework also considers such other management conditions as the human resources, their motivation and incentives, the provision of information and knowledge, and the financial control systems. This leads to an identification of the changes needed in management conditions that are likely to result in improved processes, improved decisions, and improved performance (step 4). The last step is then the identification of the required management-control processes to achieve these required improvements in processes and management conditions (step 5).

This analytical framework thus links performance, physical processes, decision-making processes, management conditions and management control in an analytical sequence. Thus providing an integral "management perspective" on irrigation performance.

DATA COLLECTION

This study's data collection occured during in-depth organizational analyses of two Sri Lankan irrigation organizations, and during comparative studies in Morocco, Sudan, and the Philippines. Besides, less intensive observations were done in India, Malaysia and Pakistan.

The data collection on decision-making processes consisted of the interviewing of decision makers in irrigation and other line agencies, ministries, funding agencies and consultant companies. Also reports, files, records and other documentation were reviewed. In addition, a literature survey was done to shape and compare the findings.

The following sections give short summaries of the most significant findings and recommendations for the management of the capacity utilization and the capacity creation of irrigation in LDCs.

RESULTS: CAPACITY UTILIZATION

The assessment of the available water supply in the observed irrigation systems tended to occur in an approximate rather than a precise way. They tended to be on the "safe" side --preferably at a 100 per cent probability, i.e., at no risk--to minimize cultivation risks, and to minimize the related conflicts with the farmers and politicians. This practice pre-emped the inclusion of the trade-offs between lower risks for the few lucky farmers, and higher risks for more farmers. Other interested parties than the irrigation agency or officer were usually not aware of the exact probabilities of the availability of the water supply. Thus, they did not share the responsibility for any related risks.

Contrary to common belief, the assessment of the demand, the allocation of water, and the regulation tended to be demand-driven in all case studies. This decision making was left almost completely to the field level staff. Higher level agency staff made water schedules based on theoretical calculations. These excluded important aspects such as the scarcity of water and the required management inputs by agency staff and farmers to achieve high water efficiencies. These schedules seldom had any value for the actual implementation of water allocation and regulation.

Higher level staff thereby tried to minimize their management inputs. Only when complaints occured did staff get involved. To minimize complaints they tended to allow field staff to satisfy the demand for water, and allowed a related superfluous water discharge in all canals (if the supply was available). The main canals thus often transported the maximum discharge. Systematic monitoring and evaluation was not done in any of the case studies, as the extra water in the canals and the "delegation" to field staff did not need any.

This minimal management approach of the agencies favored the farmers at head-end reaches along the canals. So the tail enders often had problems in obtaining sufficient water as the design and actual discharge capacities of the canals were insufficient for this type of surplus water allocation.

The flow regulation along the main canals appeared an "adhocracy". The individual operators had no contingency instructions on procedures for gate settings relative to the timing and size of flow fluctuations. They operated therefore often by trial-and-error and tended to favor thereby the distribution to the service area under their responsibility. This was done again to satisfy farmers and to minimize complaints, at the expense of the conveyance to downstrean canal reaches. Also gate operators that were responsible for tail-end reaches could not correct systematically such favoring by upstream reaches. The easiest way out for them was to request an increase of the total discharge in the main canal.

Getting more water to the end of the canal was then only possible by the allocation of more discharge to the overall system, or, if that were impossible, by rotation or staggering. Introduction of the latter measures required increased management inputs by higher level staff, and occurred only if (a portion of the) farmers, superiors or politicians complained.

The above processes were mainly caused by the low motivation of agency staff involved in the capacity utilization. The incentives to be involved appeared to be mainly the following "negative" ones: farmers were never satisfied, a lack of performance-related financial or career incentives, the continuous risk of political interference, and professional and financial incentives for construction and maintenance rather than for the capacity utilization. Similarly, irrigation agencies as a whole had no performance-related incentives, other than the fore mentioned negative ones.

The above practices, motivation and incentive constraints were more true in some countries than in others. In Morrocco, the management practices were at a more elevated level compared to the other case studies and some of the above generalizations did not apply to Morocco. Performance-related motivation and incentives were observed to be somewhat higher because of a more sophisticated management, with individual billing, and a volumetric water delivery to farmers. Yet, also in Morocco, the agencies appeared to have no financial incentives to manage the allocation and regulation along the main system, in order to prevent obvious and known water losses.

Main recommendations. In all case studies, improvement of the capacity utilization would require increased inputs by higher level agency staff. This would require that they, as well as field staff, become more motivated for this type of work. This seemed unlikely to occur if the agencies themselves would not become more interested in and accountable for the water-delivery performance.

The overall recommended directions for institutional reform to improve the capacity utilization were the following:

1. A decentralization of the irrigation agencies. This would allow greater information exchanges at lower levels between farmers and agency, and between different agency levels;

2. More financial dependence of the irrigation agency on the water-delivery performance. This would introduce some accountability for the water-delivery performance. For example through an increased dependence on service payments by farmers. More financial independence of the irrigation agencies means also a decreased dependence on the judiciary budgetary allocation by the government;

3. A more performance-oriented human resources management, such as performance-based incentive systems and career development, especially for higher level staff. This would require a decentralization of the related authority to the agency;

4. A more explicit and specific mission statement;

5. External public monitoring for more systematic accountability (if no financial or other accountability to the clients exists);

6. More transparency of and thus accountability for the performance of the regulation through a separate, central "regulation unit";

7. If WUGs are to be functional, they need a more powerful position in the water-related decision-making processes than currently observed in all case studies. This could be achieved either through more administrative authority, or through financial accountability to the WUGs. An ultimate step as the transfer of the ownership of (part of) the system (and possibly the agency) would provide the collectivity of farmers with even stronger powers to make the managing agency accountable for the performance during the capacity utilization;

8. More appropriate government regulations and related enforcement to reduce the observed adverse incentives in some more independent irrigation agencies.

Given the involved interests of agencies, their staff and the farmers, the above changes can only be realized if they get serious support from political and donor levels.

RESULTS: CAPACITY CREATION

The desired investment objectives. Decision taking on the desirable investment objectives was often observed to be done single-handedly by national politicians. Usually, donor staff in consultation with consultants and agency staff prepared such decisions. This preparation usually left little time and room for participatory interactions with other interest groups.

Politicians often determined such politically relevant objectives as the site identification and the selection of beneficiaries. The political pressure thereby caused the professional guidance to become sometimes ineffective.

The acquisition of external funding was observed to be the prevalent political and agency priority. It dominated the other desired objectives, other than those of political importance. Because of this priority for external funding, the funding agency had, in principle, and in practice, a large influence on the determination of the desirability of the investment objectives. Thus, the desirability of such investment objectives as the project size and the performance of the water delivery and agricultural production was in all case studies largely at the discretion of the donor staff or consultants.

As a result, also the interests of farmers and other local interests were unlikely, and were observed not, to be adequately represented in the decision making on the desirable investment objectives. Often the desirability from the farmers' perspective was considered equal to the maximum funding level as the funds were perceived as "handouts" to localized voters.

In combination with an observed supply-driven availability of financial resources for irrigation investment, such politically dominated processes and the related attitudes worked against choices for less capital-intensive, more effective investments in, for example, water management and conservation. This applied to all case studies.

Yet, the major gap in this decision making seemed the observed absence of an explicit definition of the desired performance levels for the new investments. The widespread and long-established experiences with ineffective capacity utilization in irrigation made this absence all the more striking. Even if donors, governments or consultants were aware of the unlikeliness of achieving the assumed performance improvements in specific systems or projects, they were observed to ignore such considerations in the investment selection and design process. Assumed performance targets of irrigation investments were kept implicit in all case studies.

The likely commitment of such stakeholders as the national politicians, governments and agencies to the implicitly defined performance targets was almost nil (except for the few who were internally motivated). The more so given the lack of incentives to achieve them, while ample incentives were observed to relate to the acquisition of new investments (in an environment with abundant availability of financial resources for irrigation investment). In all case studies, the commitment of staff of the national planning agency, the irrigation ministry and the irrigation agency toward performance improvements was observed to be almost absent. The widespread underutilization of irrigation capacities in the past did not seem to have led to a stronger conditionality toward the quality of subsequent investment decisions. The underlying reason seemed the conflict of the quality of investment decisions with the fund-channeling function of the donor agencies, i.e., with the quantity of the investments.

The feasible investment objectives. Financial resources for irrigation seemed abundant mainly because of the nature of the feasibility and appraisal assessments. In all case studies, the feasibility and appraisal assessments were observed to occur after the political decision to undertake the project. The different steps and methodologies served merely to justify the decision. Consideration of the feasibility of alternative types of projects, project sites, or a more phased development to achieve the same objectives, were ignored in all case studies.

The preparation of the decision about what was feasible and what not, was observed to be mainly the task of donor staff and consultants. Sometimes because they were considered more "independent" than staff of the recipient country or agency, in other cases because they would prevent likely delays in loan disbursements. Yet, it was observed to be very difficult, if not impossible, for them to determine the true feasibility, especially of the assumed performance improvement. Recipient agency and government staff tended to represent vested interests to realize the funding, and were unlikely to provide any information counteracting these interests. Even in the few observed cases where they were willing to do so, they were usually not asked to. Also the assessment experts and donor staff, who were driven by their organization's targets, were not interested in an absolutely neutral feasibility assessment.

The assumed performance improvements and other optimistic assumptions were thus typically not justified. They were kept implicit. Cost-benefit and sensitivity analyses were not allowed in any of the case studies to classify a project as unfeasible. They seemed therefore to have lost their functionality for an objective assessment of investment feasibility and appraisal. Instead, they were used to facilitate subsidies for irrigation investments.

The observed funding agencies were observed to have undertaken remarkably little to minimize or counterbalance some of the tendency to be overly optimistic in feasibility assessments. Rather than demanding explicit evidence of assumed performance improvements, virtually the only check and balance mechanism within the development banks was observed to be the mild "peer reviews". These meetings tended to be chaired by persons who were primarily responsible for the quantity of loans, rather than for their quality.

Performance targets for investments were implicitly set during feasibility decision making, and tended to be mainly donor-driven. Commitment to, or awareness of, these targets by staff of national governments and agencies was very low to zero.

Justifications for why an investment would not become another failure were mostly conceptual, rather than related to real-life. The different conceptual approaches developed to overcome the "management gap" (such as parallel field canals, on-farm water management, O&M manuals, water-management consultants, farmer participation and monitoring and evaluation) did not increase the commitment of the agency and government as they did not touch upon the performance and accountability issues. In fact, these solutions increased the donors' influence in actual investment planning and design, whereby the agencies felt increasingly less responsible, resulting in a diminishing commitment from their side. Sequential conceptual solutions established in a donor-driven mode, seemed to have produced progressively less and less commitment to their actual feasibility by the national agency staff.

A logical and related effect of the observed manipulation of the assumptions pertaining to the economic internal rate of return (EIRR) was the increased lack of any control over capital expenditures from the national point of view. Limits on expenditures per resource unit were observed to be non-existent in all case studies. For example, the maximum investment per settler, per unit of increased agricultural production, per unit of volume stored or regulated, per job created, per area commanded were seldom determined and were thus de-facto based only on political considerations. This led to investment maximization attitudes by irrigation agencies and politicians--at great economic loss for the overall country in current and future generations.

The functional requirements for the investment. As for feasibility and appraisal assessments also the decision-making processes about the functional requirements for the design were observed to occur in all case studies at conceptual levels only. Engineers of donors, consultants and irrigation agencies together seemed to determine these concepts and to adjust them regularly. Yet, no interaction with local system managers and farmers was observed for the determination of an explicit "program of requirements" in any of the case studies.

The resulting rigid application of the different design "blueprints" with insufficient localized information was observed to be widespread. It led to almost random turnout sizes, often arbitrary placement of structures, the planning for unsuitable soils and cropping patterns in the design and the suboptimal use of existing reservoirs and drainage lines. Also during design, the misuse of the theoretical formulae for crop water requirements was found. Sequential assessments were allowed to be inconsistent without related justification. Thus designs were adjusted to fit with the preceding overoptimistic appraisal assessments. In addition, political interference was observed to occur frequently in the design process.

Although substantial opposition against these design blueprints can be found in the irrigation management literature, all the observed funding institutions had accepted them. From their perspective, the advantage of the conceptual design seemed that issues such as the performance of the service delivery and the agency's related management control could be circumvented, while still having a "solution".

To a certain extent, awareness about the non-functionality of the designs was observed in the case studies. Still, the preferences tended to go for short-term investment at the expense of long-term performance. Construction and political priorities in the agencies together tended to resist performance arguments, and to impede changes to a more realistic professionalism. Considerable political maturity seemed required to reverse such processes. Over time, the design seemed to have become a routinized, uncreative exercise.

Awareness of how present design concepts have evolved over time was thereby observed to fade away gradually with the younger generation of engineers. Scientific design concepts have become internalized and the question of functionality did often not even arise.

Yet, the influence of donor staff and external consultants on the formulation of design concepts appeared tremendous. Although the supervision by donor staff was observed to be intermittent and minimal--their staff visited a project typically only once a year--, they appeared more responsible for project justification and success, and thus for the project's design concepts, than were the local executing agencies and government staff. To justify either new loans or loan continuation, the donor staff or consultants had to come up with solutions. These were necessarily conceptual due to their unfamiliarity with the actual local situation in terms of the institutions, farmers, and physical conditions. The observed local parties, from their side, were tempted to easily agree to almost any solution proposed as long as they themselves did not become responsible or accountable. The actual functionality of the design seemed often a minor concern to governments, agencies, consultants, and donor. Accountability for it was a non-issue in the observed irrigation bureaucracies.

The visibility of capital-intensive irrigation investments is likely to remain politically attractive. This impetus was probably an important reason for the observed donor efforts to develop ever-changing blueprints that were less dogmatic than the earlier design concepts. These provided the new solutions as justifications for new investments. The tragedy of these donor-driven, conceptual solutions was that, however appropriate these design concepts could have been, the donor was observed to become more and more co-responsible for the performance of the new design concepts as they became more and more their intellectual property. Especially because the irrigation agencies were not really responsible or accountable for either the functionality of designs, or for the water-delivery performance.

From "classical times" the technical irrigation profession was developed entirely by trial-and-error. Despite the more conceptual approaches that were developed over time, the actual development of command areas still seems to occur by trial-and-error. The early pioneers experimented on a small scale before applying their concepts on a larger scale. Yet, nowadays the abundant resource availability seems to allow for large-scale trial-and-error, and thus also for large-scale errors.

No lessons were learned from irrigation's large-scale errors, since the assumptions about the system's functions tended to remain implicit. Ideally, design should start from an agency-wide assessment of the affordable and feasible "programs of requirements" and levels of service for their investments. Such decisions were currently non-existent in the observed irrigation agencies.

Main recommendations. In all case studies, improvement of the capacity creation would require increased management inputs by higher level agency staff. This would require that they, as well as field staff, become more motivated for this quality. This seemed unlikely to occur if the agencies themselves would not become more interested in and accountable for the quality of its investment decisions and the resulting water-delivery performance.

The overall recommended directions for institutional reform to improve the capacity creation were the following:

1. A direct link between an agency's finance and the quality of its capacity creation decisions, and the ultimate water-delivery performance. For example, through cost-sharing by the agency and the clients, or through more tight funding through the reduction of the hidden (i.e., in the cost-benefit analysis) and other unconditional subsidies. The latter could be achieved through, for example, a reduction of the misuse of the cost-benefit analysis through checks and balances on all performance and other assumptions underlying the feasibility assessment (e.g., through the remedial principle). Also an explicit commitment to performance improvements could be introduced through, for example, the consistent use of a "performance and accountability balance sheet" by all major funding agencies;

2. A decentralization of the decision making to the agency or project level. This would allow for an increased capacity to process information on experiences, preferences and requirements both quantitatively and qualitatively. Currently, the staff and consultants of the funding agencies were observed to take many

of the planning and design decisions. (By such a decentralization less reliance on conceptual approaches becomes necessary as well.);

3. A more performance-oriented human resources management, such as performance-based incentive systems and career development, especially for higher level staff. This would require a decentralization of the related authority to the agency;

4. A more independent status of the irrigation agencies, also financially, seems the best way to ensure cost effectiveness and efficiency of irrigation investments.

RESULTS: PRIORITIES FOR PERFORMANCE IMPROVEMENT

Make performance an internal concern for the agency. An improved performance of an irrigation agency's service delivery can only be achieved by its managers, i.e., the staff of the managing agency. Short-term inputs by external actors cannot ensure such improved performance. Prerequisite for any of the observed managing agencies to improve its performance was that the agency made it a concern for its staff to improve their performance. The above described main recommendations were all examples of measures to make performance a concern of the staff of irrigation agencies.

Make performance a local concern, rather than an external only. Yet, such measures seemed unlikely to be initiated by the observed agencies as long as performance improvement was not their concern. Therefore, either the central government, politicians or the funding agencies should make it a concern for the agency to do so.

Possible measures to make performance a concern of irrigation agencies are, for example, the linkage of their finance to performance; the use of subsidies that do not reinforce biases of agencies toward the quantity of capacity creation (e.g., cost-sharing, fixed lump sums, proportional subsidies); the reduction of hidden subsidies; high quality investment appraisal decisions; more neutrality of donor staff toward the quantity of investment; the development of investment proposals by agencies only; and an external "water-delivery performance audit" in those situations where no financial or other accountability to clients exists. Accountability and performance issues should also become a serious issue in the so-called policy dialogues;

Let the funding agencies become prudent financiers, financially at risk for performance. Prerequisite for a managing agency to improve its performance is that the central government, politicians or donors make it a concern for the agency to do so. Yet, even the observed funding agencies appeared mainly accountable for investment quantity, and not to the quality of the investment appraisal decisions.

Possible measures to make the quality of investment appraisal decisions a concern for the funding agencies and its staff are, for example, more financial transparency and risk taking by donors. This can be achieved through, for example, direct lending to irrigation agencies rather than to governments. Irrigation agencies appeared never accountable for the (partial) repayment of the loans. Also, the funding agency could be made accountable to its board of governors for the quality of its investment appraisal decisions in terms of the match between appraised and achieved performance of its investments (rather than for the perceived professionalism and quantity). And the funding agencies agency as a whole could be made accountable for their success in facilitating performance improvement, and in "getting the performance-related processes started". Overall, making recipients more performance-oriented requires the funding agencies to "Stick to the Knitting" (i.e., to banking) and to put "Quality First" (i.e., of investment appraisals).

Manage and control towards a satisfactory water-delivery performance. Still, if an accountability would be introduced as described above, higher levels of sophistication of the decision-making processes may not evolve automatically. The recommendations of this study therefore include many specific management control decisions that aim to develop, introduce and control performance-related requirements into the decision making about the capacity utilization and the capacity creation.

EVALUATION

The application of the analytical framework had the following advantages. Any framework facilitates a more focused data collection and analysis. Further contributions to the above analysis of the used framework were: its facilitation of a consistency in analyzing processes; its enforcement of an objective analysis of the functionality of disciplinary approaches in the decision-making processes; its enforcement to consider the full scope of irrigation management concerns; its facilitation to consider the interaction and consistency between other issues than only the usually researched upon design-utilization interaction; and its integrated perspective on performance, decision-making processes, management conditions and the related management-control decisions.

Disadvantages of working with the framework were the initial difficulty to be consistent in separating processes and conditions, and the repetitions in presentation and analysis of a systematic application of the framework on all important decision-making processes and management conditions. These disadvantages do not seem major impediments for the framework's application by others. These others could be a researcher or management specialist to do a management analysis. Though also an irrigation manager could use the framework's simple interrelations (as represented in the above Figure) to take a different perspective of his work.

Prospects for future application of the framework as a check list of relevant irrigation management concerns are either the following: a systematic awareness creation about the managerial aspects of irrigation; a systematic development of research questions or manuals about the capacity utilization; and a professionalization of ex-post evaluations and impact studies of irrigation (and other development) investments. Also the framework's concept of the levels of sophistication could be used as a performance indicator for management in the following ways: to identify systematically opportunities for improvement; to assess management improvements quantitatively before and after management innovations; or, to develop normative indicators for irrigation management performance for different socio-economic and physical environments through comparative research.

Recommendations about priorities for future research on the underperformance in the irrigation subsector that evolved from this study almost all related to measures to introduce accountability for the water-delivery performance. These were the following:

1. research on specific management-control methods and techniques that are *likely* to bring accountability for performance into the financing of irrigation;

2. the establishment of the probable potential for performance improvement in different countries or regions (these estimates could then be used for realistic investment norms per unit area that may not only prevent hidden subsidies in future irrigation investments, but may also attribute a more realistic economic and financial value to performance);

3. the cost effectiveness and efficiency of the collection of service fees in smallholder systems; and

4. appropriate structures for volumetric measuring of water in smallholder systems.

Yet, much research seems to have been done on irrigation management already. Therefore, performance improvements in the irrigation subsector seem to need much more the application of the available knowledge to change the present management and control, rather than more research.

CHAPTER 1

Introduction

"What do the three blind mice have in common with 40% of distributary canals in the Punjab? ....They all lost their tails."[1]

IRRIGATION INVESTMENT TRENDS

PAST AND PRESENT investments in irrigation worldwide are immense. Estimates by the World Bank of the total accrued investments in irrigation and drainage to date amount to US$ 800 billion.[2] The century before the mid-1950s knew only a moderate development. From the mid-1950s, the growth of irrigation worldwide was extremely rapid. In less developed countries (LDCs) alone, expenditures during this period totalled more than US$ 250 billion. Annual investments in the late 1970s to mid-1980s stood close to $15 billion.[3] Anticipated additional investment in the period from 1985 to the end of century amounts to $150 billion.[4]

Irrigation traditionally absorbed a large slice of the total investment aid in LDCs. A strong example of this favored status of irrigation is the World Bank. Irrigation investments represented more than 75 percent of total World Bank disbursements in the agricultural sector till the mid-1960s. Since then, it has varied between 25 and 40 percent, remaining the largest single sub-sector in the agricultural sector. The latter was by itself, with 30 percent of total lending by the mid 1970s, "by far the largest single component in the Bank's portfolio."[5] Throughout the World Bank's history, about 75 per cent of its agricultural lending has gone to irrigation and the directly related rural credit and area development projects.[6] In general, irrigation investments absorbed between 16 and 22 per cent of total official bilateral and multilateral aid to agriculture in the period 1976-1980.[7]

A variety of reasons underlie the investment boom in irrigation since the 1950s in the Third World. Important reasons were the intermittent food scarcities and high food prices, and (geo-)political interests. Also, irrigation "biases" in donor organizations seem to have been important, especially because of the ample resource availability through the credit lines for development investments.[8]

THE PERFORMANCE GAP

Since the mid-1960s the awareness spread that the performance of irrigation investments was far below its potential[9], both in low-income and high-income countries. The most obvious signs of this underperformance were the underutilized or even dry tail-reaches of irrigation canals and command areas in underutilized systems.

Undoubtedly, irrigation has contributed significantly to the growth in agricultural production of many LDCs, if not only for its facilitating role for the success of the "green revolution". Irrigation is often considered a critical component of the package of inputs that produced the green revolution. Seckler and Sampath, for example, have stated this for India as follows:

> "Except in rare and limited areas, there has been no green revolution in India on unirrigated land . . .The analysis indicates that irrigation accounts for one-half to two-thirds of the increase in food grain production in India over the past three decades; and without the indirect effect of irrigation development enabling the use of [high yielding varieties] and [fertilizer], most of the remainder would not have occurred. Irrigation is a Sine-Qua Non of India food grain production."[10]

Yet, despite this success for food production, the performance was much less than expected at the time of the investments. Apart from documenting this yield impact of irrigation, Seckler is also an irrigation professional who has documented irrigation's spectacular underperformance. Despite the reputed unreliability of statistics in LDCs, he has ventured to present the following embarrassing image: "A reasonable rule of thumb for irrigation projects in the LDCs is that they cost at least twice as much and deliver no more than half the effective irrigation benefits specified in the plans."[11]

The exact size of the underperformance is difficult to estimate. Only few and very rough approximations have been made. Seckler estimated in 1981 that while India created a potential of 30 million ha, it actually utilized only some 11 million ha. He estimated that this could be increased to about 21 million ha through improved management and improvements in the physical facilities. Similarly, in 1983 Chambers estimated the utilized area in India somewhat higher at 14 to 15 million ha. Also, according to both of them, the poor average yields in India could to an important extent be due to yields being not much higher than in rainfed agriculture in half the officially irrigated area.[12]

Seckler has also estimated the impact on food security of the above rough underperformance estimates. Such estimates depend to a large extent on the expected demand, i.e., the predicted population growth rates. Expecting a duplication of the population of LDCs in the period 1980-2010, a doubling of their agricultural output over the same time would be needed, according to Seckler. He has argued that given the described performance gap, the investment needs for food security between 1980-2000 in the non-Communist LDCs are in fact four times more than the generally perceived requirement of US$150 billion, i.e., a total of US$600 billion. For India alone this would amount to $12 billion per year. Else, even with the envisaged expenditures on irrigation of over $3 billion a year in India there may be a *decrease* in net irrigation output, due to the neglected maintenance of the existing irrigation capacity.

These estimates of the underperformance and their consequences are "admittedly highly subjective and impressionistic" according to Seckler, but he added that "there are innumerable scraps and pieces of evidence that can be gathered that the above calculations are conservative."[13]

Though this is not the subject of this text, some qualification of Seckler's estimates seems required. It is well-known that distribution problems tend to dominate food scarcity. For example, food export figures by India and several African countries such as Ethiopia and Sudan have been considerable even during drought years.[14] Redistribution of just 5.6 per cent of India's and 2.5 per cent of Sudan's food production to the poorer sections of the population would wipe out hunger in these countries, according to the World Bank.[15] Such figures on distributional problems stress the relative value of Seckler's estimates. Moreover, Seckler's long-term planning for food production through irrigation seems not entirely noncontroversial also in the light of the doubtful relationship between population growth and hunger (i.e., the main basis of his estimates); a small country like the Netherlands with one of the highest population densities, is also the second largest agricultural exporter in the world.[16] The processes of capacity creation and capacity utilization in LDCs are likely to be important as well for tackling world hunger and poverty.

THE MANAGEMENT ISSUE AND ITS POTENTIAL FOR A "WATER REVOLUTION"

The consideration of the managerial aspects for the underperformance problem in irrigation did not materialize overnight. During the 1960s and 1970s, the investment boom in irrigation capacities stimulated a construction-orientation of irrigation agencies. Though a few early publications in the 1960s reported upon the deficiencies of the system management,[17] the utilization of this created potential received little attention. Also donors did not seriously follow up on numerous examples of disastrous underutilization. They were in a hurry to increase agricultural production through projects (i.e., new construction), rather than through the improvement of the performance of the existing facilities by means of less capital-intensive option of management improvement.[18] Only at later stages, increased and widespread awareness of the systematic underperformance and the reduced availability of suitable sites for irrigation, made it increasingly difficult to justify new investments. Against this background the international attention for this underutilization, or performance problem, gained strength.

Simultaneously with this increased awareness about underutilization, the perception gained strength that the level of management of the systems was backward in comparison with the construction efforts and expertise. The underutilization was considered not only a technical, but also a managerial problem. This applied equally for LDCs and developed countries.

The Real Potential for a "Water Revolution"

Most irrigation management professionals--admittedly, not the most objective group for such judgement--, tend to agree that performance of irrigation investments is not only less than projected at the time of investment, but also less than can be reasonably achieved with improved management.[19] The higher levels of performance that private irrigators tend to achieve on smaller, more controllable, decentralized systems, especially with pumping, seem to proof such potential for improvements and the perceived management flaw.

The management aspect of the underutilization makes it hard to estimate the potential for improvement. Though several authors have tried. It is relevant to note that these estimates typically rely more on the assessor's personal experience, than on actual data. Examples are the fore mentioned estimates for India by Seckler and Chambers. Another example is the following estimate by Keller: "In both developed and developing countries, improved irrigation system management has the potential of increasing water and energy use efficiency by 10 to 15 per cent. Moreover, area irrigated and production can at least be doubled in many cases."[20] Chambers has suggested that most people estimate the most easily recoverable slack in the range of 10 to 20 per cent, a slack that could benefit the presently deprived tail enders.[21] Still, almost no absolute data are available on improvement potential. Most estimates are merely opinion- and experience-based guesstimates.

Essentially three research projects in the late 1970s have provided the few available data on the real potential for performance improvement.[22] The research projects consisted of experiments with improved system management practices in real-life irrigation systems in Philippines, Sri Lanka, and South India. Based on these experiments, researchers have suggested that in the predominantly rice-growing areas of Asia the proposed water management interventions can generate average production increases of at least 20 per cent at very low financial costs.[23]

Also based on these three experiments, Bottrall, amongst others, has foreseen, in analogy to the green revolution, the potential for a "water revolution". The revolution would result in major increases of crop production at a very favorable benefit-cost ratio. This potential for a sustainable "water revolution" remains, however, to date largely as it was, because the evidence of these three experiments has not been repeated or sustained.

Not amazingly, therefore, even now many engineers around the world consider these perceived management flaws in irrigation as either exaggerated, or as inevitable. According to them, the performance problems could be solved to a large extent by technical solutions such as canal lining or the automation of the flow regulation. From their perspective, the management issue in irrigation remains, to a large extent, imaginary. There remains thus a serious disjuncture in the perspectives of many irrigation professionals. A more objective perspective on irrigation's performance problems seems required to reunite the different professional perspectives.

THE PROBLEM DEFINITION

In analogy with Chambers' recent book on managing canal irrigation, the main thesis here is that "past attempts to improve performance have failed because of defective analysis".[24]

The fore mentioned three experiments were essentially the implementation of rotational deliveries of water. Many engineering textbooks prescribe rotational issues as a standard technique of saving water. If so, and if they were so beneficial for performance improvement, why were these rotations not generally applied?

A more crucial question than the successful technique itself seems the question why these early experiments were not repeated on a wide scale, nor sustained. The related answers require an understanding of how irrigation systems are currently managed, how irrigation agencies work internally, and how this relates to performance objectives. Such understanding demands analytical approaches different from those of traditional disciplines that study irrigation management such as engineering, agronomy, economics, sociology and others.

These traditional disciplines have discipline-specific tools for problem analysis. This "biased" perspective usually frames the problem solving. Even after the past 15 years of increased attention for this performance issue in irrigation, a more objective and management-relevant analytical approach has apparently not come about. The following remarks by Wade and Chambers of a decade ago therefore still hold:

> "Engineers are trained in construction and are predisposed professionally to see problems and potential in terms of physical works rather than in timing, location and amounts of water distributed, Agronomists are trained in crop biology and study crop water requirements; their eyes focus on plants, and especially plants in controlled conditions on research stations rather than plants subject to the vagaries of on-farm water supply. Economists think in terms of costs and benefits, and are inclined to recommend regulation through water pricing. Sociologists study water questions at the community level but not at the main system. But in between the areas illuminated by these disciplines there is a dark space. There is no professional discipline for main system management."[25]

Wade and Chambers thus supported the idea of the development of a new irrigation professionalism "between" these traditional disciplines. They expected new, substantive approaches towards main system management. What the above list missed was the relevance for these disciplinary specialists to look at the internal organization of irrigation agencies. Whether or not they implement rotations, relates very much to the way irrigation agencies work internally. Or, as it will be called in this text, to their management and control.

Many irrigation professionals nowadays acknowledge that they have no clear concept of irrigation management. Some examples of the resulting defective analysis are the total neglect of the management processes in investment evaluations[26], and the "blueprint" project concepts incorporating a package of almost all possible ingredients without considering their utility. Often it results in a failure to address any of the crucial water management issues. Such defective analysis of irrigation management problems results in erroneous improvement attempts.[27]

Several professionals have explicitly pleaded for the need for a clear concept of irrigation management. For example, Bottrall has pleaded for the development of "a systematic method for evaluating management performance which is able to produce a detailed and objective assessment in place of what could otherwise be represented as a superficial and arbitrary personal impression". According to Bottrall, such methods would force irrigation evaluators and planners to face sensitive political issues like water management.[28]

Similarly, Chambers has written that the art and techniques of analysis for canal irrigation are in their infancy, because those who do it rarely write about how they do it. He knew of no analytical modes and tools that were water-based.[29] Svendsen has added the following remark:

> Although frameworks exist within particular disciplines--agricultural engineering or economics, for example--we have little that cuts across them. When we want a more comprehensive understanding of something, we typically commission a one-time review of the topic utilizing an ad hoc conceptual framework of the author's preference . . .It is limiting and therefore regrettable that we have been unable to find a more substantive and durable way of organizing our thinking and discussions regarding irrigation management."[30]

In the recent past, many other irrigation practitioners as well as the World Bank[31] have recognized the need for such an objective perspective.[32] Chambers has stated that such an analytical framework should be interdisciplinary, resource-based (i.e., water-based), performance-based, and opportunity-oriented.[33]

Past research results and reports thus point at a disappointing performance of investments in irrigation, and an inadequate insight in the concept of irrigation management. Also several researchers have explicitly stated the need for improved analytical frameworks. This means that more and more precise insights are required in the management and control of irrigation in LDCs, as a prerequisite for the identification of relevant improvements. The topic of this study is such an improved insight in the management of irrigation, and ways to improve it.

THE OBJECTIVES

In addressing these issues, this study aims to answer the following question: *What are the generalized changes in management and control processes and conditions that are required for improved irrigation management in LDCs?*

Addressing this question requires firstly to make an effort to fill the fore mentioned gap toward the *concept of irrigation management*. Therefore, the concepts of management and control processes and conditions are translated for irrigation. Together they form this paper's so-called management perspective. Subsequently, this analytical framework is applied to irrigation.

For the definition of this "management perspective" on irrigation performance, an existing integral, analytical management framework is translated for irrigation management. The used analytical management framework was originally developed by Kampfraath and his colleagues of the Department of Management Studies of Wageningen Agricultural University, the Netherlands.[34]

This framework has the traits mentioned above by Chambers; its approach is interdisciplinary, resource-based (i.e., water-based), performance-based, and opportunity-oriented. Apart from these traits, another advantage of the used framework is its consideration of the full scope of key decisions contributing to water-delivery performance, as well as the relevant management conditions. Chapter 3 elaborates upon the specifics of the framework's traits.

The framework's development and elaboration for irrigation was done through detailed case studies of two major Sri Lankan irrigation systems[35]. Further testing and shaping of the management perspective was done in less intensive comparative research in Morocco, Philippines, Sudan, and India, and an extensive survey of the (irrigation) management literature.

Objectives of this study in addressing the above problem definition are thus twofold: 1) the identification of generalized directions of management change for performance improvement in the irrigation subsector; and 2) the testing of an analytical framework for irrigation management.

LIMITATIONS AND FOCUS

This section gives several clarifications about the irrigation performance indicators considered relevant in this study, and those that fall outside the study's scope. In addition, some definitions and other limitations are given.

The Indicator Confusion

The *performance* of irrigation is implicitly restricted in this text to the effectiveness and efficiency of the *primary outputs* of irrigation systems. Examples are the areas irrigated, the water use efficiency and the cropping intensities.

The text focuses on the management of *water* as the *primary irrigation process*. Activities such as the agricultural production or the organizing of water users, are considered *complimentary processes* to the management of water. Other activities, such as maintenance, improvement or construction processes do not necessarily involve irrigation at all, and are therefore considered *derived processes*. Decision making about water does not only occur during capacity utilization (i.e., scheduling, flow regulation), but also during the creation of irrigation capacities (i.e., planning, investigations and design); both categories of decision making are analyzed here.

Performance of irrigation projects can be evaluated in many other ways as well. In the past, criticism on irrigation's impact on the environment, health, income distribution and gender relations has been widespread. While their importance and relevance is not denied, this text does not discuss such impacts to facilitate a more direct and unambiguous analysis toward the primary performance problems.

Underperformance is thus only evaluated here toward irrigation's primary objective, the delivery of water. Complementary objectives are not irrelevant, but are considered to be outside direct control of the managing agencies. Irrigation agencies control only the delivery of water, and farmers manage the agricultural production. Evaluating the performance of irrigation in terms of the complementary objectives risks a confusion about the accountability of the managing agencies for the only service they can really be kept accountable for, i.e., water delivery.

To a large extent, the uncertainties on irrigation's real underperformance seems related to the multiple objectives involved in irrigation. Is the objective of irrigation an increased agricultural production or is it an increased control over water availability? Or, is it the settlement of landless people, whether for welfare, geopolitical or political reasons? The confusion about this question seems to linger on in the minds of many professionals, administrators and politicians in the irrigation scene. Therefore, a priority has to be made between the possible objectives of an irrigation agency. Besides, the water-delivery objective does not stand on its own, and interrelates with the complementary objectives.

An experienced manager of Kenya's Mwea system also cautioned for such confusing influence of multiple objectives with the following phrase: "High productivity is the key...to paraphrase Matthew 'Seek ye first production and all these things shall be added on to you'".[36] Using simple objectives has its limitations for completeness, but a multitude of objectives for one organization or person dilutes clear responsibility and accountability.[37]

An improved management of the water delivery is likely to provide for a necessary physical and management environment to deal with impact issues such as health, environment and poverty. Prerequisite for a serious and systematic reduction of other adverse impacts of irrigation is a general improvement of the management performance, accountability and control toward irrigation's primary process, the water delivery.

Other Limitations

Apart from the above restriction of performance indicators, this text recognizes some others.

A far as irrigation system is concerned, "system" refers here not only to the physical infrastructure (i.e., canals and structures), and other facilities (e.g., radios, vehicles, computers, forms etc.) for the delivery of water to the water users. It also includes all agency staff and other people that influence the decision-making processes. The water users are thus part of the system to the extent that they influence the decision-making processes about water delivery. However, for the actual service delivery they are the system's clients. System is thus a dynamic concept here.

This management analysis focuses on agency management of small-holder gravity irrigation systems. Within these systems it focuses on the water delivery to water users. Water application by the water users is considered to be managed by the water users themselves. So, the analysis does not go into the specifics of the decision-making processes at the level of the field canal as well as on-farm. Neither does the analysis go into *details* of differences in interest of water users. Also the organization of water users in water user organizations is not studied. These activities have their own management perspective, with their own objectives and performance indicators. Instead, the analysis focuses on the agency processes and the ways that the different stakeholders participate in these processes. From that perspective, it also considers the effectiveness of the participation by farmers as the system's clients in the decision-making processes on the water delivery and the creation of irrigation capacity.

In principle, the requirements for construction, maintenance and rehabilitation activities are derived from the water-related decision-making processes. The study excludes these derived activities as such, however, as they also have their own management perspective, with their own objectives and performance indicators.

Water users or farmers in this text can be both male and female.

ORGANIZATION OF THE CHAPTERS

Chapter two reviews the few existing irrigation management concepts. Chapter three presents the characteristics of the used analytical management framework, as well as those of the developed irrigation management perspective. Subsequently it explains the research methodology and approach. Chapter four describes and analyzes the generalized decision-making processes and management conditions of the capacity utilization in irrigation, while chapter five does the same for the capacity creation. Chapter six integrates the findings from the perspectives of capacity utilization and capacity creation in the earlier chapters. It gives the generalized conclusions about the decision-making processes and management conditions. Subsequently it gives the required management-control processes to improve the performance of the irrigated subsector. Chapter seven evaluates the outcomes of the study and the specific contribution of the analytical framework. It concludes with suggestions for future research.

Notes

1. Murray-Rust pers. comm.

2. World Bank/UNDP 1990:10.

3. Yudelman 1985:21; Johnson 1990:17.

4. Seckler 1982:2.

5. Yudelman 1985:1.

6. Ibid:5.

7. Cassen 1980 in Tiffen 1987a:362. This figure excludes the considerable national investments, particularly in the Middle East, as well as private investment by farmers (ibid).

8. These causes will be substantiated in the course of this book.

9. The process is well described by, for example, Lenton 1989.

10. Seckler and Sampath 1985 in Sampath (undated).

11. Seckler 1982:4. Other irrigation practitioners that have reported on this quite spectacular underperformance are, for example, Bottrall (1981a), Repetto (1986:3), Frederiksen (1987:1), and, Chambers (1988:19-27).

12. Seckler 1981:10; Chambers 1988:26.

13. Seckler 1982:5. Major assumptions underlying the last estimate, for example, are a compound population growth of 2.2% per year, and a decreasing quantity and quality of the existing irrigated land at a rate of 2% per year, "equivalent to a productive half-life of existing projects of 36 years" (ibid:4). Indeed, conservative estimates.

14. E.g., Lappe and Collins 1986:11-13.

15. Ibid:11.

16. Ibid:25.

17. E.g., Thornon 1966.

18. Easter and Welsh 1986:1; Lenton 1986:53.

19. Repetto 1986:3; Chambers 1988:26; Seckler 1981:8.

20. Keller 1986:330.

21. Chambers 1980:27.

22. A large number of research papers on irrigation management deficiencies existed at the time, though without similar evidence of potential for improvement. It were therefore essentially these three experiments that have led to international recognition of the "management issue" and establishment of IIMI (CGIAR/TAC 1982 and Wade 1982b). These three experiments were reported upon in the Philippines by IRRI (e.g., Wickham and Valera 1979), in India by Wade and in Sri Lanka by Chambers.

23. Bottrall 1981a:24.

24. Chambers 1988:27.

25. Wade and Chambers 1980:A.111.

26. Bottrall 1981a:234.

27. Ibid.

28. Bottrall 1981a:236.

29. Chambers 1988:216.

30. Svendsen 1988:17.

31. Bottrall's comparative management study was partly meant to develop such an analytical framework for the World Bank (Bottrall 1981a:i).

32. Walker 1981:15; Small 1985:9 and 10 in Wickham 1985; Huppert and Walker 1989:16; Levine 1981:10 in Small 1981.

33. Chambers 1988:216; Lenton 1986:53.

34. Kampfraath and Marcelis 1981; Zuurbier et al. 1991.

35. Nijman 1991 and 1992a.

36. Giglioli 1968:9 in Chambers 1988:30.

37. The Economist recently applied a similar reasoning to the dual objectives of the Federal Reserve Board (FED) in the USA which cannot be kept accountable towards controlling inflation as long as it is also responsible for short term growth (The Economist 1992).

CHAPTER 2

Existing Irrigation Management Concepts

"The old fable of the blind men and the elephant is well known. Each blind man, feeling a different bit, thought he had something familiar. None recognized the beast. Scientists and engineers, faced with canal irrigation systems, are not blind, but they are trained to notice, observe and analyse only certain parts."[1]

PROCESS- VERSUS STRUCTURE-ORIENTED APPROACHES

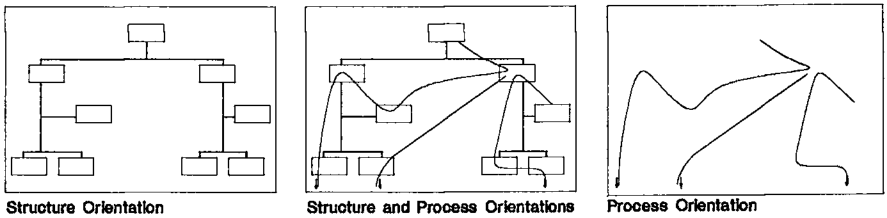
THIS CHAPTER GIVES a brief review of the few applied analytical frameworks in either irrigation management or in the management of development. To provide some perspective to this review, two major groups are distinguished, those concepts oriented on structures and those oriented on processes.

Most existing management approaches are structure-oriented.[2] Their primary focus of analysis is the satisfactory functioning of the existing organizational units, their tasks, functions, authorities and entitlements. Evolving solutions are inevitably also in terms of structural changes such as a new committee, another department or new jobs.

Major disadvantage of such an approach is its blindness to the history and evolution of the organizational structure itself. Structural changes in the past originated typically not only from requirements of processes. They were also caused by the internal dynamics of the organization such as the evolution of existing hierarchical levels, the presence and influence of certain leading officers at a given moment, or the division of the organization into historically determined departments. Such internal dynamics of the organization have gradually "biased" the structure to the effectiveness of the processes. This bias should make it logical for an evaluator to forget temporarily about this "biased" structure in a management analysis of performance.

A process-oriented approach is reverse. Such analysis focuses initially on the effectiveness and efficiency of different key decision-making processes in reaching an organization's output. The structural appearance of the organization is thereby temporarily omitted. The importance of structures is not denounced altogether. Structure is considered a mediating force in influencing decision-making processes and the resulting performance. Initially, however, they are considered of secondary relevance and therefore only sight-disturbing. Figure 1 presents a schematic look at these two types of management approaches.

Figure 1. Management: structure and process orientations



STRUCTURE-ORIENTED APPROACHES

The World Bank seems to have undertaken one of the first explicit attempts to develop an analytical management approach. Yudelman, a former World Bank Director, has stated in the following citation that the systems approach strongly influenced the World Bank's approach to raise on-farm productivity during the 1960s:

> "Put simply this [systems] approach specified the necessary conditions for agricultural development and treated them like links in a chain; research, extension, delivery, infrastructure, credit system and incentives for farmers to raise productivity . . .This "ideological neutral" system provided an analytical framework and a check list that served as a basis for lending in nearly all agricultural economies. Of course, it was widely recognized that the system's components would vary enormously with socio-cultural factors and levels of development. Nonetheless, the Bank embraced this concept of a systems approach to developing and diffusing technological change."[3]

This framework was intended for investment selection. In practice, it seems to have meant little more than providing all necessary physical conditions, and later also management conditions, that were required in a mechanistic way for improved productivity. The basis for these requirements was purely technical and structural; no operational processes were considered. The approach ignored the actual management process requirements and constraints. Therefore this type of systems approach, while widely used in practice, cannot really be considered a management framework.

Although the absolute number of explicit efforts to develop such an analytical framework for irrigation management is very small, some efforts were made during the last decade. Coward's "analytic scheme" was one of the first. It consisted of rules, roles and groups as "important organizational elements" for the following basic irrigation tasks or activities; water allocation, system maintenance and conflict management.[4] Although processes were made explicit, the approach was structuralist by assuming that provision of any of the conditions (i.e., rules, roles and groups) would lead in a mechanistic way to the required processes and results. The framework was thus more structure- than process-based. Moreover, the relation between processes, structure and performance remained undefined.

Walker has developed another early framework. He adopted a systems approach to irrigation in his PhD thesis. He classified irrigation into sub-systems such as the socio-cultural, technological, political, ecological, management, input, transformation, output and demand sub-systems. He even made further sub-divisions, and analyzed the relations between those sub-systems on the basis of the available irrigation management literature. Difficulty of such analysis was the overlaps of many of his sub-systems, though for unclear reasons he analyzed them separately.[5] His analysis has remained theoretical, because he did not do additional field research. He thus had to elaborate on the conclusions of others, and did not develop many new insights in irrigation management. His thesis' primary purpose was also more the provision of check lists of relevant issues for irrigation management. Thus aiming at increased awareness among irrigation professionals about these issues, and to prevent thus that certain issues would be left out.

Huppert and Walker did an interesting follow-up of Walker's thesis. They developed a contingency approach for the creation of irrigation capacities by defining several different environments with different levels of management uncertainty. Different investment strategies were advisable for these different environments.[6] Compared to the fore mentioned approach of the World Bank, this contingency approach was a conceptual improvement. Unfortunately, according to informed irrigation professionals and donor organizations, their classifications appeared too abstract for practical use in investment decision making.[7]

The relation between subsystem, management, water and performance remained undefined in Walker's framework. He intended it as a diagnostic tool for the planning of irrigation capacity only, and he provided no tools for analyzing the decision-making processes.

On request of the World Bank, Bottrall has developed another explicit conceptual framework. It was essentially a long check list of factors important for irrigation management that he extracted from books on management science.[8] Bottrall's framework compared sub-systems and processes without much integration. Bottrall has stated, for example, that "quality of an organization's performance is partly a function of its structure . . .and partly a function of its management process".[9] Yet, he did not further specify this relation between process and structure. Moreover, he frequently confused processes and structure. For example, he analyzed processes in terms of job descriptions, thus assuming a satisfactory functionality of these job descriptions in the actual decision-making processes. The study also classified possible reasons for performance problems in the three broad categories of resources, skills, and motivation, thus biasing the analysis and possible remedies considerably.[10]

To its credit, Bottrall's report was the first to focus explicitly on a broad range of management issues in irrigation in a comparative way. A sequence of short visits to Taiwan, India, Pakistan and Indonesia was the basis for the analysis. He thus relied more on real-life irrigation management than Walker's thesis.

Bottrall's framework was meant more for comparative than for diagnostic work. Although it looked at water and performance, the framework remained vague about the relation between physical processes, performance, decision-making processes and structure. So it did not really provide a conceptual framework in that respect.[11]

Many others have developed frameworks that focus on the relation and conflicts between farmers and the state. Taking such a perspective tends to make people "process-blind" to a certain degree. Often this has led to, for example, implicit assumptions such as that the gate operators represent the state rather than the farmers.[12] Chapter 4 shows that the process reality is much more subtle and that, for example, often the operators (if not the entire system management) do not really represent the state very much.

PROCESS-ORIENTED APPROACHES

Diemer has written a very interesting PhD thesis on irrigation in Africa. It seems to have been also the only analysis of agency-managed irrigation management that was explicitly process-based.[13] According to Diemer, anthropologists previously tended to focus on structures in societies. More recently the question how the structure had evolved over time had gained more interest. Diemer also claimed that no analytical framework had been developed by anthropologists about the relation between structure and the activities of individuals and groups, i.e., the processes.[14] Diemer tried to fill this gap with Bourdieu's theory of the influence of internalized dispositions on the behavior of individuals. In terms of the interrelation between processes and structures in organizations his theory did not fill the gap. His analysis of irrigation engineering was, however, to a large extent process-based, though it did not aim to separate structure and process in a very consistent way. His process-based analysis has led to many findings similar to those in this text, especially those regarding the utility of different irrigation engineering and technological approaches.

Diemer's thesis was absolutely unique in taking a historical perspective on irrigation technology and engineering, and the degree that irrigation professionalism has internalized them despite the disappearance of their original utility. He seems to have been also the only irrigation-related professional, who has explicitly recognized the danger of a structure-based analysis of an engineering system that is generally perceived as successful by irrigation professionals.[15] He warned for the risk of seeing it as a well-oiled wheel-work of which all components are functional because only a process analysis is likely to show the components' disfunctionities.

Diemer's analysis explicitly related physical processes, management and performance. However, it did not take a full management perspective, because it excluded the important role in irrigation management of politics, planning, donors, and finance. It focussed merely on irrigation engineering and technology. He also did not consider other management-control issues such as financial control and human resource management (the next chapter defines this concept of management control).

Several authors have applied an almost pure process-based analysis to irrigation, though they remained implicit. Unlike Diemer, two authors, Repetto and Moore focused on finance in their analysis. They applied a rent-seeking analysis on irrigation capacity creation and utilization. The term "rent" comes from economics. It refers to the difference between the value of a resource to the person who controls it and the price he has to pay to obtain control over it. The existence of rents indicates flaws in the competitive market system.[16]

Repetto and Moore have argued that rents provide major incentives for agencies and staff in the irrigation sub-sector worldwide. This makes them thus also major influencing factors in the analysis of the decision-making processes. Yet, the theory of rent-seeking ignored--as Moore remarks himself[17]--all other influences on decision making, such as the competing self-interests of rent-seekers, their satisfying instead of maximizing behavior, their internalized social norms[18], their lack of choice and information, the existing structures and rules, and the limited rationality of organizations. Nevertheless, the dominating role of rents in the irrigation sub-sector has made their analysis to become to a large extent process-based.

Rents are necessarily performance- and water-based, and Repetto's analysis was, to a large extent, also process-based.[19] Their analyses took a wider management perspective than Diemer's, but ignored above influences on decision making as well as, for example, Diemer's thesis of the intrinsic momentum of irrigation technology and engineering. Besides, their analyses did not analyze systematically the interrelation between process and structure.[20]

Chambers has adopted implicitly a process-based analysis in an early article on the utilization of irrigation capacity in Sri Lanka and South India. This process-based analysis seems to have evolved almost accidentally, as Chambers first analyzed the allocation processes at community level, and subsequently the role of the bureaucracy. On the other hand, he defined management functions that were almost identical with the management concerns of this study (though they were related to structural units).[21] Chambers' perspective focussed on a limited part of irrigation management, mainly allocation.

Also Maass and Anderson have adopted implicitly a process-based analysis. They have evaluated the performance of institutions in terms of the level of satisfaction of the goals of the irrigation communities. This required a primary focus on objectives, criteria and their use in processes. They did this in great detail to become fully conversant with the institutions and procedures. They even took a historical perspective of the evolution of procedures and methods of water allocation and regulation.[22]

All above authors have thus adopted a process-based approach. Most of these studies restricted their analysis to a certain portion of relevant factors for irrigation managers. The separation of structure and process tended to be less conscious, and thus also less consistent than will be pursued in this text. The above review does not claim to be exhaustive. Of course, many authors, without being aware of it and without adopting explicitly an analytical approach, have written on process-based experiences. Many references in further chapters are silent witnesses of this.

OTHER APPROACHES

Another analytical framework for irrigation management deserves mention here, although it does not fit in the above classification. Uphoff has developed an analytical framework for assessing possible participation activities in irrigation. The framework consisted of a three-dimensional matrix of activities related to:

1) physical structure (i.e., design, construction, operation and maintenance);
2) water-use (i.e., acquisition, allocation, distribution and drainage); and
3) organizational activities (i.e., decision making, resource mobilization, communication or coordination and conflict management)[23]

The objective of this analytical framework was merely to classify the type of processes and did thus not really relate to the structure of an organization. The above classification of process and structure-based does, therefore, not really apply.[24]

CONCLUSION

Some conclusions can be drawn from this brief review of existing concepts of irrigation management. In the first place, the review demonstrates the few explicit efforts to develop such concepts. Of those few explicit efforts, only Diemer's approach was a process-oriented approach. All concepts remained vague about the relation between process and structure. None of them tried to take a management perspective, i.e., to consider all relevant factors for irrigation managers. The potential contribution of this study is thus to fill these gaps by taking an explicit management perspective, and by systematically analyzing the relation between process and structure. Moreover, it considers other management conditions than structure only, i.e., financial control systems, human resources, and the provision of information and knowledge.

Notes

1. Chambers 1988:40.

2. Structure-oriented approaches are common in, for example, English and American management literature.

3. Yudelman 1985:4-5.

4. Coward 1980.

5. Walker 1981.

6. Huppert and Walker 1989.

7. Presently, different German institutions promote this systems approach to increase awareness about management concepts among irrigation managers. However, the systems and contingency approaches are rather theoretical, and seem therefore more fit to make irrigation professionals aware about relevant issues in irrigation management than about the management aspects of their own work.

8. Bottrall pers. comm.

9. Bottrall 1981a:7.

10. Ibid:67.

11. Bottrall 1981a.

12. Examples of such articles are Bloemen and de Moor (1982:382); Diemer (1990); and Chambers (1977a:357).

13. Probably process-related frameworks derived from anthropology have been applied in farmer-managed irrigation systems. An example of special interest is Vermillion's thesis (Vermillion 1986). He has such an anthropological process-orientation with several management science concepts of how people cope with uncertainty (e.g., Simon, Cyert

and March, Lindblom). Vermillion thus developed the only irrigation management concept, other than the one applied in this text, that effectively drew on knowledge developed in management science on decision making behavior.

14. Diemer 1990:239; see also Vermillion 1986:25. Diemer's analytical framework was a combination of three contemporary scientific approaches of Kuhn, Pfaffenberger and Bourdieu. Diemer has used the latter in his analysis to fill the vacuum on the relation between process and structure. Bourdieu has suggested that human behavior is influenced by situation and the internalized dispositions of individuals. The implication is that even though human behavior may seem to be goal-oriented, this may not be necessarily the result of conscious choices. The details of these hypotheses and implications of Diemer's analysis seem to be less relevant for this book on agency management. For a fully process-based analysis the difference of conscious and unconscious behavior of individuals can facilitate understanding but is not directly relevant as such. Bourdieu argued in terms of individuals without necessarily considering their function, and such analysis can be fully process-based. Diemer's analysis, however, often argued in terms of individuals as structural units and functions, and his analysis is therefore not fully consistent in its process-orientation.

15. Diemer 1990:139. Diemer referred here to the analysis by Chambers and Morris of the Mwea system is Kenya (Chambers and Morris 1973).

16. Moore 1987:4; Repetto 1986.

17. Moore 1987:5-6.

18. Conform Bourdieu in note 14.

19. Although Moore has argued that a certain "process-blindness" of Repetto has led to recommendations incompatible with process requirements of large-scale irrigation in certain environments. Chapters 4 and 5 elaborate upon this issue.

20. The analytical framework applied in this text does not exclude rent-seeking influences in decision making. An explicit combination of this analytical framework and the rent-seeking analysis may improve the quality of the latter considerably (see also chapter 7).

21. Chambers 1980:356. In an earlier publication Chambers presented the so-called PIM approach which was process-oriented (Chambers 1974). PIM stands for Planning, Implementation, and Monitoring. This text uses a similar classification for the decision-making processes.

22. Maass and Anderson 1986.

23. These different organizational activities have great overlaps and can just as well be grouped into one or two, eg., decision making and resource mobilization.

24. Uphoff 1986.

CHAPTER 3

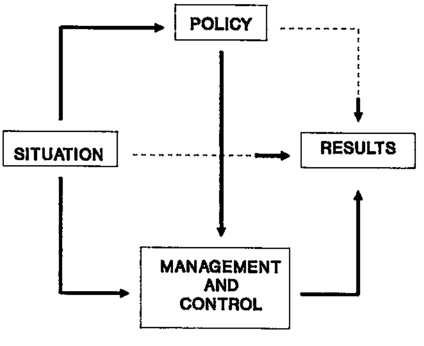
Research Methodology

THIS CHAPTER EXPLAINS the approach of this study. To that end, the concept of management is explained first. Subsequently, the concept is operationalized for the observation and analysis of irrigation management. The chapter concludes with a detailed description of the methods of data collection.

WHAT IS MANAGEMENT?

The last two decades have shown a growing attention for irrigation management. Yet, most irrigation professionals still acknowledge that the comprehension of the actual meaning of "management" in irrigation remains limited. This study is an explicit effort to fill this gap. This chapter thereto conceptualizes management into an integral, analytical management framework.

Figure 2. Management Cloverleaf[1]



______ = *the influence on management and control, and its effect on the results*
-------- = *direct influence of the situation and policy on the results*

Prerequisite for a conceptualization of irrigation management is an awareness about what management includes, and what not. What it does and what it does not cover. Although different professionals tend to define management differently, the simple graph in Figure 2 seems to represent a kind of consensus among management professionals about its boundaries.[2] The graph represents four distinct but inseparable elements of Kampfraath's so-called

"Management Cloverleaf" of which "management and control" is one, and "results", "situation" and "policy" are the three others. The picture seems simple, but is essential, and can be very helpful, for understanding what is management and what it is not.

The picture illustrates the idea of management as the major force to determine the results --and thus performance-- in any organization, including irrigation agencies.[3] So performance is always the result of decisions by people. In addition, an organization's policy and situation can directly influence the organization's results and performance as well.

Management is thereby defined as initiating (starting up), directing (choosing from alternatives) and controlling activities oriented on a certain (set of) objectives.

WHAT ARE THE CHARACTERISTICS OF THE ANALYTICAL FRAMEWORK?

This study focuses on only one leaf of the management cloverleaf, i.e., the "management and control" leaf. This cloverleaf takes the form here of an analytical management framework. This particular analytical management approach has several traits that may be beneficial to provide a management perspective on the irrigated subsector. These traits are discussed below. Where relevant, reference is made to alternative approaches.

Process-Oriented[4]

The general approach of this analytical framework is to focus on decision-making processes: decision making is considered the major force determining the performance of irrigation systems. The above definition of management is therefore in terms of processes rather than in terms of structures and organizational units (such as top management, a division, a department etc.).[5] Chapter 2 has explained the major differences of a process-oriented with a structure-oriented approach. The approach used here is based largely on a management framework developed by Kampfraath in collaboration with his colleagues of the Department of Management Studies of the Wageningen Agricultural University, The Netherlands.[6]

Figure 3 is a graphic representation of the different steps of this process-based management analysis. The identification of key decisions in regard to water delivery is the first step in the development of this management perspective on irrigation (step 1 of Figure 3). The potential contributions to the water-delivery performance of these key decisions are the basis to classify them into so-called management concerns.[7] Examples of management concerns are the strategic and operational concerns. This classification is thus different from the more traditional functional divisions such as institutional development, personnel, design, communication, cost recovery, extension, finance or administration.

Together the different management concerns encompass all those key decisions that an organization as a whole must take to reach a certain performance. Thus, the key decisions become components of the overall system performance. Performance evaluation is then the evaluation of the contributions of the different key-decision making processes to the water-delivery performance.

The key decisions also become the main orientation points for thinking about and analyzing irrigation management here. Therefore, this management perspective on irrigation is different from those used by the traditional disciplines dealing with irrigated agriculture.

Performance- and Water-Based

The used analytical framework is also performance- and water-based. Overall starting point of the management analysis is the overall system performance. This performance is the result of the physical processes leading to it. And the physical processes (like water flows) are considered the direct and necessary results of decisions by people, for example, by gate operators.[8] This performance-based analysis follows thus the following steps of Figure 3. After the definition of the relevant key decisions (step 1 in Figure 3), for each key decision its contribution to the overall performance must be established (step 2). If this contribution is deemed unsatisfactory, the processes leading to the final decisions are analyzed, and the bottlenecks in these processes are identified (step 3). Based on an analysis of the interaction between the processes and the management conditions, those changes in the management conditions are derived that are likely to lead to improved processes (step 4). The last step is then the identification of the required management-control processes to achieve these required improvements in processes and management conditions (step 5).

This analytical framework thus links performance, physical processes, decision-making processes, management conditions and management control in a logical analytical sequence. This provides an integral "management perspective" on irrigation performance.

Management conditions are means that influence the quality of the decision-making processes. They are not restricted to organizational structure only. The following categories of management conditions are recognized:

1) Human Resources;
2) Provision of Information;
3) Financial Control Systems;
4) Provision of Knowledge; and,
5) Organizational Rules and Structure.

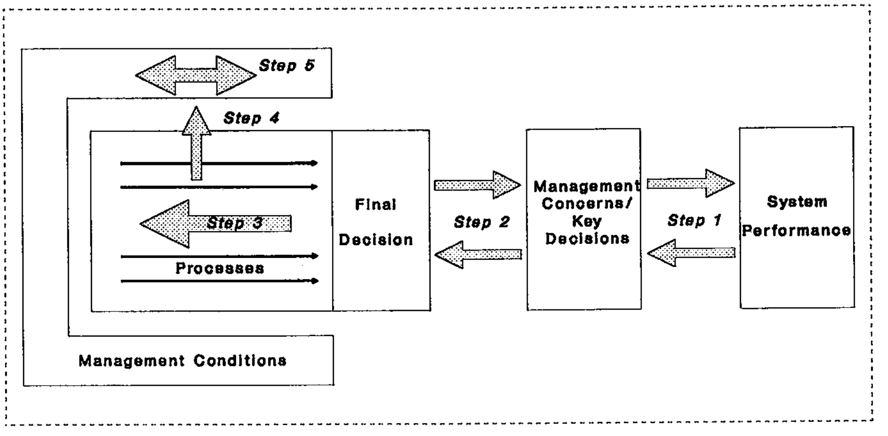
Practical implications of considering the influence of other management conditions than structure only, are the following:

1) changes in one management condition have to be done in an integrated manner with changes in other conditions. For example, a decentralization of responsibility for the water-delivery performance can only be attempted in combination with related incentives for decentralized units;

2) smaller changes in management conditions (such as a new form, procedure, or calculation method) than structural changes can be considered. Structural changes are often a major change, and the most rude and drastic possible. And these changes do not always contribute to the required results. Despite this, it is the only possible solution if one considers only

structure and rules. In practice, smaller changes are often preferable such as changes in the process within the given structure, or changes in the provision of information or financial control system. Only if these do not have the desired effect, changes in the structure can be attempted;[9]

Figure 3. Performance- and water-based management analysis



The definition of control of this analytical framework is slightly different from the definitions used in most English and American literature. The definition of control here is also process-based. Object of control is thereby not only an organizational unit or a person, but also the physical process and the related decision making.

Overall, this analytical framework distinguishes thus three types of processes:

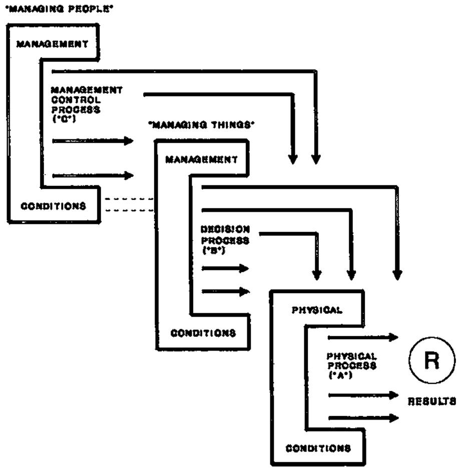
1) *physical processes* (A-process in Figure 4); and two superseding types of decision making, whereby 2) represents

2) *decision making and control* about the physical conditions and processes (B-process); while 3) exemplifies

3) decision making and control about the management conditions and decision-making processes, or the *management control* (C-process).[10]

The dotted line in Figure 4 represents the notion that the management conditions for the B-process and the C-process are essentially the same categories. Though the requirements for these same categories are different for the B- and C-processes. This analytical framework thus defines management as decision making and control.

Figure 4. Physical conditions and process (A-process), management conditions and process (B-process), and management-control process (C-process)



A Quantitative Performance Indicator for Processes: the Level of Sophistication

Another characteristic of this particular analytical framework is its definition of process-oriented performance indicators. The so-called levels of sophistication are approximate quantitative indicators of processes. Such quantitative indicators can be used for the analysis of the interrelation between management conditions and processes. The higher the level of sophistication, the higher the likelihood of a higher quality of the decisions, and the more a reduction of the uncertainty. Reducing and controlling uncertainty[11] is widely recognized as the main drive of management as long as cost efficiency and effectiveness is not endangered.

Few authors have tried to develop such quantitative indicators, although several have developed qualitative concepts. Weber and neo-classical economists assumed that people and organizations tend to optimize their objectives through such activities as systematic collection and processing of complete information, centralized decision making, formal scheduling, hierarchical control, and an objective rationality (i.e., "economic man").

Many management scientists have contested such over-rationalizations of human behavior. In the 1950s Simon proposed the concept of the bounded rationality of man. His concept recognized the limited capacity of human beings to obtain and process information and possible alternatives, their subjective picture of reality, and their "satisfying" rather than maximizing behavior (i.e., "administrative man"). Simon's concepts were widely recognized since.[12]

Also Lindblom adopted Simon's views. He added the idea that the mutual interaction between individuals (having approximately equivalent power) can often lead to favorable or acceptable results without any centralized analysis of information. As a result, the evolving direction of an organization may often be more incremental than purely rational. Different participants adjust thereby their objectives incrementally as well.[13]

Although such concepts facilitate understanding of the decision-making processes, they do not provide any quantitative guidelines or indicators for analyzing the relation between uncertainty in the processes and the management conditions.

Kampfraath's concept of the levels of sophistication makes an indirect effort in this direction; a higher level of sophistication does not necessarily, but is likely to, reduce the level of uncertainty. His concept of levels of sophistication can be used as a quantitative performance indicator for the different key decision-making processes.

Basic idea behind this concept is that the quality of decision making depends on the quantity of information used, and the way it is processed. The quality of the decision making is thus likely to increase as the processing becomes more *systematic* (1), incorporates more *feedback* (2), *foresees* the consequences of the decision more accurately (3) and *integrates* influencing decisions (4). Kampfraath used these four criteria based on information use and processing to develop the quantitative levels of the conversion matrix of Table 1.

A very low or high classification is not a performance judgement in itself. A very low level of sophistication may lead to a satisfactory performance at low costs, and may thus be cost-effective. Yet, if the performance is considered unsatisfactory, and the contribution of a particular key decision as well, then it is assumed that a higher level of sophistication is likely to lead to a higher performance. In this indirect way, this concept links management performance with system performance.

The concept can be used to facilitate the mutual adaptation of processes and their management conditions. It also can be used for a very systematic analysis of the relation between overall system performance and the related contributions of the different key decisions.

A normative judgement of the present level of sophistication of the decision making in a particular irrigation system is only possible in comparison with a statistically significant number of other systems in comparable environments. Thus three aspects of the management cloverleaf (Figure 2) have to be compared to use it as a performance standard. The International Irrigation Management Institute (IIMI) may undertake comparative research to develop such standards in the future.[14]

This study uses the concept to identify the present level of sophistication of the different key decisions in several case studies. If the present quality of these decisions requires improvement, the concept is in addition used to identify in a systematic way the opportunities for improvement. Definition of such improvements is in terms of the required changes in the processes to achieve a higher level of sophistication of these processes, as well as in terms of the related requirements for different sets of management conditions.

Conceptual Solutions

A specific contribution of the selected analytical framework is that many elements that other management schools and approaches use such as strategic and operational management, management control, human resource management, financial control, and management information systems, are logically linked into one integral framework.[15]

The framework is thereby not normative in that it provides single solutions with general validity, or with validity for specific types of organization. In the analysis and approach of decision-making processes and its interrelation to management conditions it accepts the earlier described theories of Simon and Lindblom on human behavior. And also the political aspects of decision making are not excluded from the analysis.

Instead, by putting performance, decision-making processes, management conditions and management control into one logical framework (as given in Figure 3), this analytical framework provides conceptual solutions. These can be used to develop tailor-made solutions, i.e., unique solutions for specific situations.

Table 1. The levels of sophistication on a scale 0-100[16]

Level of sophistication	SYSTEMATICS: To what degree are decisions made according to a more or less fixed pattern?	FEEDBACK: To what degree are the decisions made tested continuously for appropriateness?	FORESEEING: To what degree does decision making foresee the scope of the decision?	INTEGRATION: To what degree are problems seen on a wider context before the decision is made?
Very low (0-20)	no rules: a certain routine exists	never: unless unconsciously	hardly: ad hoc decision making	no: problems are examined myopically
Low (20-40)	"rules of thumb": broad rules form the basis of the decision making	sometimes: obvious experiences are proposed	somewhat: necessities are considered	somewhat: convincing subsidiary influences are incorporated
Average (40-60)	rules: important decision-making processes are supported with rules	regularly: the most important information is considered	reasonable: priorities are considered	in a broad context: directly related plans are considered
High (60-80)	procedures: combinations of mutually attuned rules	often: most information from the past is considered	far: foreseen developments are considered	in a broad context: important influencing factors are incorporated
Very high (80-100)	systems: balanced systems of mutually attuned procedures	always: all relevant information from the past is considered	very far: expected developments are reviewed and considered	in the entire context: all influencing factors are incorporated

HOW TO OPERATIONALIZE THE FRAMEWORK FOR IRRIGATION?

The analytical framework presented above can be used in any organization. To facilitate its application and understanding in irrigation management it is made more irrigation-specific. A first step is the identification all irrigation-specific key decisions. Also, the levels of sophistication for these irrigation-specific key decisions are defined in detail.

Identification of Key Decisions and Irrigation Management Concerns[17]

To make the management perspective irrigation-specific, the key decisions for water delivery must be defined. Two major groupings of key decisions are those dealing with 1) *capacity creation*, and those dealing with 2) *capacity utilization*. An essential difference between them is their respective time frames. Capacity creation involves the provision of capacity to enable its utilization over the medium to long term. Capacity utilization refers to water delivery over at most one year.

Further sub-division and short descriptions of the different irrigation management concerns and key decisions follow hereafter. Figure 5 displays them graphically.

1. *Irrigation capacity creation*

This comprises the key decisions determining the irrigation capacities required to achieve the pursued capacity utilization processes, and ultimately the desired water-delivery performance. Examples of irrigation capacities are not only the "hardware" such as the physical infrastructure, transportation facilities and information systems, but also the "software" like the irrigation agency staff.

Capacity creation may involve new construction, rehabilitation and maintenance activities. For simplicity reasons all these activities are referred to here as "capacity creation". In line with Kampfraath's definitions of management concerns, this group is divided below into two management concerns, the "strategic management" and "capacity management".[18]

Strategic management covers three key decisions. The first is the determination of the organization's mission and related desired objectives for irrigation investments. The second is the matching of these desirable objectives with the resources available for investment, i.e., the decision on the so-called feasible investment objectives. And the third is the determination of the functional requirements for the envisaged irrigation investments. These three are described below.

Desired objectives. An irrigation investment always intends to achieve certain desirabilities. These are defined here as the desirable objectives. This definition of desirable objectives excludes their feasibility as such, which is per definition part of the key decision about the feasible objectives.

An obvious example of a desirability for an irrigation investment is the objectives of the reduction of cultivation risks (through more control over water in certain areas at a certain time). Other examples, whether implicitly or explicitly stated, are such objectives as an increased agricultural production, the alleviation of poverty, the reduction of unemployment, the settlement of landless people, the appeasement of political supporters or geopolitically sensitive areas, the saving of foreign exchange through increased exports or reduction of imports, the sustainability of the environment, and the like. These desired objectives evolve from the related objectives of different stakeholders such as the national government, the politicians, the donors, the local community and the beneficiaries.

Feasible objectives. As soon as these desirabilities are matched with the available resources, another key decision comes into the picture, i.e., the decision on the so-called feasible investment objectives. Resources can be of a financial nature, but may refer also to the staffing capacity and capability, or to different physical resources. Examples are such objectives as the area to be commanded (by irrigation water at a certain time), the different crops to be grown, the cropping intensities, the acceptable cultivation risks, the predicted water-delivery performance, etc.

Prerequisite for the determination of the feasible objectives is the making of certain preliminary assumptions about the future functional requirements for the investments. In irrigation this is sometimes called the feasibility-level design.

Functional requirements. Given the outcome of the decision making on the feasible investment objectives, further specifications of the functional requirements for the investments have to be set. Obvious examples are such straightforward requirements as the required water levels to command certain areas, and the required canals to maintain these water levels. Examples of more performance-related requirements are the required structures to control water flows and levels, the required storages to collect and store water from the catchment, and the required intermediate storages either for the collection of runoff, or the reuse of drainage water, or just an increased responsiveness at those locations.

Capacity management is the management concern for the setting of the technical requirements for the investment. The functional requirements are thereby considered as fixed as they are per definition the outcome of the strategic management. Examples of technical infrastructure requirements are the different technical standards to be used such as the densities of engineering materials, the coefficients of expansion and shrinkage, the permissible concrete stresses, the seepage gradients and uplift or protection. Examples of technical staffing requirements are such requirements as the selection criteria and professional-development programs.

Tendering of contracts for construction, rehabilitation, and maintenance contracts is part of this capacity management. And so is the monitoring and adjusting of the actual acquisition of the irrigation capacity.

2. *Irrigation capacity utilization*

The second major grouping of key decisions is the irrigation capacity utilization. It comprises the key decisions about the utilization of the available irrigation capacities to realize a certain water delivery. In line with Kampfraath's definitions of management concerns, this group is again split into two irrigation management concerns, the so-called "allocation management" and "regulation management".[19]

Allocation management refers to the decisions about how much water is to be allocated, as well as when and where. This decision making usually deals with the matching of supply and demand (except situations where the allocation is fully supply-driven because of the absence of any gates in the system). This allocation management also entails the determination of the quality standards for the service delivery as well as the related indicators. Examples of indicators are timeliness, adequacy, equity, reliability, responsiveness, predictability, efficiency, variability, etc. There are two types of allocation decisions, the seasonal and in-seasonal allocation decisions.

Seasonal or annual allocation plan. The seasonal plan is the decision of what areas are to receive water, for what crops and at what time. At the beginning of each season or year, the matching of the available supply of water with the existing demand leads to such a plan for the allocation of water to subsystems. Of course, the subsystems can use this water for other purposes than irrigation as well. Such a seasonal allocation plan incorporates the envisaged cropping patterns and calendar, and the related cultivation risks.

In-seasonal allocation. The in-seasonal plan is the decision about who gets how much water, and at what time. Matching of the available supply of water with the existing demand during the season leads to more or less regular in-seasonal allocations of water to subsystems. Also this plan incorporates the envisaged cropping patterns and calendar, and the related cultivation risks. These in-seasonal allocations are expressed in operational targets either for the capture of water from a source, or for the storage in (intermediate) reservoirs and canals, or for the conveyance along canals, or for the distribution through (different types of) offtakes.

Many irrigation professionals consider the seasonal and in-seasonal allocation as the same plan as they seem to require almost the same type of information. Yet, the value of separate analysis is their different outcome. The outcome and performance indicators of the seasonal plan are more in terms of the cropping intensity, the cropping calendar and the cropping pattern. For the in-seasonal plan, these are more in terms of water duty and quality of the service delivery.

Regulation management. The concern for flow regulation entails the decisions of the timing, the frequency and the size of the gate settings along the canals to get water to offtakes and thus effectuate the allocation decisions. Structures are operated to capture water from a source, to store it, to convey it through canals, and to distribute it through offtakes. Such operational methods are possibly in line with the operational targets. Managers therefore make decisions about the operational methods for the different gates of different structures.

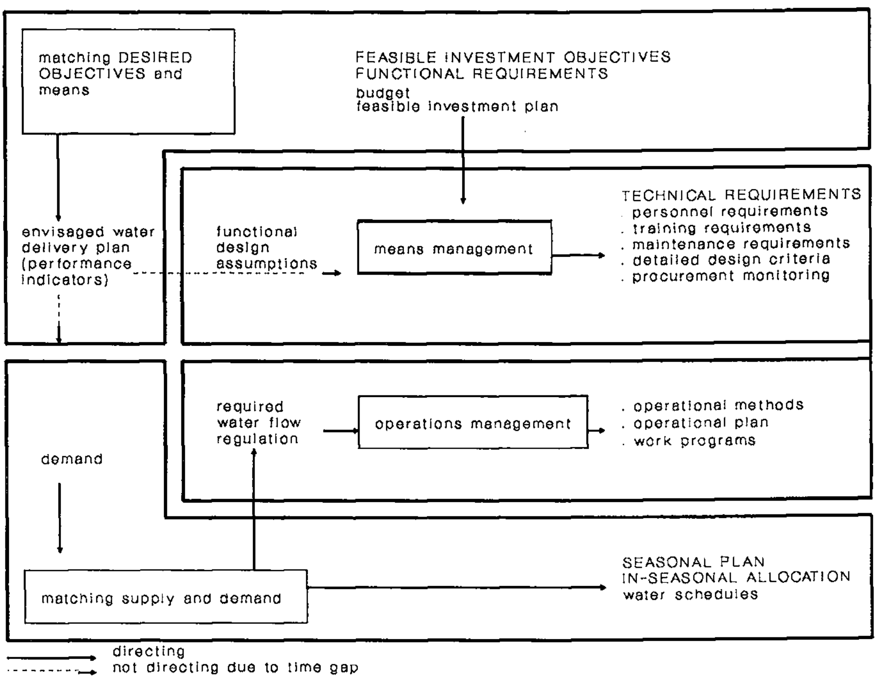
Depending on the pursued water-delivery performance, they possibly develop also a regulation plan. Such a plan coordinates the operational methods and procedures of the different structures along canals to regulate the water flows and levels.

A mutual adjustment of the management of the allocation and the water-flow regulation is always necessary. The flow regulation practices provide in principle the inputs for the allocation management. At the same time, the allocation management produces the operational targets for the flow regulation. In all situations, the final decisions refer to the flow regulation processes to realize the water deliveries. The flow regulation determines thus ultimately the performance.

Large overlaps exist between the information used and required for the above key decisions. The relevance of a separate management analysis is the different outcomes, requirements and constraints of these key decisions. These different key decisions thus represent different perspectives for the involved decision makers, and therefore require also different performance indicators. For the seasonal plan the outcome and performance indicators are more in terms of cropping intensity, cropping calendar and cropping pattern. For the in-seasonal plan the outcome and performance indicators are more in terms of the water duty and quality of the service delivery. The performance indicators of the regulation relate more to the efficiencies of water conveyance and the quality of the water conveyance.[20]

Except for the capacity management, this study discusses and analyzes the above three other irrigation management concerns of the framework. The omittance of the capacity management is due to the otherwise required detailed descriptions of the more informal processes of the capacity creation. The detailed discussion of, for example, the here and there existing mechanisms of corruption in construction and maintenance contracts, or the political and other influences in the hiring and firing of people are too sensitive to be incorporated in this text. Especially, if the text is to remain acceptable and accessible to a wide audience.[21]

Figure 5. Irrigation management concerns



Definition of the Levels of Sophistication for the Key Decisions

Another step of making the analytical framework irrigation-specific is the translation of the four criteria that determine the levels of sophistication (and the evolving conversion matrix of Table 1) for the six key decisions. This translation can be found in Annex 1.

Based on the same criteria, Marcelis has developed a questionnaire for the different management concerns. Although the development of this questionnaire focused on maintenance management, the translation of the related questions for irrigation management was not difficult. Annex 2 shows this translation for the key decisions of the capacity utilization in irrigation.[22] Essentially the same values (see Annex 2) for similar types of activities were maintained to make use of the experience of Marcelis' in-depth work to establish them. Also the lack of any reliable values in irrigation to establish alternative values made it logical to use those developed by Marcelis.

For the capacity creation such a questionnaire was not used. The political nature of these decision-making processes makes it less appropriate to make a quantitative comparison between different countries. Instead, chapter 5 gives a broad quantitative judgement based on the four criteria underlying the concept of the levels of sophistication.

DATA COLLECTION

Data collection on decision-making processes for this study consisted of the interviewing of the decision makers, and of studying reports, files, records and other documentation. Also, some direct observation of the decision-making processes and physical processes was done.

This section explains the approach of the data collection. In general, the quality of (the application of) an analytical framework comprises the same components as any other knowledge product; its relevance and its reliability.[23] These quality components are discussed below.

Relevance : the Framework

The above described framework itself provides a guideline for prioritizing and focusing on the enormous mass of issues, information, and opinions in irrigation systems and organizations. The framework thereby determines the relevant research questions for this management analysis of the irrigation sector. These are the general pictures of the six key decisions and the related decision-making processes. The managerial aspects of the decision-making processes are analyzed separately, as well as their mutual adaptation to the substantive aspects of the decision-making processes. Additional relevant research questions are the opportunities and constraints in the processes and related management conditions. Chapter 7 evaluates the relevance of the framework as applied in the preceding chapters.

Reliability : Opinion- versus Data-Based

This section deals with the other component of a good analysis, i.e., its reliability. What has been done to generalize the decision-making processes here as reliable as possible? Though the reliability of research often benefits from quantitative data and facts (i.e., to be data-based), for decision-making processes this seems doubtful. One may try to quantify aspects of the decision-making processes, for example, the frequency of a meeting. Yet, the question may linger on if the meeting serves any consultative purposes. Similarly, any quantification of aspects of the decision-making process tends to depend again on the interpretation of the figures, and is thus again opinion-based.[24]

Any generalized picture of a decision-making process therefore has to rely to a large extent on the opinions of people. If researchers want to trace a decision-making process, they have to rely to a large extent on the opinions of the people involved in the decision-making process. Decision-making processes are essentially processes of transformation of information. Information is their input, throughput and output. But information as input, throughput and output is not always traceable in files, memos or other documentation. A large part of the relevant information is "between the ears" of the people involved in the decision making. Tracing this information requires the interviewing of the involved decision makers, who give their opinion of the decision-making process. This study is therefore to a large extent opinion-based.

Yet much effort has gone into making the generalized picture of the decision-making processes as reliable as possible, and to distill from the multitude of opinions of people a balanced picture. This required the following approaches:

1. First, the initial two *in-depth case studies* served to obtain an in-depth insight in the decision-making processes, the different opinions and related interests. The analytical management framework was developed gradually and in parallel with these in-depth case studies. Simultaneously, it was used for their analysis. Most of the related data collection occurred from March 1988 till March 1989, although it continued up to December 1989. IIMI published the case studies as two Sri Lanka Country Papers[25] that serve here as reference material.

Although case studies are widely accepted as suitable for exploratory research, many scientists consider them less suitable for generalizing purposes.[26] Still, many management scientists consider case studies appropriate for addressing many scientific research issues in management.[27] For example, De Leeuw has stated that case studies are an appropriate research method to find out the exact picture of the decision making, or to identify relevant variables.[28] For this study, less intensive research in other localities supplemented the material of the in-depth case studies (see item 5).

2. Different *rounds of interviews* served to improve the data reliability further. The data collection for each case study started with a first, familiarizing round of interviews with different staff levels of irrigation-related agencies. Main subjects of the first interviews were the respondents' functions, tasks, responsibilities and entitlements, as well as a first inventory of their involvement in different steps of the different decision-making processes. Available reports and relevant research data helped the design and formulation of questions. Farmers involved in water-related decision making were interviewed in the same way.

To stimulate the communication, the "open" interview technique was used. For the same reason, the bare minimum of interview notes was made. Instead, a full report of every interview was completed the same day. Although the interviews were unstructured, the interviewer used some interview-specific lists of relevant questions to be addressed.

Several other rounds of interviews were needed to obtain a clear picture of formal and informal decision-making processes, as well as the biases, interests and constraints of different participants and organizations. Without specific information and questions on the decision-making processes during the first round of interviews, the gathered data tended to be general and broad. They often reflected merely the formal pattern.[29] Obtaining a more profound picture of the actual decision-making processes required also a more detailed insight in the processes. Initially, this was difficult to achieve through interviewing only, and some form of participant observation of the decision-making processes and physical processes was necessary. Again reports and documents were important sources of background information and incidents that could be used for developing questions. Especially for capacity creation all sorts of project preparation, appraisal and evaluation documents were important sources of such incidents. The integration of such information (incidents etc.) in subsequent rounds of interviews contributed to an improved insight in the decision-making processes. A good insight in system level decision-making processes evolved only after also the higher echelons of different agencies and donor organizations were interviewed, either once or iteratively.

Opinions of the different decision makers about organizations and their role in these processes facilitated an improved understanding of the actual decision making.[30] Though cross-checking of these opinions through repetitive and iterative questioning was of course necessary. The rounds of interviews helped to cross-check opinions of some respondents with those of others. Especially, if a certain opinion seemed linked to a certain interest, this opinion was checked with others of the same interest group as well as with those of a group with a different interest.

This balancing of opinions became gradually easier through an increased familiarity with the organization and the actual processes.[31] Especially, because more familiarity provoked respondents to give their opinion (which was usually not so in the first round of interviews).[32] This familiarity reinforced itself more and more. More familiarity with actual processes made it possible to raise more specific questions, leading again to more specific answers.

The interpretation of the data on decision-making processes here relied to a certain degree on so-called teleological reasoning. Teleological reasoning uses the logic that people tend to do things they perceive as advantageous, and neglect things they perceive as disadvantageous. Practical management research frequently uses this type of internal logic for explaining human behavior, as well as for trying to influence it.[33] And so does this study in its interpretation of decision-making processes, and identification of opportunities for change in management processes and conditions.

De Leeuw has argued that the determination of the quality of teleogical statements is per definition more cumbersome as they contain an intestable assumption: the assumed reality.[34] Therefore, teleological reasoning is used here only if respondents also confirmed the related behavior.

3. It was mentioned above that the data collection on water-related decision-making processes required some insight in, and understanding of, the physical process, in a qualitative as well as, preferably, a quantitative way. In addition, such data collection required some understanding of the substance of the decision-making processes, i.e., mostly irrigation engineering topics. The research set up thus had to envisage this in the related *observational methods*.

The author's background in agricultural engineering facilitated the understanding of the decision making regarding such technical issues as, for example, the theoretical crop water requirements calculations, irrigation scheduling, operational methods, backwater effects, sensitivity of structures, design criteria and assumptions. This technical background facilitated the understanding of the alternative choices in the decision making, the character of the technical criteria and priorities etc.

Studying the available physical facilities and their usage helped to gain an insight into the physical processes. The study of the actual usage required the direct observation of, and interaction with, the gate tenders. This provided an understanding of the different influences, interests, constraints and arguments involved in this decision making (such as the unsteady flows, easiness and the frequency of operations, the availability, reliability and timeliness of operational targets, the problems to assess the discharge, and requests from farmers).

The above observational methods were used in all case studies. In the two in-depth case studies in Sri Lanka, the following observational methods contributed to the quality of the data collection as well. A concurrent IIMI project on main canal regulation in one case study, Sri Lanka's Kirindi Oya system, used an effective tool for studying the decision making about the physical process. It consisted of automatic water level recorders in combination with data loggers. This combination provided the opportunity to monitor actual gate operations day and night, and interview the gate tenders afterward based on the monitored operations about the how and why of their decisions.[35] Especially for the study of the hydraulic behavior of the main system and the related decision making on the gate operations, this tool appeared valuable.

Direct observations of decision making by higher hierarchical levels than the gate tenders and their immediate supervisors were done to a certain extent in the in-depth case studies by observing their activities for limited periods of time. The focus was thereby on the interaction between the different hierarchical levels and between the agency staff and the water users. In addition, participant observation was done by attending formal and informal meetings.

Research notes of IIMI research assistants of different disciplinary background that worked and resided on-site in the two Sri Lankan sample areas, and discussions with them, improved the quality of the in-depth case studies at system level.

These direct observations, research notes and consequent discussions, as well as the research results of parallel IIMI projects in the same systems provided the incidents and facts used for interviewing the different agency staff. Without such detailed information it would have been more difficult to interview these managers more than once about the specifics of their work to gain an exact picture of the actual decision-making processes.

4. The concept of the *level of sophistication* is an analytical tool to compare decision-making processes in the different case studies in a more data-based mode than the case study approach. Decision making is essentially a transformation of information, as discussed above. Higher levels of sophistication characterize a more appropriate way of handling the information, and are thus likely to lead to better decisions. Although data collection on the levels of sophistication and thus on the use of information is to a large part opinion-based, compared to the human factor in the decision making, information use provides a somewhat neutral entrance for the comparative analysis of decision-making processes.

5. Most reviewers of the initial two in-depth case studies remarked the wider validity of the

findings. To enable a further generalization of sufficient reliability, *comparative case studies* were undertaken in three other countries. The obtained familiarity with the physical and human behavior allowed the comparative case studies to be of a shorter duration than the in-depth case studies. Iterative rounds of interviews were necessary only for the key decision makers. Successive comparative case studies of durations between two and four weeks in Philippines, Morocco (four weeks each) and Sudan (two weeks). In both Morocco and the Philippines two case studies were done (i.e., the Gharb and Basse Moulouya systems in Morocco and UPRIIS and Allah systems in the Philippines), while in Sudan one (i.e., the Rahad system). In all countries, in addition, top managers, policy makers and researchers of relevant departments, ministries and international development banks were interviewed.

The basis for the selection of the countries for the comparative case studies was the perception prevalent among irrigation professionals of a relatively weak (i.e., Sri Lanka and Sudan) and a strong (i.e., Philippines and Morocco) irrigation management in both rice-based and non-rice based irrigation environments. Morocco provided, in addition, for a more technology-intensive case.[36]

Additional field observations and interviews of even shorter duration were done in South India (Tamil Nadu) and Pakistan (Punjab). Also, IIMI's Management Development Program applied the management perspective provided by the framework in its Training Needs Assessment exercises, Top Management sessions and development of Training Modules in Malaysia and Bangladesh.[37] The latter exercises provided additional observations for the management perspective presented here.

6. This text presents generalized findings of the different case studies. As far as possible, references to international publications on similar findings further supplemented and validated these generalized findings. Especially regarding sensitive issues many such references to other professionals and official documents were used to ensure the highest reliability and objectivity possible (as most official documents tended to give as rosy a picture as possible on the investment performance). In addition, discussions with colleagues in IIMI and other international irrigation and management *experts* contributed significantly to the generalizing of the findings.

IS GENERALIZATION ABOUT IRRIGATION MANAGEMENT APPROPRIATE?

The subsequent chapters aim to provide a generalizing picture of the described management perspective. One may question to what degree such a generalization is appropriate at all.

Although generalization about irrigation management has been much advocated in the past, its potential has been controversial all along. A likely reason is that nobody has ever considered a process-based generalization. Generalization of processes is possible, though one has to put many efforts in its reliability, as explained in the above section. The only similar generalization available to date, is Slabbers' comparison of indigenous and western water allocation principles.[38]

Structure- or systems-based generalizations seem almost unattainable, not the least because of the wide heterogeneity of scale and relative water scarcity.[39] Bottrall, for example, has tested the representativeness of his sample systems against 24 different possible classification parameters.[40] Despite many efforts, the classification problems that have to precede such generalizations have yet to be solved.[41]

Chambers has expressed this generalization dilemma as follows: "If there is one clear lesson emerging, it is that each system is unique in its combination of resources, structures, institutions, procedures, conventions, problems and opportunities."[42] A process-based analytical management framework starts also with this assumption; it considers the prescription of blueprint structural changes per definition as inappropriate and as unadapted to a specific management situation. Yet, some generalized shortcomings with general indications of the kind of solutions may be possible.

Based on a generalization of processes, this study identifies generalized opportunities for improvement. Still, one has to be aware that such recommendations remain broad indications for the whole irrigation sub-sector, rather than tailor-made solutions for specific organizations and systems.

Notes

1. Zuurbier et al. 1991:73, after an overhead of Kampfraath and Marcelis 1981.

2. See, for example, West Churchman 1968:29.

3. Simon 1971.

4. "Processes" refers in this text to decision-making processes.

5. This chapter remarks now and then a differing use of jargon by most English and American management professionals, thus suggesting the used analytical framework to be a new paradigm. To a certain degree it is as it tries to be pure and consistent in analyzing processes. Yet, process thinking itself has become widespread and is not a new paradigm. The framework used here can be seen as a synthesis of much of the American thinking regarding management principles -- particularly Simon, but also Drucker and others--. It has some specific characteristics, in which case reference is made to the original authors. In practice, the framework represents a new paradigm where it defines certain concepts. Management and control and management function are defined more consistently in their relation to decision-making processes than in most English and American literature.

6. Kampfraath and Marcelis 1981; Zuurbier et al. 1991.

7. Kampfraath's rationale for choosing "concern" rather than, for example, "function" is that concern is process-based. "Concern" refers to the necessity for the organization as a whole, or even outsiders influencing the decision making, to take these key decisions to achieve certain objectives. "Functions" always relate to organizational such as persons and departments. Thus, the process-oriented definition of concern corresponds to function only if applied to the organization as a whole.

8. Irrigation's physical process refers to the de-facto gate operations - (thus not the decision to operate the gate and the method of operating, but the result of that decision) - and the consequent water flows.

9. This approach of conditioning or controlling the management processes by a systematic kind of trial-and-error, a cybernetical approach, has many management science supporters, both process-oriented and structuralist professionals. Only the approaches to analyze and solve the problem vary widely.

10. Kampfraath has argued that the management control type of decision making consists theoretically of an infinite number of layers of decision-making processes. Unless only one person is involved, you can always find conditioning decisions for management control decisions. Because of the theoretical nature of this argument, more interesting for management scientists than irrigation professionals, it has not been used here.

11. Uncertainty is defined as the difference between the amount of information required to perform a task and the amount of information already possessed by the organization (Galbraith 1973:5). This definition approaches the complement of the level of sophistication. Though, the latter concept leaves the judgement about the required level to the organization (or the management consultant).

12. Simon 1971.

13. Lindblom 1971.

14. For a methodology to develop such indicators, see Nijman 1990.

15. Conform Mantz 1984.

16. After Kampfraath and Marcelis 1981:39.

17. The irrigation management concerns are only made irrigation-specific for the decision making, i.e., not for the management control. Kampfraath has defined such management control concerns as well, but these are not used here.

18. Kampfraath and Marcelis 1981:33.

19. For management in general, Kampfraath has defined these concerns as "operational management" and "programming/manufacturing" respectively.

20. An example of potential performance indicators for the different key decisions is provided in Nijman 1992b.

21. For a description of these processes, see, for example, Wade 1982b.

22. Marcelis 1984.

23. De Leeuw 1990:50.

24. Conform de Leeuw 1990:101.

25. Nijman 1991 and 1992a.

26. E.g., Yin 1984.

27. E.g., De Leeuw 1990:131.

28. Ibid.

29. Conform, for example, Hunt and Hunt 1974.

30. Opinions of different people with different interests are very important to obtain a clear picture of the formal and informal organization. The in-depth observations for this study support the experiences of the interpretative sociologists that, apart from the physical appearance of the organization, organizations do not exist, other than as images in the eyes of the different participants (Lammers 1987:417).

31. Wade is one of the few irrigation professionals who has written about his research methodologies. His research methodology in this respect is almost similar with the methodology of this study (Wade 1982a:291).

32. Conform De Leeuw 1990:101.

33. Ibid:37.

34. Ibid:41.

35. This method showed, for example, that the cross-regulators in a main system in the Philippines, were operated at night for fishing purposes (IIMI 1989).

36. A recent comparative Irrigation Impact Study by the World Bank selected its sample countries on the basis of almost identical criteria (World Bank 1990d:ii).

37. IIMI/DID 1990 and IIMI/BADC 1991; Nijman and Kampfraath 1991a; 1991b; 1991c.

38. Slabbers 1989:679.

39. Chambers 1981:3.

40. Bottrall 1981a:41-42.

41. The two most recent classifications can demonstrate this. A classification by Svendsen and Small 1990 sparked off a lot of criticism, partly directed on the lack of a conceptual basis. Murray-Rust and Snellen 1991 produced and applied a more workable classification that was partly process-based (mainly the allocation). However, the latter's focus was on design-performance interactions only.

42. Chambers 1981:3.

CHAPTER 4

Results : Capacity Utilization

"Professionals have always resisted attempts to hold them accountable. It is the essence of being a professional--so the doctor, lawyer, engineer, or priest has always argued--that one is not accountable to laymen and that qualification rather than performance is the ground of acceptance . . . Society must demand that these people think through what they should be held accountable for and that they take responsibility for their contribution."[1]

"Management is based on the premise that things can be done better, which in turns means that one wants better performance. In a socio-political situation where what is legitimate is what one gets away with, can there be any concern for public system performance? And, if there is no desire to manage, what can management techniques do?... 'In the land of nudists, what can a washerman do?' --(Panchatantra)."[2]

IRRIGATION PROFESSIONALS WHO write about capacity utilization typically focus on those aspects they are trained in. The simplified image is that engineers tend to be biased toward structures and formulae, economists toward numbers, and sociologists toward participation.

Such "biased" approaches provide limited guidance for irrigation managers. Though every perspective is prone to have some biases, this chapter attempts to take a more objective perspective in both diagnosis and therapy toward the commonly applied disciplinary approaches in the capacity utilization. Apart from providing an innovative perspective on capacity utilization, this chapter identifies the related opportunities for improvement.

The following characteristics make this perspective of a different nature in comparison to earlier publications:

1) the framework's systematic focus on the substantive and managerial aspects and thus on the usefulness of different disciplinary approaches in actual decision-making processes about capacity utilization; and,

2) the framework's integrative perspective of how different management conditions (such as human resources, their motivation and incentives, the provision of information and knowledge, the organizational structure and the financial control systems) influence decision-making processes, and ultimately the performance of the irrigation organization.

This perspective is different because disciplinary specialists are typically not trained to look at these two aspects.

The first step of the development of this perspective in this chapter is the definition of the key decisions of capacity utilization. These key decisions are the allocation and flow regulation decisions. They are the basic orientation points of the diagnosis and therapy in this chapter. This set of key decisions is already different from topics normally studied by most irrigation management professionals.

For each defined key decision, the actual processes of decision making as they tend to occur in the case studies are described and analyzed. Also, a comparative performance assessment of these management processes in some selected irrigation environments is given.

The concluding parts of the chapter use these analyses and performance assessments to derive opportunities for performance improvement. Improvements are suggested in an integrated manner in terms of requirements for 1) the decision-making processes (step 3 of Figure 3 in chapter 3); as well as, 2) the management conditions (step 4).

WHAT ARE THE KEY DECISIONS FOR CAPACITY UTILIZATION?

Prerequisite for a focus on decision-making processes here is a very precise definition of what key decisions have to be taken for irrigation capacity utilization. These key decisions are classified into two groups of management concerns: "allocation" and "flow regulation".

Allocation management refers to the decisions about how much water is to be allocated, as well as when and where. This decision making involves the matching of supply and demand.

Part of this allocation management is the determination of the quality standards for the service delivery as well as the related indicators. Examples of indicators are timeliness, adequacy, equity, reliability, responsiveness, predictability, efficiency, variability, etc. In general, allocation entails the following two key decisions.

Seasonal or annual allocation plan. The seasonal plan is the decision about which areas are to receive water, for what crops and at what time. At the beginning of each season or year, the matching of the available supply of water with the existing demand leads to such a plan for the water allocation to subsystems. Water can be allocated for irrigation and for other purposes such as drinking water, bathing, and hydropower generation. This plan incorporates the envisaged cropping patterns and calendar, and the related cultivation risks.

In-seasonal allocation. The in-seasonal plan is the decision who gets how much water, and at what time. Matching of the available supply of water with the existing demand during the season leads to more or less regular in-seasonal allocations of water to subsystems. Also this plan incorporates the envisaged cropping patterns and calendar, and the related cultivation risks.

These in-seasonal allocations are expressed in operational targets for the different physical processes. Examples are the operational targets for the capture of water from a source, for the storage in (intermediate) reservoirs and canals, for the conveyance along canals and for the distribution through (different types of) offtakes.

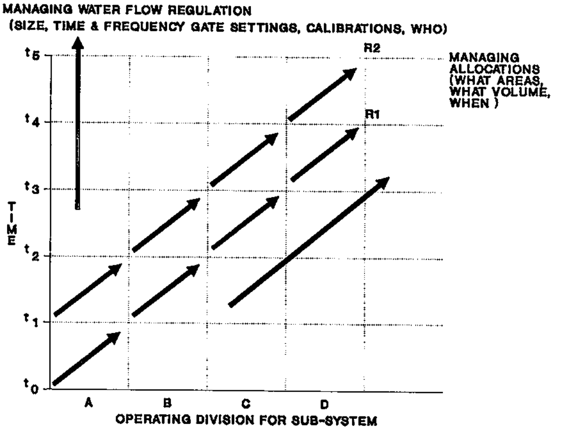
Many irrigation professionals consider seasonal and in-seasonal allocation as the same plan because it requires almost the same type of information. The value of analyzing them separately is that their outcome is different. For the seasonal plan the outcome and performance indicators are more in terms of cropping intensity, cropping calendar and cropping pattern. For the in-seasonal plan the outcome and performance indicators are more in terms of water duty and quality of the service delivery.

Flow regulation management. Flow regulation entails the decisions of timing, frequency and size of gate settings along the canals to get water to offtakes and thus effectuate the allocation decisions. Structures have to be operated to capture water from a source, to store it, to convey it through canals, and to distribute it through offtakes in line with the operational targets. Managers must therefore make decisions about operational methods for the different gates of different structures.

Depending on the pursued water-delivery performance, they possibly have to develop also a regulation plan. Such a plan has to coordinate the operational methods and procedures of the different structures along canals to regulate water flows and levels.

The essential difference between allocation and regulation also can be shown with Figure 6. The large vertical arrow in the Figure 6 represents the regulation as the repetitive operations of the same gates by operating division A at times t0, t1, etc. The management of the contributions by one of the operating divisions for improved gate settings and procedures is essentially a localized concern. Yet, the contributions of the different divisions have to incorporate the hydraulic interdependence of water flows along the canal. Decisions on regulation should establish the best operational methods of gates for different flow patterns, and so determine the potential quality of the water-delivery service. Overall, the flow regulation covers the management of the more technical, hydraulic aspects of the capacity utilization.

Figure 6. Irrigation capacity utilization[3]



The large diagonal arrow of Figure 6 represents the allocation management of volumes of water at different times along a canal and between subdivisions A, B, C, D etc. This planning determines the pursued allocations R1, R2, etc. and the required outputs from the different divisions (when, where and how much) to achieve them. These requirements are derived from the pursued allocations. For example, from the desired allocation R2, the allocation planning first derives the required output from division D, subsequently from division C etc.

The allocation management thus indicates the operational targets for the regulation by the different operating divisions. These operational targets can be expressed in water levels or discharges. Overall, this allocation management cares for the overall performance of the capacity utilization. In practice, the management of allocation and regulation interact very closely.

Allocation-Regulation Interactions

Large overlaps exist between the information used and required for the allocation and the regulation decisions. An allocation decision requires insights in the quality of regulation that can be delivered by the different operating divisions. A decision on regulation is typically in the form of "if..." a certain flow situation occurs, "...then" it is regulated in a particular manner. Examples of such "if...then" decisions are operational methods and procedures to be applied after particular flow variations due to rainfall or operation of the head sluice.

Allocation planning of operational targets needs such information of the "possible" regulation. The other way around, the operational targets for conveyance through and distribution from a canal are the output of the in-seasonal allocation, and the input for regulation decisions. Such targets may encompass requirements on timing, duration and discharge to different canal reaches.

The final decision on the water delivery is always an actual gate setting, i.e., a regulation decision. These regulation decisions may or may not be in line with the allocation plan. The less these allocation decisions consider the requirements of the regulation--or the less the regulating staff likes to follow the suppositions of the allocation schedules--, the larger are the deviations between scheduled and actual allocations.

The decision-making processes about allocation and regulation, even while mutually exclusive in perspective, should thus be strongly adapted to each other. Analyzing the management of the capacity utilization remains incomplete and defective, if one considers only one of these two key decisions.

Allocation-Distribution versus Allocation-Regulation

A misleading concept in irrigation management is "distribution". Its confusing nature is explained here with the help of the fore described "management-relevant" perspective on capacity utilization.

Most irrigation professionals use this concept of distribution.[4] Yet, all use it with a different meaning and almost nobody defines the concept.[5] Naturally, this confuses the discussion, analysis and comparison of the methodology and results of research on and interventions in irrigation management.

A listing of explicit and implicit definitions used for distribution is less interesting and is time-consuming. However, a working group of Cornell University developed a definition to which many professionals adhere.

Cornell defined the concepts of allocation, distribution, decision making and conflict management[6] as essential tasks for system management.[7] The difference between allocation and distribution relates thereby to the physical infrastructure; water is "allocated" from the water source, and "distributed" in a distribution network.

For decision making, and thus for a management analysis, this physical difference is irrelevant and even misleading. It assumes that distribution within the distribution network does not involve any allocation decisions anymore. It also assumes that this so-called "allocation-distribution" paradigm covers the full scope of management issues relevant for irrigation capacity utilization. So, professionals working with this paradigm typically ignore the more technical, hydraulic perspective of the management of flow regulation.

The difference between the "allocation-distribution" and the here proposed "allocation-regulation" paradigms may seem theoretical or trivial. Yet, the practical consequences are a systematic neglect by most irrigation practitioners of the management requirements of flow regulation, in theory as well as in practice. While many practitioners have written about the relevance of main system management,[8] this major management component is usually not considered. Some exceptions exist[9], but mostly in more technically oriented research on regulation. Typically only engineers execute and report upon these. The hydraulic characteristics and related physical and management processes tend to be considered only in the design phase, and, even then, only in a theoretical way.

A more "management-relevant" analysis of irrigation capacity utilization requires thus an explicit awareness of the existence and use of this "allocation-distribution" paradigm. This may lead to a complete and balanced approach toward the technical and managerial aspects of the capacity utilization in irrigation. And thus reduce the present widespread confusion in its analysis.

Unless in quotation, this text uses the word "distribution" only in reference to physical processes; i.e., to distinguish between the physical processes of "conveyance" of water along a canal, and "distribution" from a canal into offtaking canals.

ALLOCATION PROCESSES

This section gives a generalized picture of the actual decision-making processes in irrigation systems for one of the two basic orientation points of this chapter, namely the water allocation.

As said before, the case studies in Sri Lanka, Morocco, Philippines, Sudan, India and Malaysia are the main basis for this generalized picture. References to similar findings in the international literature on irrigation management provide for further justification and validation of the generalized picture. Following the presentation of this generalized picture, a comparative performance assessment is given of the management processes in the selected irrigation environments. These analyses and performance assessments are then used to derive opportunities for performance improvement. Opportunities for performance improvements are suggested in terms of requirements for the decision-making processes as well as for the management conditions.

This section on allocation processes has four different subsections, representing the following four separate components of the allocation decision-making process: 1) the preparation of decisions on water allocation commences with *an assessment of the supply*; 2) as well as *an assessment of the demand* for water; 3) the decision preparation generally leads to some form of *an allocation plan or schedule*; and 4) this plan may then be, or not be, the basis for the actual allocation decisions, their *implementation, monitoring and evaluation.*

For each of these four components, an initial description of the general picture of the substantive and management aspects is given. These are followed by the observed levels of sophistication in the different case studies. For some components the different observed management options are given as well. Then follows a separate analysis of the management aspects, or the "management process". It focuses on questions like what information is used, what are the main criteria, who participate, and what are the different steps in the decision-making process. Finally, an evaluation of the mutual adaptation of the substantive and managerial aspects concludes the analysis of the allocation processes.

Supply Assessment

The first component of the allocation decision-making process described here is the assessment of the supply. This supply assessment can happen for the system as a whole, as well as for different subsystems. This level depends also on the levels where decision making on the allocation takes place. For example, in a not imaginary situation, it can be the gate operators who make allocation decisions by themselves. To that end, they also assess the available supply by assessing the water level in either the upstream canal reach or the intermediate reservoir.

This supply assessment can, in principle, incorporate several sources of supply. Examples are the rainfall in the catchment area, the hydrological simulations or probability curves of inflow, as well as the actual inflow and storage in reservoirs. For their assessment several modern forecasting techniques in communications, electronics and micro-processing are, in principle, available. Examples of such techniques are minimal stream-gauging, precipitation stations, snow-pack monitoring and regional and local weather tracking.

Observed practices. Such forecasting of the likely inflow and rainfall does not seem to occur in practice. In all case studies the only basis for the supply assessment observed was either the actual inflow or the reservoir storage. Thus, the 100 per cent probable supply was used, rather than a forecast of a less reliable supply.

Frederiksen has had similar experiences with supply assessment. According to him, the experience of the system manager or operator is usually the only basis for inflow expectations. If at all, it is "sometimes augmented by inadequate data".[10]

One problem observed with historic data and probability curves is the frequently doubtful reliability of the underlying data and calibration curves. Worldwide trends of changing inflow patterns due to deforestation in upstream catchment areas further augment this problem.

Calibration curves of the reservoir capacities and main intakes of systems were observed to be often only theoretical. In general, they tended to remain unchanged after the original construction of the system. Due to siltation, weed growth and erosion of canals over time the absolute value of supply assessments with such calibration curves becomes negligible. Such a theoretical nature of calibration curves was observed in the studied run-of-the-river systems of the Philippines and India, and the reservoir systems in Sri Lanka and Sudan. Also in Morocco the volumetric modules were observed to be uncalibrated. (The error involved in the latter case was probably less, because the discharge released from such modules is less sensitive to water level fluctuations).

Observed management processes. The above described mode of supply assessment clearly has only a relative value. It provides system managers only with an indication of the supply, which is apparently often satisfactory enough for them.

The observed rationale for many system managers to be satisfied with such relative supply assessments is the difficulty to keep them accountable for the quality of their allocation planning. Simultaneously, the general unreliability of data and assessments makes it also more difficult to keep them accountable for their actual allocation decisions. And thus also for the quality of their supply assessments.

Forecasting of the likely inflow increases moreover the absolute uncertainty of the assessed supply, and thus of the cultivation risks envisaged in the allocation plan. This again increases the likelihood of complaints by their superiors, the farmers, or politicians. Generally speaking, it is thus, and has been observed to be, in the interest of the system manager to play "safe"[11] in their allocation decisions. And thus to make conservative estimates of the available supply as well,[12] preferably even at a 100 per cent probability. So forecasting of the likely inflow is generally not done.

As the use of inflow forecasts increases the absolute cultivation risks, system managers will only do it if there is need for them to do so. Such pressure may be exercised by, for example, the agency itself. Or it may be exercised by an interested group of farmers, that attaches some value to a less conservative estimate to allow a more economic use of the available land and water resources.

An agency may do this, for example, if a group of farmers exert pressure to use the extra water,--i.e., the used margin in the conservative estimate-- for an extra crop or area. This was observed, for example, in Morocco's Gharb system. There, system managers make these forecasts typically every six months and one month before the starting date of the season as part of the preparation for the decision to start rice cultivation. A particular group of farmers in Gharb can only cultivate rice in very wet years. These farmers have thus an obvious interest in a more precise supply assessment. So they exert in this respect a strong pressure on local authorities and the irrigation agency. Also here, however, the basis for the final decision was observed to be the 100 per cent reliable supply, that was assessed just before the start of the actual rice cultivation.

The fore mentioned low priority of system managers for more accurate and early supply assessments was observed to engender in general the approximate and relative nature of these assessments. The limited availability of funds and limited communication and transport facilities to make more timely and accurate assessments was observed to be usually a consequence of this low priority.

Demand Assessment

Decision making on allocation not only requires the assessment of the water supply, but also the assessment of the demand for water. Like for the assessment of supply, the demand can be assessed for the system as a whole, but also for different subsystems and even for the individual client.

What is demand? This question is relevant given the common and persistent confusion in irrigation-related disciplines of the requirements of crops and people. There can be little doubt that in day-to-day irrigation system management demand refers to the "soft" water requirements as expressed by *people and institutions* such as water users, politicians, and staff of involved agencies. This demand may be both for irrigation and non-irrigation purposes. Such demand can be expressed in requirements such as the areas to be irrigated, the water duty[13] and levels, the cropping pattern, the cultivation calendar and the related cultivation risks for the different subsystems.

The irrigation and agronomy sciences restrict demand usually to only the "hard" water requirements of *crops, soils and canals*. Unfortunately, these "hard" requirements also dominate the thinking of most irrigation professionals. Further parts of this chapter elaborate upon this issue.

In this text, demand includes both the "hard" and "soft" water requirements. So, demand assessment thus can incorporate several or all of the following parameters:

* cultivation and irrigation plans or progress of farmers;

* envisaged, historical or measured on-farm vertical percolation and lateral seepage rates or canal seepage rates;

* expected, historical or measured rainfall in the cultivated command area;

* canal operational losses;

* actual or theoretical evapotransporation of crops;

* the water level at the head of the concerned subsystem; and,

* requests of water users or politicians regarding the above parameters.

Important demand parameters for the pre-seasonal planning are the irrigated area, and the cropping pattern and calendar. During a cultivation season, however, the quantity and quality of the day-to-day water delivery for different subsystems is more important. Cultivation risks and related uncertainties are always important.

In principle, demand can be assessed on a more or less frequent basis. This frequency may vary with the water availability.

Observed practices. The generalized description and analysis of the decision-making processes to assess irrigation demand is given below. A classification of different degrees of demand assessment is used to focus this description and analysis. Simultaneously, this classification reflects the different levels of management inputs by higher staff levels in this decision making.

No demand assessment. In several irrigation environments such as Pakistan and the Indian Punjab, the original design of the irrigation systems precluded any demand assessment by agency staff. Design and construction of these systems envisaged very few gates to allow the spreading of water over a large area. These systems served thereby subsistence purposes, rather than the achievement of high yields per unit area.[14]

Allocations to and from the main system are largely supply-driven in these systems. No demand assessment is necessary or seems to happen, other than possibly the determination of the starting date for the cultivation season or the closure dates for maintenance.

Field-level demand assessment. Apart from the above fixed type of design concept, all other design concepts do provide for more flexibility to respond to changes in demand and supply. These other design concepts, in principle, always assume that demand assessment involves higher level staff than field staff. (Field staff refers in this text to the gate operators and their immediate supervisors whose physical basis is near the irrigation canals under their responsibility. Higher level staff are those whose basis is in an office that coordinates the capacity utilization for a (sub)system.)

In practice, this seems seldom the case. In all case studies, higher level staff were observed to become directly involved in demand assessment only if their superiors, farmers or politicians complained about water issues. Thus, they had a reactive rather than active management role in demand assessment.

Few publications make generalizing remarks about demand assessment. Levine states for Indian irrigation agencies that information flows were to a large extent downward "with relatively little of an operational nature moving upward."[15] This implied the absence of any demand assessment by higher level staff.

Few interviewed irrigation professionals denied the lack of involvement of higher level agency staff in demand assessment. Neither did they deny the general validity of the fore mentioned reactive attitude of higher-level agency staff in this decision making. The generally given excuse was the general lack of motivation and incentives for agency staff to put many efforts in demand assessment.

In general it seems that *the assessment of demand for water in manually operated systems typically occurs at field level by the farmers, gate operators and their immediate supervisors.* This does not mean that system managers or other higher level staff never make field visits. Of course, most do an occasional basis, and some do even more regularly. Yet, for the demand assessment this usually plays a marginal role.

Higher staff levels often considered themselves to be involved in demand assessment in an indirect way through their assessment of the theoretical crop water requirements. Several theoretical formulae were developed since the early 1970s. Their intention was to enable irrigation managers to improve performance of irrigation systems through better assessment of crop water requirements.[16] Often, however, irrigation managers used these theoretical formulae as the only demand assessment, even while they only represented the technical, "hard" requirements. They thus omitted from the equation such "soft" parameters as the scarcity value of water and related required inefficiencies in water allocation.

In contrast to the illusion given by the scientific formulae, even the "hard" requirements cannot be predicted accurately with these formulae for individual farms and small subsystems. It is hard to assess accurately most parameters required in the formulae, such as the irrigated area, the progress of the land preparation, requirements for land soaking, effective rainfall, and seepage and percolation rates. For example, IIMI measured the actual land soaking requirements in Kirindi Oya to be 400 per cent to 750 per cent of the calculated total water requirements.[17] Similarly, IIMI measured the seepage and percolation rates in Uda Walawe to be 475 per cent to 530 per cent higher than estimated.[18]

With such large deviations, the validity of the outcomes of the formulae depends to a large extent on the accuracy of the assessment of seepage and percolation. The latter usually varies considerably from one field to the other within one system, and even within one allotment.[19] So in developed countries, the use of such theoretically determined on-farm requirements is often in combination with a field-level assessment or calibration by farmers. There farmers even apply sophisticated tools like tensiometers for that purpose.

Also in all case studies, these indirect, theoretical demand assessments by higher staff were usually replaced or complemented in practice by field-level demand assessments. Higher level staff usually assessed only the aggregate, and inaccurate water demand for main and secondary canals; either through secondary data collected by field staff, or through irregular in-situ assessments of water levels in the canals.

In many systems, higher staff levels assessed only the seasonal demand regarding the cropping pattern and calendar (i.e., required starting dates and crops for different sub-systems). Sometimes, they assessed this directly in coordination meetings with water user representatives and local authorities. In other cases, they assessed this demand indirectly through information collected by field staff. This type of seasonal demand assessment by higher level staff happened in the case studies in the humid tropics of Asia, but also in, for example, Morocco.

Accurate or approximate demand assessment. Higher level staff, as was mentioned before, seldom had information to judge the water demand of farmers. So the assessment of water demand by them often occured only in an approximate way. This was the case, for example, in most systems in the humid tropics of Asia.

The expression of water demand at field level was usually in terms of an approximate water level or duration, rather than in terms of a volume or a discharge. This had several reasons. Farmers and gate operators were not always familiar with discharge or volumetric quantities. Measurement facilities, if available at all, were often not working properly; either because they were not calibrated, because of backwater effects, or due to faulty construction. Thus also higher staff levels could only obtain information in terms of approximate water levels or discharges.

In some cases higher staff levels made efforts to assess the water demand despite the lack of reliable and detailed information from the field level. This demand assessment through water level or theoretical formulae could only be approximate as well.

Accurate demand assessments occured only in those exceptional countries where every farmer submitted an individual request for a certain volume of water. In Morocco demand assessment was more accurate, because farmers expressed their weekly requirements in terms of volume. The availability of measuring facilities (i.e., fixed-discharge modules) at the farm gate facilitated this volumetric awareness. An important reason that it happened at all there, was the enforcement of the related volumetric billing of water. The latter made volumetric demand assessment more a necessity than in the other case studies.

This accurate type of demand assessment brought with it considerable administration costs as well. Yet, Moroccan authorities claim it to be cost efficient so far.[20] Unfortunately, very little comparative data are available on these administration costs for smallholder irrigation.

Also demand assessment regarding cropping calendar and pattern was usually in an approximate way only. Data collection on preferred or actual cultivation patterns often existed in Asian irrigation systems. Yet, due to low motivation of involved staff, these data were often not very reliable. Also, in the Asian case studies, for example, the demand assessment regarding cropping calendar by higher level staff was usually in meetings for groups of farmers, and never for individual farmers. Only in Morocco the agencies assessed the individual farmers' cropping plans rather accurately.[21]

Observed management processes. This priority for field-level demand assessment had several reasons. Most important was usually the desire of higher staff levels to minimize their management inputs in demand assessment. The field-level assessment was partly also the result of the recognition by irrigation managers that higher staff levels seldom have information to judge the actual farmers' water demand. Partly, it was also the result of the tendency of field staff to accommodate demands of farmers as far as possible, even if they were excessive. Still, the most important reason for the field level assessments was the first mentioned lack of motivation of and incentives for higher staff levels to put efforts in more accurate assessments.

Hard and soft. The question if demand refers to people or to crops seems a major point of confusion among irrigation professionals. Engineers and agronomists tended to consider the crop, water and farmers as part of a rational system.[22] They neglected by that the "soft" parameters, such as the opportunities of time utilization by farmers, and the scarcity of water because of the involved cultivation risks.

Strangely enough, this misconception persists against the odds. Some economists have pointed out the theoretical misconceptions for some time now.[23] Still, many engineers in the case studies insisted on using the theoretical crop water requirements without any other yardstick to judge water demand. Even though the limitations of its usefulness--and misuse in other cases--only increased since the 1970s, because of the increased use of high yielding varieties, and other field crops than rice (OFC). (Most new crops increase the absolute cultivation risks, and thus the relative scarcity of water and uncertainties for farmers[24]).

To a certain extent, the persistent misuse of these theoretical approaches is understandable given the few alternatives that were available to engineers. Really, the only alternative was to increase their management inputs in interacting with field staff and farmers for a more accurate demand assessment. So far the pressure for such increased management inputs was absent (according to interviewed engineers in Sri Lanka, Malaysia, Morocco and Philippines), so engineers could afford to sustain this type of theoretical demand assessments.

In public systems, where water was seldom sold on a volumetric basis, the demand was rarely short. As long as water was available, the allocation thus usually focused on maintaining sufficient supply, rather than on assessing the actual demand.[25]

The professional confusion about what really represents "demand" combined with the absence of accountability toward more accurate assessments stimulated a situation where many engineers continued to put vain efforts in calculating these theoretical crop water requirements. The outcomes of these calculations usually deviated considerably from the actual demand assessment at field level.

Sometimes engineers were aware of these anomalies. Unfortunately enough, often they were not. Also, irrigation curriculae continue to train engineers in these theoretical formulae as the best and only way to determine irrigation requirements.

This persistence of irrigation professionals to base their demand assessment mainly on "hard" parameters contrasts with the day-to-day decision making by farmers and field staff of irrigation agencies. For the latter, "soft" parameters are the main basis, as for farmers reducing uncertainty and risk is the driving factor to provide irrigation water to crops.

So farmers who have to pay for water often prefer to pay and use much more water than necessary for the crops from a purely physical point of view. Examples from the USA, Morocco and Pakistan have demonstrated this.[26] In the Pakistan case, farmers were even willful to pay a price twenty times higher for the assured water from their neighbor's tube-well--to supplement the water supply from the gravity system--than for the unreliable water supply from the canal system.

Also in farmer-managed irrigation systems (FMIS), researchers have found many other criteria than physical efficiency alone to be important components of farmers' water requirements. Widely known are the substitution of individual costs for the farmers such as farm labor, draught and weedicides by a higher on-farm water use. These are clear examples of situations where the physical efficiency of water use (i.e., the interest of the national economy) may conflict with individual interests.[27] Slabbers has quoted several generalized principles that appeared important in case studies in FMIS around the world. Among others, he has mentioned the minimizing of conflicts with "co-users, relatives, group or village members" and the consideration of overall income effects of irrigation for individual farmers (rather than a consideration of profitability of irrigation per se).[28] Minimizing conflicts is even more necessary for those farmers who do not have their fields adjacent to a canal, and who thus have to receive water through another farmer's field.[29]

"Soft" demand parameters tend to be dominant as well in actual decision making by all levels of agency staff in most LDCs. A main criterium observed to be used in assessing water demand by field and higher level staff in all case studies was the minimizing of conflicts. Similarly, for example, the Commission for Irrigation Utilization of the Government of Andhra Pradesh (India) has found this to be the general guideline adopted by all irrigation staff.[30]

Such behavior of agency staff leads to an underrepresentation of the national interest, if no other resource allocation systems, like the price system, enforce some balance on the physical water efficiency. Although many engineers know this, they insist on using the theoretical crop water requirements. This gives them at least some kind of balance for the physical and economic efficiency and thus for the national interest.[31]

Also in developed countries such "soft" demand parameters seem very important. In France, for example, pressures on politicians have led in the early 1950s to a law that prescribed agencies to deliver water to farmers on demand. Fortunately, against a certain price. Similarly, Maass and Anderson have described in detail how six irrigation communities in Spain and America managed to defend, as part of their water demand, other objectives than purely the physical and even economic efficiency.[32] They concluded from their case studies amongst others that the crystallization of such interests into the water demand requires necessarily long-lasting and thus costly processes for irrigation communities.[33]

Field-level based assessment. Apart from the issues of water wastage and local favoring, all above arguments and observations strengthen the case for field-level based assessment of irrigation water demand, as generally applied in practice (in those systems that are not completely supply-driven). At these levels the many conflicting criteria and interests can still be matched. Besides, local knowledge about the nonuniform soils and topography seems indispensable for demand assessment. This strengthens the need for field-level assessment and the participation of farmers in the related decision making.[34]

In the past, such participation has been pursued in several countries in two different ways; either through hiring local people as so-called "common-irrigators"[35] or, more widespread, through direct interaction by field-level agency staff with farmers regarding their water needs.

For both these solutions, however, engineers have yet been unable to judge the accurateness of demand assessments by field staff. They lack any norms in this respect. Colonial engineers in Indonesia, for example, recognized their inability to judge instantaneous demand assessments by their field staff as occurring, for example, during meetings. At the time, they expected that a better agricultural knowledge of the field supervisors, or a link with the agricultural department could improve such judgments.[36] Something which is easier said than done in practice, and this problem has not been solved even today.

A management tool that may facilitate more accurate demand assessment is a water right. Water rights make the demand of (sub)systems more explicit, and may thus improve the clarity and quality of the demand assessment. Yet, in most agency-managed systems, especially in Asia, water rights are absent.[37] The section below on matching of supply and demand further discusses the role of water rights in decision making on water allocation.

The only system observed in the case studies and in the literature (on agency-managed systems) that led effectively to more accurate demand assessment and simultaneously addressed the issues of water wastage and local favoring was in Morocco. It consisted of the provision of incentives at field level to assess more accurately. Farmers in Morocco have such incentives because they have to pay for their water use.

Matching of Supply and Demand into Allocation Plans or Schedules

On the basis of one of the patterns of the above described assessments of demand and supply, the decision preparation generally leads to matching these two into some form of an allocation plan or schedule. These processes are described below separately for the (pre-)seasonal and in-seasonal allocation planning.

Observed general picture of seasonal planning. The observed seasonal allocation tended to take place along the simplified lines as described hereafter. The system engineer often limited the matching of supply and demand for the pre-seasonal planning to an initial estimate of the (probable) available supply. Matched with gross water duties, --often adopted as the demand per unit area--, this initial gross supply estimate led to a proposed starting date and potential area to be irrigated, sometimes specified with an explicit cultivation risk.[38]

Observed estimates of expected rainfall and of the expected demand for the different areas were only approximate, either based on historical experiences[39] or on the theoretical crop water requirements alone. The latter was sometimes somewhat adapted to reflect again the historically derived gross water duties[40].

Often agricultural staff did a parallel assessment of the cultivation plans of the farmers. Due to the low motivation of staff, these assessments tended to be rather unreliable and more "desk-based" than "field-based".

After these two separate assessments by engineer and agricultural staff, a coordination meeting was usually organized. Local authorities convened these meetings if it involved different line agencies.[41] Sometimes, if an authority type of organization set up existed, the Director or Project Manager initiated them.[42]

Over time, most observed systems had developed rules of thumb of a certain reservoir or river level that justified the commencement of the cultivation for (part of) the system.

Observed levels of sophistication. The above practices do not reflect the differences in management performance among the different case studies. Figure 7 gives the observed comparative picture of the levels of sophistication of matching of supply and demand for the different case studies. The underlying questions and answers can be found in Annex 3.

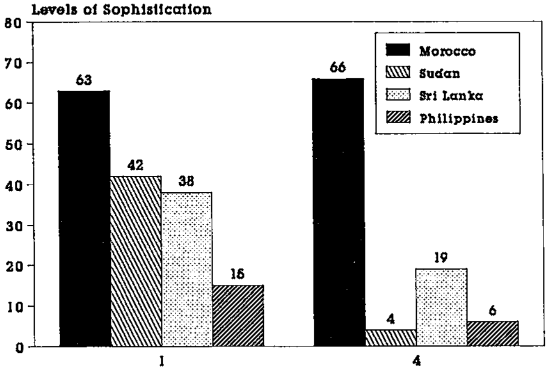
In the Sri Lankan and Philippine case studies the observed seasonal planning consisted mainly of theoretical scheduling. The Sri Lankan agencies thereby incorporated the experiences from the past more often than in the Philippines. Examples of experiences from the past are the historical water duties, irrigated areas and related cropping patterns and calendars. In the Philippines the schedules were observed to be an objective in themselves for the system managers. The results did not go beyond their desk.

In Sri Lanka a pre-seasonal meeting tended to be held with all farmers before the start of the cultivation season. This is an additional reason the seasonal allocation in Sri Lanka was of a somewhat higher level of sophistication than in the Philippines. Yet, usually the Sri Lankan irrigation agency already drew up the seasonal plan beforehand, and was unwilling to change it during the meeting. No serious matching of supply and demand in such meetings were thus observed, neither possible with a large number of farmers. In practice, the meeting tended to serve only to inform farmers about the plans. In the Philippines, such a pre-seasonal meeting was usually completely absent.[43]

In the Sudan, the observed seasonal planning incorporated the demand side to a still lesser extent. The planning consisted mainly of desk work. Although the plan missed the relevant information, the agency still expected the farmers to follow this plan. Still, its level of sophistication is higher than in the Asian case studies because the agency enforced a certain cropping pattern, and did the related planning.

In Morocco, the observed level of sophistication of this decision making was completely different. Before the cultivation, farmers had to submit a written request to the gate operators. This included a request for the allocation of a specified quantity of water related to a specified crop[44], and to a specific part of the system. Cultivation had to start thereby at a specified date. Farmers had to sign for this request and were later billed for the requested water, unless rainfall occurred. The gate operators submitted this request and related water-delivery plan to their superiors, and they subsequently submitted it to a central water control office.

Figure 7. Levels of sophistication of the matching of supply and demand



Note: *1. Seasonal allocation plan*
4. In-seasonal allocation plan

Unless water was short, farmers were allocated the requested amounts, because they were billed for these volumes; the incentive for water saving lied in the farmers' hands. Farmers paid a subsidized, but still substantial price for the water. (Still, the agencies had few financial incentives to save water, because they depended partly on budgetary allocations from the central government.) If water was short, high-level meetings by agency, regional authorities and farmers' representatives established the priorities between crops and areas.

Observed seasonal allocation options. A more refined insight in the above generalized pictures of the seasonal planning processes requires an understanding of the generally applied criteria.

The two criteria observed to be dominating this decision making were 1) the desire by higher staff levels to minimize their management inputs in this decision making, while 2) minimizing complaints. Only seldom water saving appeared to be an important criterium, unless as a way to minimize complaints. The following descriptions of frequently observed practices elaborate upon the prevalence of these two criteria.

The above two criteria imply a tendency to issue in practice the maximum discharge to the system. Consequently, an observed practical supply constraint for the seasonal planning was frequently the physical discharge capacity of main and other canals. This was especially so at the beginning of a cultivation season when the irrigation requirements are usually the maximum to allow for land soaking and land preparation.

Several seasonal allocation options were observed that dealt with such capacity constraints in the main canal. Four options are discussed below. As described above, the logical sorting criterion for these four options is the required levels of management inputs. The less management required, the more frequent the option was observed:

1. The observed easiest solution for system management was to open the sluice and see where the water will go, and where not. It was almost equal to a no-intervention approach by agency staff. It favored the farmers situated at the head reaches of canals, or farmers that were otherwise powerful and influential. It was a *"free for the fortunate few"* solution.

In the past, such an extremely passive role of the irrigation agency was the official policy of, for example, Sri Lanka's Irrigation Department. At the time the Agricultural Department and Revenue Division were still fully responsible for capacity utilization below the head sluice. The design concept of the main system was somewhat adapted to this approach as well. The main canals had no gated cross-regulators so that, in absence of any control by the managing agency, interference with conveyance to the tail-end reaches of the system was less easy.

Also the River Valley Development Board adopted this practice in Sri Lanka's Uda Walawe system, till the Mahaweli Authority took over from them in the early 1980s. It had disastrous consequences for the tail-end reaches; ten years after its original construction only 30 per cent of the command area had received any water.[45]

This no-intervention solution was observed to be still the main practice in the river diversion systems in the Philippines.[46] There tail-end problems were serious as well. For example, the Asian Development Bank (ADB) has found in an impact evaluation study of a number of systems in the Philippines that 30 per cent of the average command area never received any irrigation water.[47]

For this no-intervention approach, the preparation of a seasonal plan or schedule is not really necessary. So the seasonal planning and scheduling in Philippines was also observed to be a nominal desk exercise, bearing little relation with the actual implementation.

Gated cross-regulators in main canals in such systems increase the options for interference by upstream farmers and operators, and thus increase the likelihood for tail-end problems. The utility of these (generally applied) structures in the Philippines, for example, seems therefore doubtful if not negative within the context of the current management practices.

2. The second easiest option for agencies to reduce overloading of the main canal is an organized reduction of the irrigated area for a particular cultivation season. A *rotation of the cultivation between different areas between different seasons* achieves this. This management option requires the availability of cross-regulating capacity in the main canal. The advantage of this strategy is the concentration of the discharges.

This strategy was observed only when serious water shortages existed, for example, in Sri Lanka's Kirindi Oya system. According to Chambers, this approach is quite common in South India.[48]

3. The introduction of *staggering* of the cultivation along the main system is another option. It was observed to be more management intensive and controversial for the agency compared to the former two options. Staggering replaces the "natural and wild" implementation, or "involuntary" staggering[49] resulting from no intervention at all. Staggering of the cultivation

may facilitate the reduction of canal overloading, and the acceleration of the implementation of the seasonal plan. This option also requires cross-regulating capacity in the main canal.

Irrigation professionals have claimed the following advantages of staggering: 1) the concentration of peak discharges that allows for a faster implementation and thus for an extension of the total command area[50]; 2) the spreading of peak demands for farm labor and power (e.g., draught animals, tractors)[51]; 3) it allows a better matching of the scheduled peak discharges with the peaks of the river discharge. Observations for this study suggest that the latter advantage is, to a certain degree at least, rather theoretical in view of the "involuntary" staggering that occurs anyhow.[52] The spreading of the farm power and labor factor, in coordination with more concentrated discharges must be considered therefore as the main advantages of the staggering. The first factor especially has a serious delaying influence on the implementation of the cultivation season in many countries, as argued before.

Staggering of the cultivation was observed to be effectively applied in the Moroccan case studies, and in Sri Lanka's Kirindi Oya system. No agency-initiated staggering was observed in the Philippine and Sudanese studies.

Staggering of the cultivation was also introduced rather successfully around the turn of the century in colonial Indonesia (i.e., the so-called "golongan" system). However, the required close interaction with the rice farmers apparently weakened during the 1920s, and the system did not sustain.[53] Yet, IIMI researchers have observed that some form of staggering prevails in many Indonesian systems. It consisted of the simultaneous starting of all head-enders within a period of three or four days, followed some weeks later by the simultaneous starting of all tail enders.[54] In general, staggering seems much easier to introduce in new systems[55] than in old systems. Changing the prevailing habits in an existing system requires comparatively large management efforts.

4. The introduction of *rotational water allocation* along the main canal was observed to require even more management inputs of the agency. Several systems implemented a rotation along the main canal. Usually it occurred during temporary water shortages, or if problems existed to command tail-end reaches of the main canal. The involved reaches of the main canal varied from the tail-end reaches only (if the flow regulation problem was not very serious) to rotations from the reservoir in the most extreme cases.

Murray-Rust has observed the latter, for example, in Sri Lanka's Gal Oya system. The head-end reaches appropriated much of the discharge there. The only way of commanding the tail-end reaches was to overload the main canal during some days, while closing the head-end offtakes.[56]

Rotation as a management option to overcome the main canal capacity constraint is a different objective from saving water. Irrigation professionals often believe and recommend the implementation of a rotation to save water. During this study, no systems were observed where this was the actual objective of the introduction of the rotation, even if the rotation had some water saving effects.

In Sri Lanka's Uda Walawe system the observed rotation did not reduce water waste. Although it restricted the duration to head enders, it did not restrict the discharge. Murray-Rust and Snellen have found this as well in South India's Tungabhadra system.[57] Moreover, seepage losses may increase considerably due to refilling of canals, or due to temporarily increased heads during the rotation.

Replogle has described different types of rotation by combining in different ways the following three determinants of a rotation: discharge, duration and frequency. He varied all three from fully fixed to fully flexible.[58] He has also described the perceived advantages and disadvantages for irrigation managers of the different types of rotation. Flexible rotations tend to provide more freedom for the field level staff to make ad hoc adjustments to the rotation on request of farmers. Rigid rotations tend to "ease delivery system complexities and problems."[59] According to Replogle, the fully fixed rotation "requires the least capital investment in canals or distribution pipelines and involves the least water-agency management and operational input."[60] A more flexible rotation increases the required management input by the agency. Though a fixed rotation discourages an accurate match between water delivery and the physical crop water and labor requirements because it "restricts crops to those adaptable to the set frequency". Besides, not all soils in a project are similar, and well suited to the selected frequency.[61]

In practice, agency staff in most observed case studies preferred a fixed rotation. It reduced the need for interaction, and it reduced the fight between farmers for water. On the other hand, there were many instances where agency staff erroneously claimed they implemented a fixed rotation. The actual rotation in the field then often appeared to have some flexibility, especially at the tail of the rotation period.

The above four management options reflect increasing degrees of management efforts to deal with constraints in canal capacity. These options did not necessarily, or primarily, deal with water conservation or the reduction of water wastage in irrigation systems. In general, water rationing was observed to be a little important criterion in the seasonal water allocation. Exceptions existed, however. Observations for this study and the literature provided the following examples of practices that are more specifically intended to ration water:

1. *Zoning* is an example of a policy that aims partly on water saving. Zoning implies the restriction of the cultivation of certain crops to certain parts of an irrigation system. Apart from water saving, the intention of zoning is also to achieve a better match of crops and soils.

In several countries this policy exists. For example, such a policy was observed in Morocco (the so-called *assolement*). It intended to force farmers to cultivate those crops that the planning had envisaged during the original project development stage. By thus restricting the cultivation of the more water-consuming crops, like the semi-tropical fruit trees, the government tried to ensure the achievement of the planned profitability.[62] To facilitate enforcement of this policy, crucial design criteria, such as canal capacities, field-level layouts and land consolidation, were adjusted accordingly. Despite these efforts, the policy succeeded only with variable degrees for the fruit trees and sugar crops, and largely failed for most other crops.

Different zoning policies exist also in several states of India. Chambers, amongst others, has reported on, for example, the so-called "localization" in South India, and "blocks" in Maharashtra.[63] These policies intended to enforce the cultivation of certain crops on the most appropriate soils, and to omit areas unfit for irrigation. Facilitation of water management and conservation was the major driving force in these Indian states. Several authors have observed that this policy failed completely. The related discharge capacities of the canals were apparently also dysfunctional.[64]

Also in colonial Indonesia, the zoning and staggering of sugar and rice cultivation existed. The enforcement of this zoning and staggering occurred only after water shortages led to conflicts between sugar and rice growers. The objective of the zoning policy was to ensure water for the sugar cultivation, if necessary, through the rationing of water from the rice areas. The combined pressure of zoning and staggering policies on the water availability for the rice areas was quite serious. The shift of many farmers toward the cultivation of less water-consuming crops, like sweet potatoes instead of maize, proved this.[65]

The strategy in rice-based irrigation systems to stimulate farmers to grow alternative crops such as shorter duration varieties of rice[66], or other field crops than rice (OFCs), relates somewhat to zoning. It partly intends to save water by either shortening the cultivation season or by growing a less thirsty crop.

Observations in all case studies were, however, that farmers in large-scale systems were unwilling to change their most preferred cropping pattern only to save water for the interest of the state or of the tail-end farmers. This suggests that zoning is unlikely to succeed unless farmers experience some form of related force or incentive. Examples are the cultivation permits or rights that were observed in Morocco, and the (preferential) water pricing or water scarcity for certain rice farmers in colonial Indonesia.

2. *Yield optimization* is another measure specifically intended to ration water. In Indonesia and Morocco two different types of yield optimization seem to occur.

During droughts in Morocco, a special meeting was observed to set the priorities for the water allocations. Interested parties such as the local authorities, the different line agencies and the representatives of commodity-based farmer groups tended to attend this meeting. The usual priority was the saving of the most valuable crops (like tree crops), while assuring also the survival of certain food crops important for the national food situation. A clear and explicit strategy for yield optimization was usually decided upon and implemented.

During droughts in the observed Asian irrigation systems, the physical inability to command certain areas was more important than any organized type of yield optimization. Though some efforts have been made in Asia in the past.

For example, the colonial administration in Indonesia, especially in East Java, introduced the so-called "pasten" system to cope with water shortages during the dry period.[67] Pasten describes the relationship between the available water supply at the intake gate and turnouts, and the water needed by crops at different growth stages. Based on theoretical crop water requirements, "relative non-rice crop areas" must be calculated. The multiplication of the latter and the total system deficit factor (Factor K) makes an equitable distribution plan for the limited available water. The Pasten system aimed at balancing out the yield response functions for different crops, and by that for maximum crop yield within individual blocks (whereby sugar got again preferential treatment).

Although theoretically sound to a certain extent (vide the earlier remarks in the section on Demand Assessment), and possibly feasible under colonial rule, the system is very sensitive to inaccuracies and less committed management. Researchers and other professionals have reported that in practice the planning either adapts itself to the water availability, or bears no relation to the implementation, thus rendering the system meaningless.[68]

3. A last form of water rationing is the introduction of certain *spatial and temporal cultivation rights*. These can be found only in some traditional farmer-managed irrigation systems (FMIS). Different types of spatial and temporal cultivation rights exist. Examples are the scattering of one family's holding through several zones of which one or more may receive water, or a sequence of rights to cultivate the same piece of land.[69] Chambers has remarked that these systems successfully facilitate the concentration of similar crops, and thus more efficient water use.[70]

Agency staff were thus observed to only marginally apply the latter three management options for water saving. Comparatively, they were frequently observed to apply the options to deal with constraints of discharge capacity of the main canal during the implementation of the cultivation season.

This reliance on a physical impediment reconfirms the starting point of the classification; the fore mentioned negative incentives of agency staff toward the water-delivery performance tended to be the main drive for the choice for any of the above management options. The same incentives were observed to dominate the other key decisions of capacity utilization, i.e., in-seasonal allocation, described hereafter, and the flow regulation.

Observed general picture of the in-seasonal allocation planning or scheduling. This in-seasonal allocation planning is often called water scheduling and this term is used hereafter as well. The observed in seasonal allocation tended to take place along the simplified lines as described hereafter.

The system engineer often limited the matching of supply and demand to estimates of the (probable) available supply. Matched with gross water duties--often adopted as the demand per unit area--, this gross supply estimate usually led to a proposed water schedule for field-based agency staff.

Observed estimates of expected rainfall and of the expected demand for the different areas were only approximate, either based on historical experiences or on the theoretical crop water requirements alone. The latter was sometimes adapted to reflect again the historically derived gross water duties.

No systematic interaction on these schedules was observed to occur with farmers and field staff. Although the implementation of these schedules were observed sometimes in the main system, they were seldom so within the distributary system.

Observed levels of sophistication. The above generalized description applies in different degrees to the different case studies. There were considerable differences between them. Figure 7 gives the observed levels of sophistication of the in-seasonal allocation in the different case studies.

The scheduling during the season in the Sri Lankan and Philippine case studies did usually not relate to the demand-driven allocation practiced at the field level. This demand-driven type of allocation is described more extensively below. In Sri Lanka, the schedules tended to incorporate more the historical water duties, rather than theoretical only. Reliance on theoretical duties was observed to be the general practice in the Philippines.

In Sudan, the in-seasonal scheduling, the so-called "indenting", was observed to be at field level similar to the demand-driven allocation prevalent in the Asian case studies.

In Morocco, also during the season farmers were observed to submit a written and signed request for a certain volume and timing of the water delivery before the implementation of the 10-day water-delivery schedules. This request had to be submitted to the gate operator. Officially, they had to sign also after the actual delivery, but this was observed to be done irregularly. If farmers wanted extra water (i.e., above the requested amount) during a certain water delivery, the gate operators could authorize this at the end of the delivery period. They did this with numbered notes, of which the central water control office strictly checked the distribution.

Observed scheduling options. As for the seasonal planning, a more profound description of the in-seasonal allocation processes is organized here around the dominating criteria used in these processes. These criteria are the same as those for the other key decisions of capacity utilization, being the desire by higher staff levels to minimize their management inputs in this decision making, while minimizing complaints. Water saving is only seldom an important criterion, unless to minimize complaints.

A logical organizing principle for the management options is thus the required levels of management inputs by higher level agency staff. In-seasonal schedules can essentially incorporate the water demand in three different ways. These are discussed below in sequence of increasing management intensity for higher level staff:

1. *"On demand" or demand driven* allocation means that farmers are allocated water individually, as requested by them, and within a period of a few days or a week. This was observed to be the least management-intensive option for higher level staff, because it is usually done by either the field staff or by the designed "hardware".

   In contrast to common belief of (especially control-oriented) engineers, this demand-driven allocation appeared possible in all design concepts up to a certain level (though it may require different levels of management inputs).[71] This is described hereafter.

   In France, for example, this type of water allocation is national policy. As a result the French developed irrigation-specific *downstream control technologies*. Downstream control means that control over water allocations is decentralized to the field level, and that information on water demand is transmitted hydraulically. This considerably reduces the need for information exchange between different hierarchical management levels. So such downstream control infrastructure does not require any schedules.

   Demand-driven allocation appeared also possible with design concepts providing for some *upstream control* regulators. (With the latter, downstream water levels cannot, or can only partly, influence the water allocations.) Demand-driven allocation in upstream control design concepts tended to be usually a way of reducing management inputs for higher level staff.

   Demand-driven allocation in a main system with upstream control regulators always requires some "water wastage" on top of the normal conveyance losses. Efficient matching of changes in demand with allocated discharges all the way from the head sluice requires a very efficient and responsive internal management information system. Such a high level of responsiveness seems difficult to achieve without real-time management through, for example, radio or electronic communication devices.[72]

Even with high-tech management, a certain "water wastage" remains always necessary. This water wastage is a "pressure" or margin of extra discharge in the main system to cope with immediate requirements that cannot be satisfied otherwise due to the response time or inertia of the main system. They are thus the management requirements, or the so-called slack.[73] If the management information system is less efficient, these slack requirements become larger.

Although most South and South-East Asian systems are designed for upstream controlled variable flows, only demand-driven allocation was observed in the case studies.[74] The latter overrided thereby any regular scheduling. Instead, considerable slacks were observed to be issued to the main system to compensate for insufficient management inputs by higher level staff.[75]

Moroccan systems are usually considered better managed than their counterparts in Asia. Yet, considerable slacks in the main systems with upstream regulators in Morocco were observed there as well. These slacks allowed to compensate for low levels of management inputs in matching supply in the main system with the demand for water, and the related flow regulation. Still, such slacks in the Moroccan systems were observed to be restricted to mainly the main system. Within the distributary system, the demand-driven allocation was observed to be well-managed by higher level staff in comparison to the other case studies.

An example of such a "managed" demand-driven allocation in a main system with mainly upstream regulators was observed in the right bank main canal of the Moroccan Basse Moulouya system. In this system, provisions existed at field level for weekly scheduling as well as adjustments to these schedules. The gate operator developed schedules and adjustments based on written requests from farmers. These requests had to be submitted to the gate operator prior to the implementation of the schedule. Any adjustments had to be covered in the slack period at the end of the scheduled period of ten days, but within the total scheduled allocation period and volume to a sub-system that was irrigated from one offtake in the main canal. In general, schedules and adjustments below these offtakes were observed to be implemented strictly and the allocation was thus completely demand-driven.[76]

An assumption in systems that are designed for demand-driven allocation is that, because farmers have to pay for water volumetrically, they themselves economize their water use. Thus, the price system would take over the water allocation function, and effectively delegate it to the farmer. Some factors constrain a more widespread use of this water pricing than the present level.

Apart for the downstream control and computerized controlled systems, there are serious imperfections of this market as the water delivery tends to be unpredictable and unreliable. Moreover, if it starts raining at the moment of actual delivery, farmers usually refuse to buy and suddenly the water is of no value (as was observed in several Moroccan systems).

Even if the market is perfect, farmers may still waste water if they value the reduction of uncertainty very high. This can be observed, for example, in Pakistan, Morocco, and even in California. Higher water prices would be the only solution to such physical inefficiencies. Unfortunately, the feasibility and acceptability of higher water prices in most LDCs relate to extremely sensitive issues of food policy.

Another relevant factor in this individual billing is the collection costs of water charges itself. These can be considerable in smallholder systems as those in Morocco and Philippines. Reduction of these collection costs was one rationale for introducing water user groups in Philippines.

In Asian systems no volumetric billing exists. The demand-driven allocation that was observed in all Asian case studies thus leads to wasteful on-farm water use.

In Sudan no volumetric billing exists as well. However, several researchers have reported that, despite the observed demand-driven allocation, this does not lead to much on-farm water waste in Sudan.[77] Likely reasons are the exceptionally low percolation and flat topography of the Sudanese irrigation systems.

2. *Arranged or "modified demand".* The so-called arranged or modified demand is a scheduling practice that is more management-intensive for higher level staff than the demand-driven allocation. Modification of demand means that farmers' requests are the basis for regular allocation schedules, but that their water demands are not fully satisfied. They are modified. Possible forms of modification are the following:

* Modified volume: a maximum volume of water is allocated to either a unit area or to a farmer.

As yet, no indicators exist for determining such a volume in a manner that is neutral and reliable toward soil or crop. The theoretical water requirements that are supported by on-farm or intensive field experiments may provide for some broad indicators. In practice, large variations were observed to occur with real-life requirements (vide criticism in the section on Demand Assessment). Although all observed irrigation systems intended to implement this arranged allocation with the theoretical crop water requirements, and all observed operation and maintenance manuals assumed it, no observed irrigation system successfully applied it.

Calibrated crop water requirements may provide a tool,however, for making an initial estimate of the required water volume during the commissioning of a system. This was observed in Sri Lanka's Kirindi Oya system for estimating the releases from the head sluice. On the other hand, such a gross estimate could be estimated without the theoretical water requirements as well.

No modified volume schedules were observed in situations of sufficient water availability. During drought, volumetric rationing was observed to be used in the schedules of most case studies.

Also Moore has reported that even the most reliable water schedules in Asia, like those for Taiwan, do not give the volume of water. They give just the date, crop and rotational methods, if any.[78]

* Modified timing: the water requests are restricted to a certain period to fit a certain rotational schedule.

A limited canal capacity may make this necessary, or, possibly, it may be considered necessary to concentrate discharges to save water. This type of arranged allocation is prevalent around the world. It seldom is, however, for water saving reasons, as argued before in the section on Demand Assessment.

* Modified frequency: the agency can try to influence the crop choice by imposing certain frequencies.

In Sri Lanka, for example, this type of modification has enforced the cultivation of other field crops than rice in System H of the Mahaweli. This method is probably not frequently applied in LDCs. Replogle has reported it to be used for small ranchettes and lawn waterings in the United States.[79]

* Modified discharge: the water requests are considered in the schedule only in terms of a maximum or minimum discharge, or in terms of certain standard quantities.

Maximum discharge may be determined, and also made necessary, by canal or offtake capacities.[80] This was observed in, for example, the main system of Sri Lanka's Uda Walawe. There, the scheduled discharges from the main canal were only specific in duration because these canals would take the maximum discharge anyway. Minimum discharge may be related to the minimum at acceptable efficiency of the water conveyance.

Agency staff and farmers often internalize maximum and minimum discharge modifications. This means that neither party even thinks about excessive overloading of canals, or about asking for a very small discharge to be conveyed over a large distance. Even if internalized, this type of modification is still real, but it is theoretical as well.

On the other hand, in most observed South and South-East Asian systems such modifications were not even realized. Canals were frequently overloaded or operated at minimal, continuous discharges. In such cases, a possible modified discharge is a very real management option, of course.

Formal scheduling often applied standard discharges. Many irrigation systems have also been designed for a perceived farmer-friendly, on-farm discharge (i.e., design discharge or "main d'eau") of 30 l/s.[81] Such standard discharges seldom materialize in actual field-level allocations unless an exceptional level of flow regulation exists, and farm gates are provided with either so-called fixed offtakes, on-off gates or modules with openings for standardized discharges (e.g., in Morocco).

Only in Morocco standard discharges were observed to be applied. Farmers request water also only in terms of these standard discharges. This modification is thus internalized. The difference with the demand-driven type of allocation is therefore somewhat theoretical.[82]

In comparison to demand-driven allocation, the introduction of the above forms of modified demand requires increased management inputs by higher staff levels.

3. *Supply driven* allocation means that agency staff determine allocations without consideration of the actual demand of farmers.

To implement such schedules requires either a very high level of management inputs from higher level staff to manage the operation of the gates, or a design with with little flexibility (i.e., almost no gates). Else farmers and gate operators are likely to subvert the schedule. In practice, only systems with either little flexibility--and thus with little management inputs by higher level staff-- or with water shortage tend to implement this mode of water schedule.

An example of the first, are the systems in Pakistan and the Indian Punjab. There the absence of movable gates in the physical infrastructure enforces this type of allocation. Canals can be operated essentially on an on-off basis only. Officially, a fixed rotation (called "warabandi"), already foreseen during the design, is the only possible way to operate these systems. The warabandi was designed to fight famine by spreading a limited discharge over a very large area, rather than providing water for optimum yields per unit area. In practice, researchers have found below the outlet all sorts of informal rotations. Above the outlet, however, warabandi is a supply-driven rotation in a water-short environment.

All other observed supply-driven scheduling occurred only in systems where water supply was short. This water shortage was either permanent, due to limited water supply or limited canal capacities, or temporary, during periods of peak demand or reduced water supply. (Of course, a supply-driven schedule during water shortage can also be arranged with farmers. Then, however, it is here defined again as an arranged or "modified demand" schedule.)

Even in the only observed main system with duckbill weirs as cross-regulators (in Sri Lanka's Mahaweli system H), the allocation appeared to be demand-driven. If a particular secondary canals required more water than scheduled, the operators could give it by giving less to other canals or by requesting an increase of the discharge from the headsluice.[83] Such partial inflexibility thus did not prevent the system management to allocate water in a demand-driven mode.

In flexible systems, a fully supply-driven allocation was not observed to happen under abundant availability of water. Objectives of a supply-driven allocation under these conditions could be either to enforce economic water use in reservoir-based systems, or to accelerate the implementation of the cultivation season (i.e., by advancing the sowing dates of different subsystems) in river diversion systems. Even under colonial administrations this type of supply-driven allocation did not materialize. Only through enforcement of the physical infrastructure, like for warabandi, a supply-driven allocation seems implementable. Even there, however, this physical force can be and has been found to be subverted to a certain degree.

Despite this apparent impossibility to implement supply-driven schedules in flexible designs, they were observed to be the basis for many irrigation engineering practices and manuals in South and South-East Asia. Some frequently observed examples of the results/outcomes of this "supply-driven" thinking (i.e., allocation without any consultation with farmers) were the theories of the crop water requirements advocated in operation and maintenance (O&M) manuals; the one-cusec field canal; the gated cross-regulators; the measuring structures at farm turnouts and offtakes to field canals. The observed Sri Lankan agencies, for example, did not give the latter structures any function in terms of [modified] demand-driven allocation. They only had to facilitate enforcement of supply-driven allocation.[84] Similarly, the measuring structures in distributary canals and at the head of the main canal, were based on such supply-driven rationales in all Asian case studies.[85] Even most observed monitoring and evaluation systems envisaged in O&M manuals of the Asian case studies intended to enforce a supply-driven allocation[86].

Apparently irrigation professionals are often biased toward approaching allocation in a theoretical, supply-driven way. Several factors seem to cause this behavior. One observed reason was the lack of reliable indicators to guide the modification of demand volumetrically, neither to modify it instantaneously. Another, and more important, reason that was observed was the limited experience, interest and need for staff of agencies and consultants to deal with real-life constraints in matching of supply and demand.

Combinations of the fore mentioned different methods of incorporating demand into allocation schedules were observed to occur in all case studies simultaneously in one system during one cultivation season. This is something that planning and design considerations seldom take into account.

How does the above typology of scheduling options relate to other typologies? The advantage of the above typology compared to others is its consistent management significance, rather than physical significance only. So the above generalized picture deals with "realities" and "probabilities", rather than the more common "possibilities". (The latter's advantage, on the other hand, is its convenience for designers and planners.)

Most existing typologies of schedules define them in their physical appearances, such as free, on-demand, continuous, rotation, modified-demand etc. Horst, for example, has recognized the following types of water deliveries: continuous and intermittent. The latter is further subdivided into free, on-demand and rotational.[87] Similarly, the recent guide for preparation of O&M manuals and strategies prepared by the World Bank (in collaboration with the Working Group on Management, Maintenance and Operation of the International Commission of Irrigation and Drainage) talks about demand, modified demand, rotation and continuous flow.[88]

In terms of management these classifications are inconsistent. For example, although rotation and continuous flow are physically different, they can in terms of management be used for demand, modified demand and supply-driven allocation.

Also Cornell University has recently developed an "operational typology" as a combination of schedule, degree of responsiveness, and type of operational procedures. It defined schedule, however, in terms of continuous and intermittent deliveries, and it thus based its classification only on its physical significance.[89]

Chambers has remarked in his latest book on irrigation that "classifications and categories used for describing types and aspects of different schedules are still at a primitive stage".[90] In view of the above examples of physical- rather than management-based typologies of several important actors in the irrigation subsector, his remark seemed fully justified.

Those who have defined typologies, seldom elaborated upon them in terms of the related real-life practice and operational objectives. An exception is Replogle. He has made efforts to elaborate systematically on the relation between schedule and management objectives. Primary objective of his typology was the development of a standard terminology for schedules that also conveyed "the intended operating concept".[91] He thus did not intend to write about the actual operating concept.

He was correct in defining supply-driven as rigid. On the other hand, he used the word "rotation" incorrectly as a synonym for rigid. He did this, as he said, to yield "somewhat to tradition".[92]

Replogle's supply-driven type rotations were all fully crop-based. He did not specify the real-life function of farmers, if any, in his different typologies. His typologies thus may have been completely theoretical, and he may even have intended them for classification purposes only. His flexible schedules[93] comprised the demand and modified demand schedules used in this text. He defined the latter scheduling options in terms of their potential interests and disinterests for farmers.

Replogle has written his terminology mainly for the irrigation environment in the United States. Given the above arguments, most of his terminology and examples seem hypothetical also for the United States, but certainly out of place for LDCs.[94]

Another aspect of scheduling that the literature on scheduling typologies has neglected is the incorporation of the hydraulic characteristics and rainfall. One of the few references to this issue does not elaborate much more than the following related statement: "Difficult areas in preparing a delivery schedule are the estimation of water propagation time, water use efficiencies and effect of rain interruptions."[95]

In actual practice, this difficulty was observed to be solved in most case studies by issuing extra discharge, or slack, in the main system. Efficiencies, water propagation time, and rainfall may be known to the agency staff, even in the comparatively sophisticated water scheduling in the observed Moroccan case studies, they were not quantitatively integrated in the schedule. Often the gross water release at the head of the main canal integrated them in an approximate way only. After rainfall, or other flow fluctuations, the typical reaction in all case studies was an approximate minor change at the head of the main system.

This slack in the main system seems therefore indeed the "central gap" in irrigation management, as Chambers has called it. The sections of this chapter on flow regulation discuss the underlying reasons for this gap in more detail.

Management process. The *pre-seasonal matching of supply and demand* results in important, political, decisions about who will cultivate, what and where. The political nature of this decision making makes it logical for governments to make provisions for local authorities to chair and lead this decision making. This was also observed in most case studies. These provisions were regulated either by laws (e.g., in Sri Lanka), or through guidelines (e.g., in Philippines and Morocco). In Sri Lanka, for example, the law even demanded farmers to approve the seasonal plan in a so-called cultivation meeting.

Engineers usually did the preparation of the plan. Sometimes field staff of the agricultural department or division provided them with data on cultivation plans. Except Morocco, no interaction with farmers occurred during the preparation.

Limited motivation of agricultural field staff to carry out the data collection on cultivation plans was observed to make the reliability of the data often doubtful. And so was thus the reliability of the evolving cultivation plans.

The only observed cases where these data were reliable enough to be useful for the seasonal planning were the Moroccan. This reliability was high because the plans coincided with water orders by farmers. Farmers had to sign for them, and received bills for them. The accountability and interests were thus quite direct. In addition, the data were more reliable as they came straight from the primary source.[96] Apart from Morocco, however, these data were not seriously used in seasonal planning, and usually engineers prepared the seasonal plan behind their desk.

Engineers were thereby observed to keep their planning assumptions implicit, and to take as little risk as possible. Murray-Rust has described a typical case for Sri Lanka's Gal Oya system. There, engineers made very conservative estimates of irrigable areas. The farmers in the remainder of the command area subsequently caused these estimates to be exceeded considerably. These farmers speculated on a larger availability of water, and thus rendered the engineer's planning useless. The engineers were reported to keep their estimates secret for outsiders on purpose to prevent any accountability for the planning.[97]

This type of planning fails to reduce uncertainty. It also maintains unjustified expectations of farmers who are unlikely to get what they want. It thus boosts speculative behavior of farmers to get what they want anyway. Such speculative behavior and growing distrust in the agency's planning itself was observed in Sri Lanka's Kirindi Oya system to lead to more and more problems and political intervention for the managing agency.

System managers were also observed to do the *scheduling of the in-seasonal allocation* behind their desk, without relating to the actual demand assessment. That is to say, if scheduling was at all done. Replogle, for example, has reported on the absence of planning in most systems in the USA as follows: " . . .most schedules have been in place for several decades and were chosen for reasons usually valid at that time . . .not necessarily . . .still valid".[98] Such types of non-schedules were also observed in Sri Lanka's Uda Walawe and the Philippine case studies. Schedules that were fixed at the beginning of the season were often observed to remain unchanged during the season, even after rainfall.[99] Thus the schedule became a purpose in itself, rather than a tool to guide and plan the actual matching of supply and demand.

Without effective scheduling, the gate operators were observed to develop and establish the allocations with little support of superiors other than a field-level supervisor. System managers usually had very little insight or knowledge in the actual way of matching demand with available supply.

An example of this was a senior engineer in Sri Lanka's Mahaweli Economic Agency. He sincerely rejected the possibility of the Technical Officers of Uda Walawe, a system he was directly involved with, being the de-facto system managers: " . . .these people do not take decisions, but only do what they are told." The reality was--and engineers were often unaware of this--that gate operators, and their immediate supervisors took most, and sometimes all, decisions on allocation and regulation.

Gate operators left on their own to decide on allocations, are likely--and were also observed--to choose the easiest way out, through favoring farmers within their area of responsibility. Individual operators represent localized rather than system wide interests, and along the main system such solutions favors head enders. Even if the gate operators do not want to favor head-end reaches or powerful farmers within their area without effective support from superiors they have few options other than to give in to those farmers. If those farmers feel they get too little, those farmers are likely to take just more either by influencing the gate tenders, by demolishing the structures, or by blocking the canals. Such processes were observed in all case studies, although they were less prominent in Morocco than in the others.

Of course, the just described processes may happen also to a certain degree if higher staff levels attempt to make a schedule and guide, monitor and evaluate its implementation by gate operators. Suppose, for example, that a senior staff member wants to economize on water use--

without starting to put much time and effort in managing his or her subordinates and initiate a systematic monitoring and evaluation system--; the only thing he or she can really do is to judge and to refuse water increases at the head of main, branch or distributary canals. However, they have no arguments to do so.[100] This is thus a risky strategy, because he or she also becomes thereby responsible for possible crop failures if water is short due to their refusal.

Motivation for investing much time and efforts to take up such risks is unlikely, especially without an institutional expectation and support for water saving. The actual expectation is even "negative" given the likely opposition of colleagues if career, construction and cultivation interests are conflicting. Besides, water users are seldom satisfied whatever the performance, and there is a constant possibility of interventions by politicians. A more likely choice for a responsible decision maker, who is left alone, is to maintain a low profile.

Such constraints confronting an individually motivated system manager were observed and reported upon in detail for Sri Lanka's Kirindi Oya system.[101] Several irrigation professionals such as Chambers, Moore and Levine, have reported on similar institutional impediments and negative incentives for performance improvement.[102]

Schedules that have been developed at field level in the fore mentioned permissive ways, necessarily favor the head enders to a certain extent. This applies to all types of canals, whether main, branch, distributary or field channels.

Water-based corruption. Even more extreme are the cases that Wade has found in South India. There system managers sold water for their individual benefit. They thus created uncertainties by increasing the value of water. Theoretically, this price system might have led to a more efficient water allocation. Yet, Wade has convincingly argued that the market was "highly imperfect, because the farmers cannot be sure in advance that they will get what they paid for, or that when they get it, it will be worth what they expect (if heavy rains fall in the mean time, the value of irrigation water may be very small)".[103] Moreover, the extraction of money concentrated on a few critical and incidental points, and did not lead to a better control over flow regulation and allocation.[104]

Wade's corruption in South India seemed extreme, however. There are few other cases reported upon of such systematic and systematically organized (i.e., up to the state-level politicians) water selling, although it seems to happen in some other parts of India and Pakistan as well. Corruption was a major incentive in all observed irrigation agencies, and seems endemic in most irrigation agencies in LDCs.[105] Apart from Wade's observations, however, it has usually been related to construction and maintenance activities rather than to water delivery.

Political aspects. The water allocation process of "who gets what, when and where" is indeed, as several irrigation professionals have reported, "essentially a political process".[106] Water allocation was observed to be often misused for political purposes, conflicting with the common interests.

In the observed Asian systems, the intervention by politicians in the water allocation was omni-present. It thus continuously influenced the attitude and behavior of irrigation managers. Only a minority of irrigation managers seemed able to win the support of politicians for more consistent water allocation and regulation.

Seemingly extreme cases where the President or Minister himself decided to authorize the cultivation in a certain area or not were unfortunately quite normal; whether they were at great water loss or not, or at the expense of others. The seasonal water allocation in the Thamrivarani system in Tamil Nadu (South India), for example, was observed to happen entirely at political levels in Madras, some 700 km away.

Politicians typically did not seem to get feedback on the sometimes disastrous consequences of some of their decisions for their supporters, or those that result from decisions by other politicians. Even if they did, they often did not seem to care--i.e., instant popularity at the expense of the medium- or long-term national interest.

In this respect, certain areas and countries were observed to be better than others, of course. Only in Morocco this political intervention (and thus misuse) of water allocation was observed to be as good as absent.

Responsibility for water saving. The above provides a multitude of arguments against taking up the responsibility for water saving in most irrigation systems. So this responsibility was indeed observed to be often ill and vaguely defined for the whole, or part of the, system. Even in Morocco, nobody was typically responsible for limiting or reducing water waste.

Thus the national interest in saving water did not yet crystallize, and the observed agencies and engineers were so far successful in circumventing the few attempts to hold them accountable. Individual interests of farmers and agency staff were here at conflict with the national interest.

Awareness among engineers about such resistance was observed in all case studies. In addition, professionals have reported explicitly on such resistance for Sri Lanka, Sudan, and Pakistan.[107]

Water rights. A water schedule may serve to reduce uncertainty of the water delivery from the farmers' perspective, and to increase the clarity of the responsibility of the irrigation agency and its staff. The allocation of water rights to farmers or subsystems may have a similar function. Such water entitlements can be in the form of a share per unit area, a share per person/household, a fixed discharge per unit area, a fixed volume, or instantaneous demand.[108]

In most farmer-managed irrigation systems, water rights are an important criterion in the decision making on the allocation of water. Radosevisch has found that in agency-managed systems, especially in Asia, it is usually absent. He has stated this as follows:

> "The problem that exists in many countries is the lack of commitment by the government to allocate water in a definitive fashion. As a result there is little reliability for the water user to take the risk of his own investment . . .It is recommended that governments develop a system for allocating water to users and identify the type, quantity, source and location of use in the form of some documentation. This raises the issue of "water rights" versus "licenses" or "ownership" versus an "interest" by the water user."[109]

He also found that in the few cases where a kind of water right exists in Asian agency-managed systems, it never obliges the agency to pay indemnities for crop failures due to faulty service delivery.[110]

In many systems "customary laws" have been found[111] whether or not stimulated by the absence of official water rights. Maass and Anderson have reported on such customary laws to be enforced through court cases, sometimes in combination with official water rights.[112] Such customary water rights often reflect values like time-priority (e.g., first in time, first in right or prior appropriation), which do not necessarily correspond to the most efficient or effective water use. In many countries, farmers were observed to establish a customary water right from either fellow farmers or gate tenders, once they had planted their crop.

The achievement of more certainty to farmers and agency can be greatly facilitated by the establishment of water rights by the state or agency.[113] Attaching a quantitative value to customary laws or priority rights can increase certainty for everybody, and can make it possible to refuse water to head enders in certain cases. Fixing or confirmation of such water rights prior to new construction or rehabilitation is also likely to improve the planning and design decisions.[114]

On the other hand, formal water rights and laws probably can force only limited accountability from agency staff on a day-to-day basis, especially regarding the water efficiency. Such accountability depends on the strength of the law, but also on the internal control and incentive systems of the managing agency. Also Maass and Anderson have stressed such relative value of water rights as follows:

> "One gains a highly imperfect sense of how water is distributed in irrigated areas by reading the vast literature on national and state water codes and laws or the equally abundant literature on the legal nature of water rights. There is a difference between legal concepts of water rights and water practice, and many students of irrigation have overstressed the importance of rights, about which they can write at length without leaving their desks."[115]

Overall, water rights can give more certainty to farmers and agency, but on their own they are unlikely to fill the accountability gap in the irrigated subsector.

Implementation, Progress Monitoring and Evaluation

The last part of the allocation decision-making process consists of its actual implementation, and its subsequent monitoring and evaluation.

Observed levels of sophistication. Figures 8 and 9 give the observed levels of sophistication of the implementation, monitoring and evaluation in the different case studies.

Implementation. In the Philippines and Sudan, the implementation of the allocation decisions was observed to be fully determined by ad hoc requests and urgencies of water users. The intervention by the higher level staff of the irrigation agencies was thereby minimal. Schedules were observed to be purely theoretical and very different from the actual implementation.

In Sri Lanka, there appeared to be somewhat more intervention. Although, there were some official rules and instructions on starting dates, rotation and fines for delays of the implementation of the seasonal allocation decisions, these were not always applied. Still, the observed Sri Lankan systems had some important rules and rule sof thumb laid down in schedules, though they were not strictly implemented.

In Morocco, many rules applied to the implementation. These were also observed to be reflected in the schedule and to be implemented to a large extent.

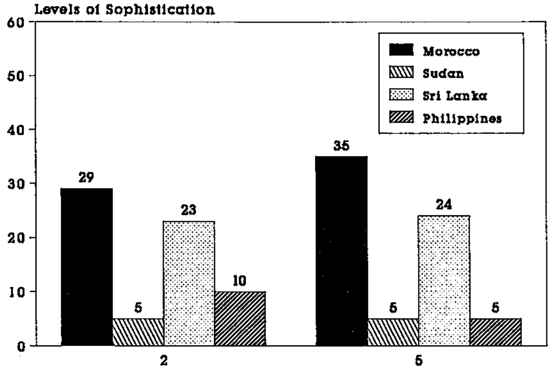
Monitoring and evaluation. In Sri Lanka, Philippines and Sudan, the monitoring and evaluation of the implementation of allocation decisions was observed to be very limited. This was again a consequence of the demand-driven allocation, which in principle did not require any.

The observed monitoring and evaluation of actual allocations was not perfect in Morocco as well. Still, it was of a much higher level of sophistication than in the other case studies.

Observed practices. In the observed South and South-East Asian systems, the implementation of the *land preparation* was delayed in comparison to both the potential and scheduled implementation.

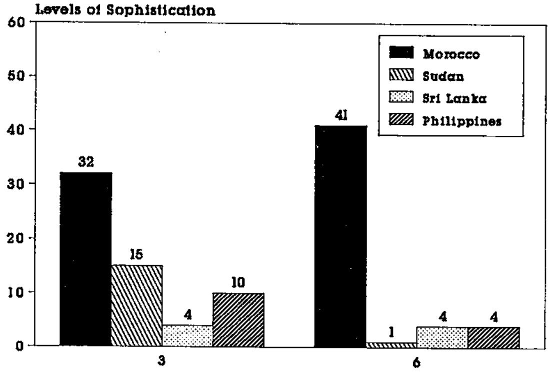
A quick implementation represents the theoretical system interest, because delays in the implementation influence directly the potential starting dates for the second cultivation during the dry season. Thus they influence the annual potential cultivated area and cropping intensity. This was observed to be true for all systems where the canal capacity was the main controlling factor on a season's implementation speed. It was observed to be especially true for the observed river diversion systems in the Philippines.

Figure 8. Levels of sophistication of the implementation



5. In-seasonal allocation plan

Figure 9. Levels of sophistication of the progress monitoring and evaluation



Note: *3. Seasonal allocation plan*
6. In-seasonal allocation plan

A quick implementation was observed, however, to conflict with individual interests of farmers. Individual farmers preferred to have maximum flexibility of the water supply during this time. Such maximum flexibility helped them cope with such problems as the acquisition and costs of different inputs, labor and farm power (e.g., tractors and animals).

Agencies usually succumbed to this pressure and allocated water on-demand. No efforts were observed to speed up the land preparation through systematic monitoring and evaluation to better match water supply with farmers' demands.

This approach during the land preparation has consequences for a system's water efficiency and cropping intensity. For water efficiency the implications are serious given that the normal amount of water used during the land preparation is between 35 per cent and 40 per cent of a season's total, while it can be as high as 50 per cent.[116] Thus, for example, a reduction of the sixweek period of land preparation by one week in Uda Walawe was observed to lead to an increase of the water efficiency by about 9 per cent.[117]

During the cultivation season, the implementation of allocation decisions without any monitoring and evaluation was observed to occur in all systems, except the Moroccan.

Actual allocation was by trial-and-error and ad hoc, and monitoring was based on complaints of water users or field staff. Even during rainfall, water discharges were usually not changed, unless the canal bunds started to overflow; important criteria during rainfall were the minimization of management inputs and the protection of the physical infrastructure.

Similar to the above observations on South and South-East Asian irrigation systems, Levine has observed that monitoring in India is more exception than rule: "Monitoring of the performance of irrigation systems in India is practised only to a very limited extent, limited in terms of the number of systems, and in terms of the character of the monitoring."[118]

Only in one observed Moroccan system, effective monitoring and evaluation did occur. Repetto has claimed this to occur also in Tunisia, Mexico, and China.[119]

The evolution of monitoring requirements. Levine has remarked that the semi-arid zones of India and Pakistan traditionally needed little monitoring and evaluation, because few control structures were available anyway.[120] There, monitoring and evaluation would only be useful to measure either the water level at the tail-end, or the rainfall or for maintenance purposes.

According to Levine, in the humid zones of Asia, on the other hand, irrigation's function has always been different from those in semi-arid zones; it "was intended primarily as a supplement to rainfall during the rainy season. It was the mechanism for carrying the crop -- usually rice-- through the occasionally extended dry periods within the rainy season, and for some limited dry season agriculture on a relatively small fraction of the command area. Under these conditions the irrigation supply frequently was in substantial excess most of the time, and managing the water was of importance only infrequently."[121]

The only South and South-East Asian cases of serious attempts to introduce systematic monitoring as reported upon in the literature were for Indonesia under colonial rule. They resulted from the desire to protect the sugar interests against water scarcity in the dry periods. To that end, the following monitoring system was introduced. Gate operators had to note down hourly in their note books who had received water, for what duration, what discharge and for what area. Some engineers commented later that if these note books would be checked often and irregularly, it would be possible to reduce manipulations. Still, they did not mention if this checking really happened.[122] The literature suggests that monitoring and evaluation happened only in the rice areas adjacent to the sugar areas, i.e., to ensure the rice areas would not take more than their allocated quantity.[123] Overall, the literature suggests that also this attempt of monitoring and evaluation was only partly successful.

The need for monitoring has increased considerably over the last decades, at least theoretically. Although chapter 5 substantiates this further, an introductory background for this increased need for monitoring is the following.

Economic and technical justification of large investments in the irrigation subsector during the past decades have made it necessary to assume higher water efficiencies than traditionally achieved in Asia. To facilitate such improved irrigation management, but also to facilitate the irrigation of the high yielding varieties, new design concepts had to be introduced. These designs generally tended to envisage more control and measurement structures. Thus assuming that increased management inputs were necessary as well. The introduction of higher densities of measuring facilities would facilitate a more precise allocation, although it required increased efforts of monitoring and evaluation of actual deliveries.

Using these measuring facilities in a functional manner was observed to have the following two major constraints:

1) *Technical deficiencies*. Comparative IIMI research in Sri Lanka and Philippines into the functionality of measuring facilities has exposed an unexpected high vulnerability toward technical flaws. IIMI has found backwater effects due to siltation or improper construction of canals or structures, as well as a systematic lack of calibration.[124] Only fixed-discharge modules, which are somewhat independent of upstream water levels, were observed to pose such constraints much less, as was observed in Morocco.[125]

2) *No incentives to use them*. A more serious constraint relates to the required management input. The observed practice of (modified) demand-driven allocation in all case studies other than Morocco, with its considerable slacks to compensate for management inputs by staff and individual farmers, did not necessitate any quantitative flow assessment.[126] Thus, the measuring facilities were not used for monitoring in most cases, and their actual technical non-functionality remained an irrelevant and minor problem.

Several irrigation professionals have doubted also the *cost effectiveness of volumetric metering* in smallholder irrigation systems. Repetto has contested this vision. According to him, for Egypt estimates of such costs are only 3 per cent of the full costs to deliver water. He has argued also that several LDCs such as Morocco, Tunisia, Mexico, and China, do meter water in smallholder systems. According to him also, only few economic studies have been done on this metering of irrigation systems in LDCs.[127]

Another function of measurement structures in some exceptional cases is the possibility of farmers to check the delivered discharge.[128] The present fixed-discharge orifice modules (Neyrpic) were observed in Morocco to provide this opportunity. Although this function per definition is less important for improving the control by the agency itself over water wastage, it may help marginally by an additional possibility to monitor the performance of field staff.

Literature and observations for this study suggest that measuring structures are used only for discharge measurement in countries such as Morocco and Mexico, where farmers buy water volumetrically. Systematic monitoring and evaluation seem to occur only in these countries as well. Although there have been many attempts in other countries to introduce monitoring and evaluation systems, their implementation tended to be an objective per se. As no pressure to improve the water-delivery performance guided them, the quality of data evolving from such systems was often low.

Management process. Increasing the performance of irrigation systems requires incentives for those who waste it. Or, it requires the tightening of the control by the managing agency over water wastage by the involved users.[129] Users can refer thereby to farmers as well as agency staff. Tightening the control of the agency can only be achieved through monitoring and evaluation of the implementation of allocation decisions.

Despite the need for increased monitoring and evaluation, the related attitudes and efforts of engineers were observed to have changed little over the past decades. In all case studies, monitoring was observed to be resisted by agency staff to prevent more accountability. Such resistance was typically strongest from those who would have to initiate and realize the improved performance, the engineers at the level of the irrigation system.[130] In some cases, manipulation of the monitored data prevented them from reflecting the actual performance.[131]

Negative incentives toward water-delivery performance. Observed reasons why engineers resisted this monitoring and related accountability were many.

In all case studies, positive financial incentives existed for engineers and irrigation agencies as a whole through skimming contracts for construction and maintenance. In all case studies, these positive incentives for contracts were observed to work as "negative" incentives toward involvement and performance in water delivery because no comparable incentives were available.[132]

Levine has found the following negative incentives toward monitoring and evaluation, which applied equally well in all case studies:

> "Promotion is primarily based upon seniority (though specific assignments may reflect other factors, such as political influence), rather than specific performance. It is more important to avoid trouble, especially that which must be transferred upward, than to vigorously carry out operational mandates. There is no reward, other than negative, for "treading on someone else's turf." Becoming concerned about what the farmers do impinges on the responsibilities of the agriculture department . . .Monitoring, beyond the minimum, is extra work with no intrinsic reward. Evaluation is likely to identify or at least focus on things that are wrong rather than right. Almost all signals give the same advice: don't put effort in monitoring and evaluation."[133]

Such negative incentives for the whole agency made it unlikely in all observed agencies to introduce any or a more serious monitoring and evaluation for tighter control and internal accountability for water wastage.

No official support for water-delivery performance. In some cases individual irrigation managers had the courage and motivation to implement formal rules. But they were observed to be often withheld the required support by their superiors. An example were system managers in Sri Lanka and in the Philippines, who tried try to punish a farmer who has demolished an irrigation structure. They were observed to receive little official support and to have to pay the costs of the court case out of their pocket.

In the same countries, also the official regulations on service fee payments could not be enforced before court. After farmers complained to politicians and top management, the engineers usually adhered to their demands. Individuals were observed to have little influence on this system.[134] Only, top managers, whether at system or agency level, probably can make an impact as individuals.[135]

Such institutional and legal support was lacking in most case studies, though it is essential for enforcing any schedule, rule or discipline. For example, the willingness of the agency to sanction the water-delivery rules and laws was of utmost importance for the relative success of warabandi in Northwest India.[136]

Of the observed countries, only in Morocco the agencies supported enforcement of rules to a meaningful extent. This was an important reason there was some discipline and control in the Moroccan systems, and why farmers paid their bills.

Such enforcement was not observed to be necessarily "against" the farmers' interests as it increased the general quality of the water delivery. Similarly, Chambers has reported on several environments where farmers preferred a more decisive management system, more enforcement and "prompt and condign punishment".[137]

Mutual Adaptation of the Substance and Processes of Allocation Decisions

The fore going observations on the allocation decisions provided also separate discussions of the related management processes. Several professional approaches such as the theoretical water requirements and measurement structures appeared to be less useful than they were originally designed for. This section briefly summarizes such mutual adaptations of the substantive and managerial aspects of this decision making.

Most professional approaches for assessing supply and demand, scheduling, monitoring and evaluation, were observed to be often useless in actual decision making. The use of such approaches thereby often deviated the attention of staff from tackling the real issues.

These approaches could not compensate for the absence in all case studies of an agency-wide support for delivering water at reduced levels of water waste. This applied equally to specific irrigation engineering and management solutions such as schedules, measurement facilities, monitoring and evaluation systems, crop water requirements, organization structures, on-farm techniques, land levelling, canal lining, rehabilitation, performance indicators, water user groups, water management consultants, improved water-delivery techniques or procedures.

Only in the Moroccan case studies, several professional approaches (such as the schedules, measurement facilities, monitoring and evaluation systems, crop water requirements, organization structures, and to certain degree, on-farm techniques), were observed to be more functional in the allocation decision making.

The accountability and responsibility gap that was observed in all other cases was not a technical problem, but a political problem. Reducing water waste represents a theoretical national interest within the professional domain of irrigation engineers that was not enforced on agency and farmers in all case studies.

FLOW REGULATION PROCESSES

So far this chapter dealt only with allocation processes; who gets how much water for what part of the system, for what crop and at what time. The complementary decision for capacity utilization, and second basic orientation point of this chapter, is the regulation decision. This decision deals with the actual transport of the water in line with the allocation decisions.

Regulation has its own requirements. These may be different from those foreseen in the allocation decisions, also because of the time lags between the two types of key decisions. Therefore, the actual regulation may deviate from that envisaged in the allocation decisions.

Regulation is less frequently studied in irrigation management. The prevalence of the "allocation-distribution" paradigm seems the main cause for this. Therefore it may be useful "to set the stage" on the regulation concept with an elaborate, descriptive definition as follows:

> "Water flow regulation requires contributions of staff for operation of the different control structures and related communication. Preparation and calculation of these contributions can reduce the occurrence of inappropriate operational methods, losses and unnecessary delays in water delivery. The costs of preparation and calculation have to be outweighed by increased water flow regulation and delivery efficiencies. Especially if iterative processes occur like for water flow regulation and delivery, preparation and calculation will be useful.
>
> Preparation and calculation of flow regulation refer mainly to operational methods of control structures, and possibly an operational plan for integrated and coordinated operation of different structures along canals.
>
> Operational methods (or procedures) mean the timing, frequency and size of gate settings of individual control structures to realize flow changes through these structures. These operational methods can vary for different flow conditions in a canal. For example, the filling and emptying of canals, flow and level variations, little or heavy rainfall, or an emergency shut-down. The operational method can incorporate different parameters like upstream and downstream water levels, back water effects, level(s)-discharge curves. These curves can be assessed by experience, through theoretical formulae, or through more or less frequent calibrations. The operational method can be determined more and less frequent, and at different hierarchical levels. The operational methods may or may not be laid down in an operational plan.
>
> An operational plan will indicate how and at what times, (part of) the control structures in a (sub-)system have to be operated during a certain period in line with certain choices made concerning the allocation. These operational plans can be made more or less frequent, and at different hierarchical levels. Such a plan may or may not cover different types of structures (e.g., intake works, cross-regulators, offtakes, turnouts).
>
> After the completion of the preparatory stage of the water flow regulation, the division of water flow regulation activities over different staff can be done through more or less specific instructions, and may or may not be adapted to the actual time required."[138]

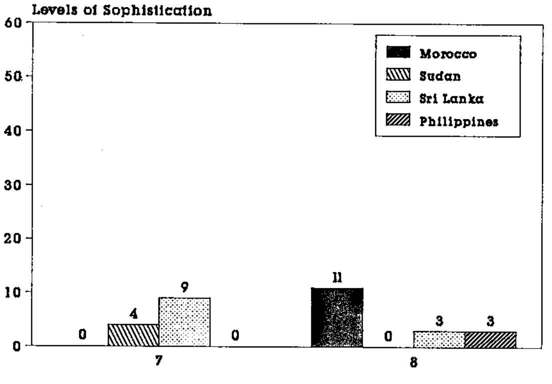
Much more than for the allocation, the generalization on regulation here refers less to similar findings in the international literature. Few such descriptions in literature appeared to exist. This absence of case material reveals also a major part of the message of this section: regulation processes are a no-man's land, a blind spot. Discussion with IIMI colleagues and observations for this study confirmed this. Irrigation professionals in developed and less developed countries alike seem to have little insight in the actual operational methods and procedures of gates by gate operators.

Two different sorts of professional biases seem to have caused this. First, many engineers talk about canal regulation, but only in terms of design options of physical infrastructure, and seldom in terms of practices by system management.[139] Secondly, and as mentioned before, many irrigation professionals have neglected this "other" key area of main system management, by their application of the "allocation-distribution" paradigm in diagnosis of system management. This concept conceals the management concern for regulation, and related hydraulic phenomena. So, this section is more based on observations for this study than on references to literature.

Observed levels of sophistication. Figure 10 gives the observed comparative picture of the levels of sophistication of the flow regulation for the different case studies. Flow regulation, or coordination of operations along canals, is weak in all cases studied. In both the Sri Lankan and Philippine case studies higher level staff had not given such instructions. In the Sri Lankan case studies a standing order existed that required that the water level upstream of the cross-regulators was maintained at full supply depth. This was an inappropriate instruction given the limited information available to the operators, and given the unsteady flow in the canal.

Higher level staff only got involved in coordination of flow regulation during water shortages. If tail enders claimed part of the available water resources to be allocated to them during a temporarily shortage, higher level staff would have to get involved in introducing and implementing rotations to the tail-end reaches. During more permanent water shortages, higher level staff got involved only if tail-ender farmers managed to mobilize sufficient political support, or other pressures on engineers, to secure systematically water for these tail-end reaches. These were thus reactive management interventions.

Figure 10. Levels of sophistication of the flow regulation



Note: *7. Preparation of operational methods and plan*
8. Control over staff utilization

Even in Morocco[140], no management efforts were made to regulate the flow along the main systems. The Moroccan designs provide for sophisticated technical regulation. These did not prevent gate operators to operate the few available manual gates for localized allocation purposes, thereby interfering with the designed regulation concept. Superiors who were aware of such practices did not manage them, even if they were aware of the resulting losses through spillways and overflowing of canal bunds. Like in most irrigation systems, these superiors allowed a higher discharge in the main system as pressure to compensate for such irregularities.

Only in the main system of Sudan's Rahad system, it was observed that superiors made an effort to give specific instructions to gate operators in terms of timing and size of gate settings. Still, in view of the unsteady hydraulic behavior of the water flows, these superiors did not have sufficient information to give such specific instructions. On the other hand, they may have had some experience in regulating specific canals and thus managed to control the regulation to some extent.

The levels of sophistication of the control over time utilization by field staff were observed to be very low in all case studies. The supervision of gate operators by their immediate field-level supervisors was observed to be somewhat more intensive in the Moroccan case studies, but remained very low. Naturally, a high level of control is difficult to achieve given the large geographical distances in most irrigation systems.

Observed practices. A more refined insight in the above generalized pictures of the regulation processes requires a more thorough understanding of the generally applied practices and criteria.

Given the hydraulic interdependence of water flow, the most logical way to structure the description and analysis of the regulation processes here is to follow the water flow from source to field. The management description in this section deals thus sequentially with the following physical processes 1) the water issues from the head sluice; 2) the conveyance along the main canal; 3) the distribution from main canal to distributary canals; and it concludes with 4) the operational plans as more systematic forms of coordination of the operations along canals.

Flow regulation in any system starts with the regulation of the inflow into the system from a river or reservoir. Observations in most case studies showed that the agency's *operational targets for distribution from the head sluice* were usually better defined than any other operational target.

In many systems it is defined in terms of discharge. A certain theoretical relationship between water level and discharge is thereby assumed. This was observed in, for example, Sri Lanka's Kirindi Oya system. Calibrations of such formulae were not observed in any of the case studies.

In many other systems it is defined only in terms of a water level. Usually this is the water level that satisfies the (modified) on-demand delivery in the rest of the system. This latter level corresponds frequently to the maximum water level possible without overflowing of the main canal. This was observed in Sri Lanka's Uda Walawe and Morocco's Basse Moulouya systems. Also, it was observed to be standard practice in most of the Philippine diversion systems. In all observed systems the agencies did not monitor the discharge or level at the head sluice. For Morocco, the Basse Moulouya system seems an exception in this respect.

Operational targets seldom seem to be expressed in a precise time. In all case studies, an approximate timing of this starting point of the entire regulation in the system was considered sufficient. Instructions for operation of the head sluice typically indicated the changed discharge or level only, and not the desired timing of the operation. Only in Sri Lanka's Uda Walawe system, it has been observed that a fixed timing of operation of the head sluice was claimed to be maintained. (This practice facilitated the calculation of stored volumes on a 12-hourly basis for hydropower purposes.)

Instructions regarding undesirable times of flow changes were never observed. An example of such an instruction would be the preferred timing of the last water issue of the day. This could prevent undesired flow fluctuations at downstream reaches during the night.

Feedback of the actual time of operation of the head sluice does probably occur more regularly. Still, it has been observed for this study only in those systems where also facilities for hydropower generation used the water issues from the head sluice.

Given the fore mentioned approximate nature of the timing of the head sluice operation, it is impossible to provide *operational targets for conveyance along the main canal* in terms of time. Such time targets would be necessary to enable coordination of the regulation to stabilize flow fluctuations.

Such coordination is less necessary for main canals without (gated) cross-regulators. This was observed, for example, in Sri Lanka's Uda Walawe system. There, the operational targets tended to be integrated in the allocation decisions. Given the few opportunities to interfere with the conveyance in such canals, the flow stabilized comparatively quickly. Still, the allocations to subsystems along the main canal were usually not completely fixed, and some fluctuations at the tail end tended to remain even in such canals.

In main canals with gated cross-regulators, however, coordination of the operations of different cross-regulators is indispensable for the stabilization of flow fluctuations. Determination of any useful operational target for conveyance without precise information on timing is very difficult. While gated cross-regulators are provided to operate the main canal at variable flows --often intended rather optimistically to facilitate more effective use of rainfall--, the canal is simultaneously divided in a cascade of small reservoirs situated upstream of each regulator. Theoretically, the storage upstream of each of these regulators has to be managed to stabilize flows along the canal, especially at the tail-end reaches. Theoretically, this requires advance instructions to the different gate operators of the expected time, size and frequency of gate settings. Such warnings to field staff of expected discharge changes were not observed in any of the case studies. Given the frequent practice of approximate timing of the head sluice operation, such warnings were also unlikely.

In the studied Philippine systems which were provided with gated cross-regulators, no operational targets for conveyance at all were observed. Instead, gate operators used the cross-regulators for localized allocation objectives; i.e., the manipulation of the water level to allow increased distribution through upstream offtakes.[141] So the water levels at the tail of such main canals fluctuated considerably.

Also in Morocco, no operational targets for conveyance were observed. Partly this was a logical consequence of the small absolute number of cross-regulators that can be manually operated in Morocco. Although these gates were mainly meant for maintenance and repair purposes, they were operated on an ad hoc basis. Therefore the influence of the absence of operational targets for the conveyance, was, although less extreme, still existent.

In the only observed main system with duckbill weirs (i.e., in Sri Lanka's Mahaweli system H) no operational targets for the conveyance appeared to be necessary as only offtakes were available. The instructions for these few offtakes appeared integrated with the requirements for a stable conveyance along the main system. Thus the duckbill weirs appeared to ease the flow regulation considerably.[142]

The only operational targets for conveyance that were observed for this study were expressed in water level. Such targets were observed in Sri Lanka's Kirindi Oya and Sudan's Rahad systems.

In Kirindi Oya, the control water level upstream of the gated cross-regulators had to be maintained at full supply depth (FSD). FSD was a standing order in Sri Lanka's Irrigation Department, and was based on the assumption of steady flow. In actual practice the water levels in the main canals were constantly fluctuating, and the target of FSD could not be adhered to. The observed operational methods of the cross-regulators focused on maintaining a control water level to achieve a distribution target through upstream offtakes rather than on any conveyance objective. Like in the Philippines, this localized operation of cross-regulators caused considerable fluctuations along the main canal, increasingly so from head to tail reaches.

Also in Sudan's Rahad system, system managers of the Ministry of Irrigation were observed to collect information about water levels. They did so every three hours at important, but uncalibrated, locations along the main canals. Also, they made daily, or at least regular, inspections of the water levels along the laterals. Only in Rahad the irrigation managers were observed to give specific operational targets to operators in terms of timing and size of gate settings. Still, they did not have enough information on actual flows to justify such instructions. Although their regular data collection and field visits may have provided them with some relevant experience to manage the flow regulation along the main and lateral canals.

Rahad's high level of management inputs in regulation in comparison to the other cases seemed directly linked to their formal and informal[143] accountability to their client, the powerful Rahad Agricultural Corporation.[144] In the other cases, the clients consisted of individual farmers or weak farmer groups. These could not and did not enforce any serious accountability of the agency for its service delivery.

In all cases, system managers were thus observed to add an excessive slack to the main system discharge instead of managing the cascade of small reservoirs along the main system.

In certain situations this slack could be physically observed even. In Kirindi Oya, for example, a branch canal served at a certain stage to drain fluctuations in the main canal. Simultaneously, the maintenance of a considerable slack in the canal compensated for fluctuations and kept the farmers satisfied. A spillway halfway the 120 km right bank main canal of Morocco's Basse Moulouya system had the same function. In both cases, it was physically obvious that the system management added a considerable slack to the main canal discharge, rather than that it managed the water levels along the main system.

The introduction of some operational targets for conveyance was only observed if management inputs of field staff were the sole preventive measure for overflowing of the canal bund.[145] Otherwise, field staff and their superiors did not worry about the slacks involved in conveying water along the main system.

What are the major causes for these slacks in the main system? The obvious major cause for such slacks to occur was the observed lack of accountability for the regulation in the main system. Only in Sudan's Rahad system some accountability existed in this respect. In addition there were also technical constraints to develop appropriate instructions.

The technical constraints related to the hydraulic interdependence of the upstream and downstream water levels of gated cross-regulators. The hydraulic interdependence made it difficult to determine, or even to calibrate, the discharge through the gates. Such hydraulic interdependence could extend over distances of many kilometers.[146] Even if a calibration would be done, it should be repeated regularly, because of the changing hydraulic resistance (or rugosity) of a canal reach due to weed growth and siltation.[147] This naturally impeded appropriate instructions for regulation. Though it did not justify their absence.

The technical and accountability aspects are likely to have reinforced each other in the past. Together they seem the major reason that main system management remains a blind gap for irrigation professionals. Only during the last decade some efforts in modelling its hydraulic behavior have started to address this seemingly crucial aspect of the main system management.

The next physical process to be managed by the regulation is the *distribution from main canal to distributary (or lateral) canals.*

The related operational targets are usually expressed in terms of a certain water level over a weir at the head of the distributaries. In principle, a schedule indicates the timing as well. But in neither of the case studies schedules were observed that specified the required size and frequency of the gate settings.

As described before in this chapter, the actual operational targets for distribution in all observed irrigation systems were the resultant of the (modified) demand-driven allocation and regulation downstream, rather than the consequence of some plan or schedule from higher hierarchical levels. This study found only two exceptions: 1) if there were no gates available to influence flow as in the warabandi systems of Pakistan and Indian Punjab; or, 2) in the Moroccan systems where the operational target for distribution from the main canals was somewhat well-controlled, both physically and managerially.

Physically, the offtake in Morocco consisted of a combination of a downstream control counter-balancing gate and a balancing reservoir with the Neyrpic orifice modules. This construction was sensitive toward precise installation as well as toward interference by farmers of the balancing gate. On the other hand, the modules allowed only a limited range of discharge fluctuations, so interference by farmers had only limited impact.[148]

By comparatively good decision preparation and monitoring of its implementation in Morocco, the agencies could maintain operational targets for this distribution from the main canal. Thus they could maintain a schedule on a discharge (and volumetric) basis.

Within distributary canals, schedules sometimes incorporated *operational targets for distribution from the distributary.* Though they never did so for *conveyance along the distributary.* Within the distributary canals, the allocation and regulation were usually the responsibility of only one gate operator. Such operators determined their targets on an ad hoc basis, and thus integrated allocation and regulation in their tours along the canal. In practice, there was often no operator active anymore at that level, and the management (or the battle for water) was done by, or left to, the farmers. This was observed in certain parts of Sri Lanka's Uda Walawe system, and in several Philippine systems.

Operational plans in terms of integrated operational methods and procedures in time, size and frequency of adjustment of gate settings for the different offtaking and cross-regulating structures along the same canals were not observed in any of the case studies. The literature survey and discussion with irrigation professionals suggest that such operational plans are almost absent in LDCs, like in many developed countries. Techniques and monitoring systems to facilitate the preparation and implementation of integrated operational methods and procedures seem to be still in their infancy.

Some innovative research efforts in this direction are currently undertaken, although on a limited scale. Sri Lanka's Irrigation Department and IIMI experiment with such methods in Sri Lanka's Kirindi Oya system.[149] They found that two or three targeted gate settings after a flow variation could restabilize the flow within a day. The agency's practice was the opposite;

frequent and ad hoc gate operations in reaction to localized water level fluctuations.

A simulation model facilitates the above research. Given the unsteady and complicated hydraulic nature of water flows and control structures, it seems also very hard to develop more integrated operational methods and plans without such a simulation model. Even, very large management inputs by irrigation managers probably would not suffice to understand and control fully the dynamic hydraulic behavior of canal flows. Several knowledgeable IIMI colleagues confirmed this possibility.

In some exceptional cases, an integrated operational method or procedure was observed. For example, in Sri Lanka's Kirindi Oya a procedure existed by which the officer, who was primarily responsible for allocation to the tail-end reach of the main system, was simultaneously responsible for monitoring the conveyance through the main canal, and for the allocation to different upstream reaches. A clever idea, in principle, because it is in the officer's interest to safeguard sufficient water for the tail end. Instead, unless there was a water shortage, the manager was observed to claim a larger slack to the canal as a whole, thus making his work a lot easier. Still, this operational procedure was an improvement compared to no monitoring at all.

A small remark about design consequences. The absence of integrated operational methods (as well as the lack of related motivation and incentives, of course) challenges the general practice in South and South-East Asia of designing main systems for variable flows and assuming supply-driven allocation. The enforcement of supply-driven allocation seems impossible in the whole region--if anywhere--if the water supply is abundant, which is the case most of the time. (This of course excludes the fixed design concepts where the hardware enforces the supply-driven allocation to a large extent.) The resulting demand-driven allocation in the supply-driven design concepts is only possible by systematically adding considerable slacks in the main system. The question arises if the design concept should be oriented toward facilitating the reduction of slack either during the major part of the season or during the few dry periods only? Or, is it possible to design for slack reduction during the whole season?

Very little knowledge exists so far about the actual size of the slack. The fore mentioned IIMI research hopes to quantify this for Kirindi Oya. Few professionals have reported on the slack at all, leave alone that they have tried to estimate its size. Replogle, as one of these few, has mentioned such "carry water" or "push water" to be 25 per cent for a system in the United States.[150]

Replogle's rejection of the need for any slack for flow regulation again demonstrates that flow regulation is a real no man's land. The geographical distances, the dynamic behavior of canal flows, and the immediate risks for crops make a certain slack an absolute necessity. Even high-tech dynamic regulation cannot prevent some slack as an extra pressure for flexibility in allocation and regulation and their interaction. Replogle has remarked correctly that if the slack is reused in the tail ends as a "prompt, special service", "this process works against scheduling procedures that are intended to reduce excess irrigation and improve on-farm system distribution uniformity."[151] Yet, this points more to insufficient scheduling quality as it does not reduce the need for this extra "pressure" for regulation in its interaction with any variable allocation, whether of perfect quality or not.[152]

Also in developed countries, the managerial aspects of main system management are likely to have remained a no man's land as well. In France, for example, irrigation professionals use the term "dynamic regulation" for flow regulation that is supported by active utilization of simulation models, a network of remote water-level sensors and an electronic data-transmission network facilitating real-time operations.[153] The intermediate step of dynamic regulation through better management methods or procedures seems to have been by-passed there as well.[154] The half a dozen French regulation specialists who were interviewed in this regard all confirmed that this may well have been the case.

Management process. Just like for the allocation, the flow regulation decision making was fully delegated to gate operators. (Although without any monitoring and evaluation by higher level supervisors, "left" seems a better term than "delegated".) Although gate tenders were sometimes warned about the approximate timing of flow changes, they were never informed about the size and duration of flow changes. Operation of gated cross-regulators after a discharge change--whether because of a discharge change from the head sluice, or due to rainfall, or to the operation of upstream gates--, was thus necessarily a time-consuming trial-and-error process for the gate operators. Higher level staff seldom determined margins of allowed fluctuations, even though some operators were observed to use such margins for their own convenience.[155] Therefore, the operator of an upstream regulator typically released flow changes on an ad hoc basis, and all downstream operators were confronted with the resulting fluctuations.

Performance evaluation of the regulation focused only on the level of complaints by other agency staff, farmers or politicians; i.e., on the allocation rather than the regulation itself. Against this background it was very logical for gate operators to give priority to localized favoring of the physical distribution function (i.e., to achieve an allocation objective) over the physical conveyance function to tail-end areas (i.e., a flow regulation objective).

Gate operators had several regulation options to favor localized distribution at the expense of conveyance. In a system with gated cross-regulators in the main system --a common feature of systems built in Asia during the past decades--, the gate operators were observed to have typically the following options:

"* If they can allocate enough water to the distributary canals without impairing the standing orders (i.e., full supply depth and the gradual release of increased flow), they probably will do so, but will issue a certain extra discharge to allow against fluctuations in the main canal. These fluctuations can become substantial for offtakes further upstream of the cross-regulators (IIMI 1989a:F.71);

* They can also issue too much water to the distributary canal anyway, to be sure that water users will not complain;

* If they cannot get enough discharge to the distributary canal, they can close the gates of the cross-regulator a little and allow a certain overflowing of the cross-regulator; either temporarily, as they can always defend their case to any supervisor by arguing that the water level in the main canal is fluctuating (i.e., rising), or permanently, if the water users claim that they do no get enough water.

In practice, it has been observed that the most frequently chosen option by the gate tenders is the operation of one or more gates of the cross-regulators only, without operating the gates of the offtakes (IIMI 1989a:94). This means that the allocation to the distributary canal is realized through manipulation of the control water surface in the main canal, at the expense of the operational targets for the conveyance through the main canal."[156]

Except for Sudan's Rahad system, system managers were not observed to make efforts for any systematic monitoring of the regulation. Even if higher level staff would make an effort to monitor actual operational methods, this would have been very hard because of the fluctuations occurring. Also the sheer geographical distance made it often difficult for higher level staff to monitor a main canal seriously. (Which was still not sufficient excuse to abstain from any related efforts.) Besides, the whole management system discouraged bottom-up information.

Superiors were observed to discourage bottom-up information; sometimes actively by blaming subordinates for those problems, but often also passively by their superior attitudes toward subordinates. Subordinates, on their turn, were observed to refrain from informing superiors in many instances. This strategy caused them to retain more discretion for themselves.[157] A sound strategy, given the details involved in day-to-day decision making on allocation. This applies even more for flow regulation, because these decisions have to be taken in real-time. On the other hand, this real-time nature as well as the geographical distances involved makes the regulation decisions even less accessible for higher level managers than allocation decisions.

Field staff working under such freedom and without clear performance objectives and indicators are unlikely (and were observed not) to maximize their management inputs and vigilance to economize water. Rather, like higher level staff, they usually preferred to minimize their own management inputs as well, even if obvious water wastage occurred such as in Morocco's Basse Moulouya and Sri Lanka's Kirindi Oya.[158] Only, if physical threats existed such as the overflowing of canal bunds, a higher level of management inputs was observed.[159]

Mutual Adaptation of the Substance and Processes of Regulation Decisions

The fore going observations on the regulation decisions provided also separate discussions of the related management processes. This section summarizes how well the existing professional approaches toward flow regulation, if any, were adapted to the processes of decision making.

Few professional approaches toward flow regulation appeared to exist in all case studies. These few applied mainly to design concepts and had little relation to actual regulation processes.

So far, regulation seems to have been an exclusive domain of engineers. Most of the interviewed engineers defined and considered regulation a physical and design issue, and were unwilling to accept possible processes deviating from those assumed during design.[160] The idea that flow regulation requires a slack, or "pressure", is rejected even by some well-known engineers. This shows a blindness of a large part of the irrigation engineers to the management processes required for this perceived technical problem.

As such, this is not surprising. The following, similar case in an edible oil processing industry shows the learned, but almost innate, inability of engineers to imagine behavior deviating from their "logical" design:

"Initially, the management requested a study into their operation to propose measures for energy saving. According to them, the study had to be done by management specialists with a technical background, because the perceived problem and the solutions were technical. We contested this prejudice, and explained them that whatever occurred in the factory, was a result of decisions, and thus a management problem. Although, within this management picture, technical aspects and causes could be important.

The study revealed that fluctuations of energy consumption occurred. Operators reacted upon these based on their personal judgement and preferences, apparently in a completely chaotic way. Also, the instructions by engineer and production supervisors to the operators were conflicting. The actual operations depended fully on the judgement of the operator and the production manager. The engineers never even imagined to check if the actual operations differed from those instructed and were not aware of the impact of the operators' judgements. This confirmed our initial idea of a management problem with some technical aspects."[161]

The similarities of this industrial case with the irrigation sector's regulation problems are remarkable. The process industry has even a comparative advantage over the irrigation sector in this respect, because the geographic proximity of the actual operations facilitates monitoring considerably. Moreover, in profit-driven process industries, engineers have a stronger urge to reduce slacks (a reason they invited management specialists in the first place). Even then, the engineers in this edible oil industry could not imagine that operators would do things differently than assumed. Against this background, the neglect by engineers and other professionals of the managerial aspects of the regulation in irrigation is thus not that bizarre.

As a result, it is also not surprising that several regulation concepts used by irrigation engineers are somewhat misleading toward their functionality in day-to-day system management. Suggestive concepts such as "passive" and "active" control, or upstream and downstream control--Annex 3 gives definitions of these concepts--should be read with utmost care in this respect. Although these concepts are defined as design options, they tend to be used in an inductive mode to discuss allocation and flow regulation.

In practice, upstream control concepts become often downstream control by the actual management practices.[162] Even passive control structures like high-head orifices can be used actively by operators for a downstream mode of regulation. Only canal capacities tend to be absolute physical controls as they cannot be seriously changed by staff or farmers without considerable investments. So the mentioned "control" classifications could better be replaced by a less suggestive one like an upstream and downstream mode of regulation. The latter terminology can be better adapted to field realities, rather than to hydraulic concepts only. Annex 2 makes some first efforts toward such a terminology, though it is not more than that.

REQUIRED CHANGES IN PROCESSES TO IMPROVE CAPACITY UTILIZATION

The Present Management Performance : The Levels of Sophistication

Figure 11 provides a comparative picture of the levels of management performance, or levels of sophistication, of the key decisions of capacity utilization in Morocco, Sudan, Philippines and Sri Lanka. Chapter 3 describes the basic rationale behind this concept. A short note on its use here follows below.

How The Concept is Used

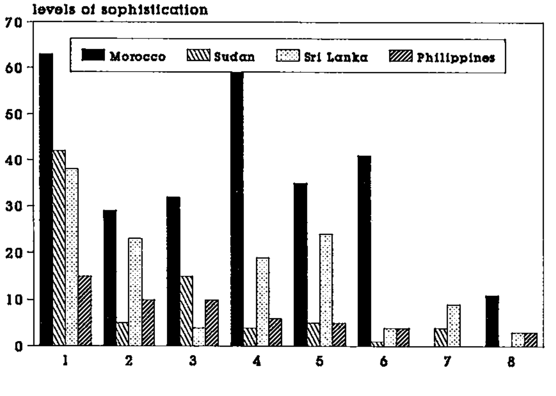
The concept's application in the chapter's fore going parts serves primarily to provide an impression of the different levels of sophistication of irrigation management in the sample countries. In addition, it is used here to identify systematically the opportunities for improvement (step 3-5 in Figure 3 of chapter 3), if the present quality of decisions requires improvement.

The definition of opportunities for improvement here is in terms of requirements of the processes to achieve a higher sophistication of the processes (step 3). Also the related requirements for different sets of management conditions are given (step 4). The management-control decisions required to achieve these different sets of management conditions (step 5) are subsequently discussed in chapter 6. Both the required management conditions for capacity utilization and capacity creation are thereby considered.

The identified requirements for improvements apply for the average picture that evolved from the case studies. Some requirements for improvement apply thus less to the Moroccan cases, where the level of sophistication of several key decisions was observed to be higher than in the other case studies.

A very low or high classification of level of sophistication is not a performance judgement in itself, as argued before in chapter 3. A very low level of sophistication may still lead to a satisfactory performance and may thus be cost-effective. But if the performance is considered unsatisfactory, and the contribution of a related key decision as well, a higher level of sophistication may lead to an improved performance. Only in this indirect way, this concept links management performance with irrigation system performance.

Figure 11. Levels of sophistication of the capacity utilization



Note: <u>Seasonal allocation:</u>
1. Matching of supply and demand
2. Scheduling the implementation
3. Progress monitoring and evaluation

<u>In-seasonal allocation:</u>
4. Matching of supply and demand
5. Scheduling the implementation
6. Progress monitoring and evaluation

<u>Flow regulation:</u>
7. Preparation of operational methods and plans
8. Control over staff utilization

What are the Changes Required in the Processes?

Allocation. Increased levels of sophistication require in most case studies new approaches of demand assessment. This requires an improved match of the assessments of farmers' requirements (regarding cultivation calendar, cultivation pattern, cultivation risks, and water deliveries) by field staff and their superiors. Most engineers currently devote their efforts to assess the farmer's water requirements based on the theoretical water requirements. This practice deviates their attention from assessing the real-life requirements.

A changed professional approach requires a formal recognition by agencies and engineers that improved assessment also must rely on water levels or discharges, rather than on theoretical assessments alone. Water levels or discharges may have to be combined with farmers' requests. Such higher quality demand assessment by higher staff levels was observed only in the Moroccan case study. Even there, the matching of supply at main system level with the demand can be improved considerably.

Logically, higher level staff can never assess the multitude of individual demands of farmers by themselves. So their demand assessments must rely on those by field staff and farmers, whereby higher level staff should be involved in the assessment of the reliability of this field-level demand assessment. They can do so through increased guidance, monitoring and evaluation of field staff, and through increased interaction with farmers. Monitoring and evaluation of the water allocation by field staff often requires also (better calibrated) measurement structures.

More interaction with farmers before and during the cultivation season may also facilitate a reduction of divergent expectations, and thus a better goal congruence among of farmers and between farmers and agency in the decision-preparation stages.

More explicitness about the involved cultivation risks and water-delivery performance targets and trade-offs makes the farmers more co-responsible for the success of the season. The irrigation agency then becomes mainly responsible for the quality of the water delivery, rather than for the success of the season. The risk implied in estimating the probable rainfall is then not the responsibility of the agency alone anymore.

Flow regulation. A higher level of sophistication of main system flow regulation implies an improved coordination of operations along the main system. A direct implication is an improved separation of the conveyance along the main system and the distribution to offtakes along the canal.

Water levels along the main canal must be used as inputs for instructions for conveyance by higher level staff. These instructions must be specific in terms of timing, frequency and size of gate settings. Without involvement of higher level staff such coordination is very difficult, also given the likely localized favoring of head-end reaches by gate operators. Without systemizing such instructing and guidance by higher level staff, the monitoring of the actual operations by them remains very difficult. This is especially so given the fluctuating water levels, and the ad hoc operations by gate operators.

A higher level of sophistication of flow regulation seems more difficult to achieve than for allocation. It requires the measurement of the timing of gate operations and water levels, and of the resulting transport of water volumes. Related instructions on gate settings require rapid information exchanges between field staff and higher staff levels. This complexity of the regulation is one obvious reason for its widespread neglect so far. Simultaneously, the managing agencies sustain its neglect as they do not like to become accountable for the actual water delivery.

Are these Changes Really Required?

The above requirements are not absolute. Neither are they a plea for the capacity utilization as the best opportunity to reduce irrigation's underperformance. A priority between capacity creation and capacity utilization can only be made after the analysis of the capacity creation in the next chapter.

Higher levels of sophistication, and thus higher management inputs, of capacity utilization are not always feasible or desired. Although prioritizing between opportunities for improvement in specific cases can best be done by either the responsible managing agency, the government or the financier, this analysis concludes on some generalized priorities for the whole irrigation subsector.

The major alternative to the above requirements is an increased level of sophistication of the key decisions of capacity creation. The next chapter discusses these. An agency may perceive the above higher levels of sophistication for capacity utilization as inachievable. Then, it may be preferable to adjust, for example, its design concepts so that it assumes lower levels of sophistication during capacity utilization. An example is a lower density of control and measurement structures, which is one rationale behind the warabandi systems in Pakistan and Indian Punjab.

If, on the other hand, either allocation or flow regulation gets priority, the above requirements are definite for the subsector as a whole, and for the direction of individual cases. Although the details may be different for a particular case.

CHANGES IN MANAGEMENT CONDITIONS REQUIRED TO IMPROVE CAPACITY UTILIZATION

This section identifies those changes required in management conditions that are likely to lead to improved processes (step 4 in Figure 3 of chapter 3). The improvements in the processes of capacity utilization in the previous section are the basis for the changes in management conditions.

The following classes of management conditions are considered: human resources, provision of information, financial control systems, provision of knowledge, and organizational rules and structure. A change in one management conditions may require complementary changes in other conditions. For example, the introduction of a monitoring and evaluation system (Provision of Information) is only useful, if, for example, staff (Human Resources) are also given incentives to use the system for performance improvement. Overall conclusions and recommendations of required changes are thus best considered in an integrated manner.

Human Resources

Decisions are always made by people. Consequently people are the most important management condition in an irrigation system, like in any organization. In contrast, irrigation professionals have neglected this management condition in comparison to other disciplinary interests. Chambers has described this as follows:

> "Canal systems are all too easily thought of as delimited by the physical domain of the capture, distribution and application of water, and by the bio-economic domain of the growth and disposal of crops. But the human domain so dominates in operating the system that to limit analysis to the physical and bio-economic domains is not just misleading. It is, in a practical sense unscientific. It is people who make changes. And those with the greatest power to make changes are the managers in charge. Whether it is improving scheduling, reducing losses at night, instituting joint management with farmers, or other interventions, the managers hold the initiative. They are not just part of the system; for purposes of reform, they are the key. To understand the environment they work in, their motivation and their behavior is, thus, crucial in any search for an improvement in performance."[163]

Increased attention of irrigation professionals for this important factor of management control has come only in the 1980s, according to Chambers.[164]

Observed constraints in the provision of staff. Several deficiencies in the irrigation agency's human resources were observed in all case studies.

The attitudes of agency staff tended to impede effective information exchanges about water issues. Attitudes and behavior of engineers and other agency staff toward the farmers and field staff tended to be rather top-down and hierarchical. So the agency staff often appeared to discourage interaction with farmers and their own field staff. Of course, many exceptions to this general picture existed as well.

Traditionally, field staff was always suspected to be more loyal to localized interests than to the agency.[165] Without clearly defined and enforced agency or "system" interests, also higher level staff was observed to adapt the same permissive attitude toward localized interest. Over time, the attitudes related to no or minimal capacity utilization seem to have gained their own momentum. Such attitudes as such already seem to become an obstacle to improved capacity utilization.[166]

Technical knowledge of agency staff was observed to be at sufficiently high levels for the capacity utilization. As far as expatriate consultants were present in the case studies, their presence tended to relate to management constraints in the capacity utilization such as water management, the introduction of non-traditional crops, and project management. The technical knowledge of consultants was deemed indispensable only for very specialized technical issues such as major dam construction.

Knowledge and skills of the engineers of the irrigation agencies about the management of the water allocation and regulation was low in all case studies.

Insufficient staff was also a frequent complaint of interviewed agency staff. Although the O&M budgets were indeed small compared to the actual needs, the performance of the available staff was low. No performance-related incentives led in all cases to low staff motivation for performance improvement. So, in all cases, more staff would not necessarily have led to increased performance without changes in the related incentives. Therefore, the potential need for more staff in different agencies is considered here subordinate to the need for improved motivation. Or, as Chambers has said: "The conditions, motivation and incentives of managers are the key."[167]

Incentives. The incentives of irrigation staff seemed pretty much similar to those of other professionals; convenience and amenity, promotion and career, status, income, and avoidance of stress, and professional satisfaction.[168] In all case studies, however, these incentives tended to direct irrigation staff toward construction and maintenance, rather than toward water-delivery activities.

Construction and maintenance provided for a multitude of positive incentives. The following observations by Chambers about what most engineers perceive to be the advantages of a construction job, were observed in all case studies:

> "More for "hard" applied science people; offered more independence of action; were less monotonous and offered more variety of experience; carried better promotion prospects; involved less public relations; were less vulnerable to transfers by dissatisfied politicians."[169]

More importantly, funds for construction and maintenance activities provided for the major financial incentives for irrigation agencies, and thus for the individuals in those organizations. Each contract was considered to provide ways of skimming more or less financial or in-kind benefits for the involved agency and individual staff members, whether legally or illegally. In addition, each contract provided an agency with new infrastructure, new vehicles and other facilities, and sometimes a contribution to its general overhead.[170] And these contracts were for free for the agency, because the agency itself is seldom required to repay the capital investments, not even partly.

Without any performance requirements from national government or farmers for the agency's capacity utilization, a distorted financial setting for the irrigation agency was observed. Their actual operation was to a certain extent similar to that of a consultant. These financial gains from projects were observed to have biased, over time, the whole incentive structure in all observed irrigation agencies and ministries.

Also the political visibility of construction works was observed to reinforce this bias. Overall, major positive incentives for construction were observed.

Water-delivery activities, on the other hand, appeared to provide merely "negative" incentives. Staff instructions tended to be the minimization of both upward information, and complaints by farmers to politicians and superiors.[171]

Several irrigation professionals have also observed that incentives exist for bad management, as summarized by Chambers:

> "If they gain income from bad management: from lack of scheduling, unpredictable water deliveries, poor communications, and misinformation, then ways have to be sought to make it rational for them to change. Otherwise, many nice manuals are written, poor performance will persist."[172]

Frequent political interference in hiring and firing, promotion or transfer in agencies further reinforced this biased goal congruence.[173]

Motivation. All fore mentioned pressures work in the same direction and against the motivation to do a quality job in capacity utilization. In all key decision-making processes this low motivation appeared a dominating constraint toward performance improvements. Any solutions to improve the performance will thus have to address this crucial constraint.

The management of human resources. What to do about the deficiencies in managerial attitudes and behavior? Specific management training might be capable to change such attitudes or, at least, increase awareness about them.[174] However, such changes in attitude and management skills cannot be sustained without the development of more priority for capacity utilization.

Related incentives for all involved staff or farmers seem to be the most crucial requirement. Such incentives can be provided by the introduction of performance monitoring and evaluation, in combination with related financial or career incentives. Although the introduction of the latter was often observed to be difficult for the reasons given hereafter.

All studied irrigation agencies depended for most policies on human resource management (HRM) on the national government and politicians. Hiring and firing, salary levels, performance-related bonuses were centrally controlled in the line departments, but even in the observed semi-autonomous irrigation corporations in Sri Lanka, Philippines, Morocco and Sudan.

Many managers, researchers and donor staff seem to accept this lack of freedom in HRM as inevitable.[175] They focus their attention, instead, on other solutions like the development and introduction of systems for performance monitoring and evaluation. They hope thereby on some performance improvement, even in the absence of any link with HRM policies.

Performance monitoring and evaluation, however, seem to be useless, unless it can be linked to the incentives for irrigation staff. Moreover, a reasonable separation from political interference is required. Therefore, the present lack of freedom regarding HRM should be considered a major weakness of the observed irrigation institutions. And a major reason to change them. Similar observations were made for Sri Lanka by Chambers, for Indonesia by Kelley and Johnson, and for Morocco by Development Finance Consultants.[176]

HRM and organizational structure. The section on "Organizational Structure" at the end of this chapter elaborates on this subject. Nonetheless, some remarks are made here on the interrelation of performance and incentives for different institutional set ups.

A linkage between performance and incentives exists in all cases where capacity utilization is generally perceived to be (comparatively) well managed. For example, in some irrigation systems in the USA and Taiwan[177], farmers apparently have the power to hire and fire irrigation staff, including the engineers. Hiring and firing are the more negative incentives, and thus the weakest link.[178] Yet, links between positive incentives such as rewards or praise can be found as well in comparatively well-managed systems. This seems to be the case in private irrigation companies, in France, and in New Zealand. There the survival of the irrigation agency depends on the collection of service fees that is based on the quality of the service delivery.

In LDCs, no such fully independent irrigation corporations seem to exist yet, and incentive systems seem always to be separated from performance in capacity utilization. Such dependance can be rooted in different funding arrangements. Either, dependance is caused by straightforward government-supported or -guaranteed funding for operation and maintenance of an irrigation corporation, like in most such organizations in Philippines, Morocco, Sudan and Sri Lanka. Or, it can be based in less direct, and more hidden, government-support for irrigation investments in deferred maintenance/rehabilitation or modernization, like in most organizations in LDCs.

An additional big advantage from a HRM perspective of being more independent of the government is the likely reduced level of vulnerability to political interference. Even if political interference persists, its financial consequences is more readily obvious and clear. A reduction of the level of political interference reduces the influence of this other major disincentive for irrigation managers to be involved in capacity utilization. Thus it also increases the credibility of merit-based careers.

What should be clear from the above, however, is that, compared to the importance of the fore mentioned incentive and accountability issues, other measures seem of little relevance for improving the management processes, if they stand on their own. Solutions such as technical training[179], manuals[180], external consultants[181], more staff or other facilities will be irrelevant as long these fore mentioned issues remain unaddressed. Repetto has stated it as follows:

> "..."better management" is an elusive goal, since the dominant parties involved have weak, if any, interests in attaining it. Without fundamental changes in the incentives that motivate these parties [i.e., changes in the management control], efforts to strengthen irrigation management probably won't substantially improve performance in public systems. To a large extent, the current emphasis on management as the critical problem in public irrigation reflects acceptance of the long-dominant engineering perspective. Most engineers, who still run virtually all irrigation agencies, conceptualize irrigation projects as hydraulic systems designed and built to operate in certain ways. If they don't actually operate that way in practice, then, according to the engineers, "they are not being managed properly." However, seen not as hydraulic but as socio-economic systems, those same irrigation projects are designed to operate in a quite different way--in accordance with the principles of rent-seeking--and, in fact, they do so."[182]

Amazingly enough, all studied aid donors had made little efforts to incorporate in their investment considerations the influence of these incentive structures on capacity utilization. [183] Chapters 5 and 6 elaborate on these donor considerations.

Provision of Information

Information provision is crucial for effective and efficient management of an organization. Decision making relates to processes in the minds of different involved actors, which essentially depend on information for its preparation, enlightenment, and energy. Decision making involves choices among alternatives, among different compositions of information. A decision is essentially a transformation of information.

Observed constraints in the provision of information. In all case studies, except the Moroccan, more information regarding the actual requirements of the farmers was needed for the *seasonal allocation planning* to achieve an average level of sophistication. Their preferences relate to the cultivation calendar, the cropping pattern, the irrigable area, the staggered cultivation, and cultivation risks, the water duties, as well as the trade-offs between them. Especially, the preparatory stages and the implementation of the seasonal allocation decisions require such information.

In all case studies, except the Moroccan, the seasonal allocation planning did not consider the actual water users' requirements at the levels of the project, block (or branch canal) and distributary channel. Such information should become available, especially during the preparatory phases of the allocation planning by the system-level O&M division (and possibly the Agricultural division). Improved mutual understanding and adjustment, and fewer divergent expectations of clients may evolve.

In all case studies, improved informing of the water users about the decisions, arguments, and criteria used in the different steps may strengthen their confidence in the decision-making processes.

In all case studies, except the Moroccan, no reliable historical measurement data on realized water deliveries to important subsystems were available for the determination of realistic water duties. Higher levels of sophistication require therefore at least one, but preferably more, regular calibrations (e.g., every two or three years, depending on the siltation in a specific location).

In all case studies, except the Moroccan, no weekly information was available at block and project level regarding the actual implementation of the seasonal allocation plan. Neither were by the end of the land preparation, evaluation reports on the actual implementation sent to an agency's head office.

To achieve at least an average level of sophistication (i.e., a score of 40-60, see also Annex 1), the staff level that prepares the *in-seasonal allocation schedules* requires regular or frequent feedback of realized water issues to branch canals, distributary and field channels, and of corresponding water levels in the main and branch canals. In all case studies, such feedback was only partly observed. Also, it should get feedback on adjustments of scheduled allocations. This feedback could be realized through forms, in which case they should be cross-checked. Cross-checking can be done by daily independent measurements of water issues to at least distributary canals, and through regular field visits by project-level staff.

The achievement of at least an average level of sophistication requires regular feedback of the residual effective rainfall. This was not observed in any of the case studies, although the frequent feedback in the Morrocan cases of the actual demand incorporated the effective rainfall.

The achievement of at least an average level of sophistication requires good communication lines to react on important deviations from the scheduled allocations (i.e., those that cannot be covered by the established allowable margins). This was not observed in any of the case studies.

Reacting on important deviations also could be facilitated by an improved information-processing capacity; the use of computers and standard software could be applied to make frequent and quick changes in the schedules and to produce notes for dissemination of the new schedules to field staff and water users. It would also make the management system less dependent on individual staff members if allocation experiences were recorded, for example, in a database, seasonal reports, etc. Such facilities were nowhere observed.

The achievement of at least an average level of sophistication requires performance evaluation by the agency's head office. It requires registration of allocation schedules and comparison with important earlier experiences, and regular monitoring and evaluation of actual implementation of the most important operational targets. Potential performance indicators for the in-seasonal allocation are the water duties for different main and branch canals and distributary channels. These could be monitored regularly. Only in Morocco this was observed.

Although even there the water duty was not a serious performance indicator for the service delivery as a higher consumption meant more income for the agency.

Serious performance evaluation requires, again, an increased accountability of the irrigation agency as a whole toward its water-delivery performance. This is unlikely to come about without any related external requirements.

The achievement of at least an average level of sophistication of the *flow regulation* requires the provision of the O&M divisions with the actual time of operation of the reservoir sluices and realized discharges. This was not observed in any of the case studies.

The achievement of at least an average level of sophistication requires the informing of gate tenders about the exact time and size of flow variation at their structures. But also they should be instructed about the required time and size of gate adjustment and the frequency of checking the resulting level changes, and the frequency of adjustment of the gate settings.

The achievement of at least an average level of sophistication requires also the feedback to higher-level staff of the actual time and size of gate adjustments required for the flow variation to reach important points along the main and branch canals (e.g., the tail ends, or the head ends of branch canals and distributary channels). Also, they should receive feedback of the time required to stabilize at these points after an important change of discharge through the reservoir sluices, after heavy rainfall, or after important changes in distribution in upstream reaches of the main and branch canals. Also, information on all changes in distribution realized along the main and branch canals should be fed back to higher-level staff regularly. Moreover, for an average level of sophistication regular feedback should occur about variations in water level along the main and branch canals. Such feedback on flow regulation was not observed in any of the case studies, except for Sudan's Rahad system. There some feedback occurred on water levels along the main system.

Average levels of sophistication require information flows as mentioned above. They require increased management inputs and efforts of different staff levels in all case studies, except the Moroccan. These are unlikely to occur without increased institutional support from an agency's head office. Such support could be in the form of guidance, evaluation, and appreciation of increased performance. To this end, regular or frequent monitoring of the processes of the allocation decision making by an agency's head office is required at least for guidance, and evaluation and especially for stimulation of staff. In the present situation in most case studies, the involved staff is not appraised for its performance, other than "negatively", i.e., in cases of complaints.

Errors. The foregoing argued that irrigation managers in all case studies, except the Morrocan, had access to very little relevant management information. In addition, errors in the available information appeared a problem for higher staff levels in all observed irrigation agencies.[184] This reduced the usefulness of the available information for capacity utilization.

Improving this quality would require again the assistance of, and the monitoring and evaluation by higher staff. Especially in large systems, and even more in smallholder systems, it is physically and managemently impossible for top managers to control adequately this quality by themselves. On the other hand, errors were often irrelevant because the information "is not used anyway".[185]

Information provision and organizational structure. In all irrigation systems, the required quantity and quality (e.g., timeliness, reliability, appropriateness) of information about the requirements of farmers and field staff seems enormous. This is due to the high variability of soils, topography and socio-economic situations[186], and the considerable geographic distances. Especially in LDCs, the large numbers of farmers in large-scale smallholder systems aggravate this information load. It becomes even more cumbersome with high intensities of flow-control structures.

Such huge information needs easily cause information overloads for higher hierarchical levels of staff. One way to moderate these constraints is through pre-processing of information through, for example, "management by exception". Another way is through improved telecommunication or transport facilities[187], as introduced in some modernization programs nowadays. Especially for flow regulation the latter options may facilitate increased and better information exchanges. However, the quality of "management by exception" and the reliability of monitoring and evaluation still require regular on-the-spot checking. This is especially so if localized interests overshadow possible incentives of staff to economize on water use. (Given the localized interests for excess water availability, information systems without such incentives will function only marginally anyway.)

This suggests that, supposing such incentives exist, from the perspective of information exchange requirements alone, only decentralization of this information processing and decision making can lead to higher levels of sophistication of capacity utilization.[188]

Potential and logical units of decentralization are either the system level, or the subsystem served by one or more main, distributary or lateral canals.[189] Generalizations about the appropriate level and size for decentralized units are difficult to make, however. Such generalizations cannot depend on information considerations alone, but also on the coherence of the problem. Some relevant factors are discussed in the section on Organizational Rules and Structures.

Decentralization without incentives to achieve higher performance levels will not lead to higher levels of sophistication. In such cases, the pressures by localized interests are likely to lead to even more local water waste. Performance improvements can only be attained if the decentralized units have incentives to achieve them.

Financial Control Systems[190]

Irrigation service fees have received much attention in the past by donors and recipient national governments. Donors seem to have pushed for this form of cost recovery of their irrigation investments largely for ideological reasons; i.e., for the perceived effect of more efficient resource allocation and more adequate O&M funding.[191] Despite this attention, the collection of service fees in most countries has been disappointing, and donors met "widespread non-compliance with these lending covenants"[192] by the national governments.

In all cases of this study, except the Moroccan, service fee collection rates were very low. Neither was there any relation between the volumetric water delivery and the size of the service fees. Duane, a World Bank staff member, has reported that most irrigation agencies in LDCs cannot and do not try to measure water volumetrically[193], a necessary condition for any relation between cost recovery and efficiency.[194] An often mentioned exception in Asia seems Taiwan--of course nowadays more a Newly Industrializing Country (NIC) than a LDC. Taiwan is often quoted for the links there between the collection rate of service fees and the management performance.[195]

Moore has recently reviewed the technical and political feasibility of measuring volume in Asia and of the introduction of related water pricing. He was pessimistic about such opportunities and argued that Taiwan's perceived example was a misconception.[196] He may have a point, but he may also be wrong. Because cost recovery seems a rather donor-driven issue, chapter 5 gives a more extensive discussion, also of Moore's objections, in the section on Feasible Cost Recovery.

A larger constraint than the volumetric measuring seems the will of politicians and donors to enforce such payments from the Asian farmers. In all Asian case studies politicians were unwilling to seriously introduce service fees for irrigation water. In the Moroccan case studies, volumetric water charging occurred, but also in Sudan it did not.

The financial control in all observed irrigation agencies mainly focused on minimizing the expenditures on operation and maintenance. Finance for the organizations as a whole as well as for the different units depended on the government budgetary allocation, and lacked any relation to their performance.[197] Without any financial control system that related the finance for an organizational unit to its performance, the efficiency argument implicitly pursued by the donors did not evolve.

Most governments of LDCs are not eager to make irrigation agencies more independent. Duane has nicely described why they are not eager to do so: "to keep such agencies firmly in the political domain where there is maximum opportunity to exercise discretion and minimum constraint from the rules of commercial undertakings."[198] Similar observations were made in all case studies.

It seems precisely for this reason, that very few, if any, really independent large irrigation agencies exist in the LDCs. Semi-autonomous agencies such as the National Irrigation Administration (NIA) in Philippines, and the Office Regional de Mise en Valeur Agricole (ORMVA) in Morocco, were observed to depend still on annual budgetary allocations and guarantees from their national government. As a result, the institutional pressures on staff in those agencies to reduce water waste were still limited.

In contrast, in more financial autonomous irrigation agencies or organizational units, the agency or unit as a whole has incentives for improvement of service delivery.[199] This has been claimed for, for example, Australia, New Zealand and France.

More financial autonomy may lead also to more independence of the organization to provide incentives to its staff and to become more independent in its human resource management policies. The latter were observed to be often difficult to realize within a government agency because financial reward systems tended to be centrally controlled and to be set on an across-the-board government basis.[200]

Yet, even without financial independence different other forms of financial control and accounting could probably stimulate, to a certain extent, a better accountability of different organizational units. Accounting systems that would make the resource use and efficiency of these units more clear may itself provide, to a certain degree, for an incentive. They may facilitate more decentralization of decision making to these units as well. Yet, similar to the above incentive system, central governments often prescribe accounting systems, and it may be difficult to change the accounting system for an irrigation agency only. Besides, introduction of accounting systems without any financial accountability for the agency as a whole may render them less useful.

Provision of Knowledge

The provision of formal knowledge to irrigation managers about relevant management techniques and attitudes of capacity utilization is very limited. Since the 1970s, workshops, literature and the more formal education familiarized irrigation managers in all case studies with the technical methods of water scheduling and demand assessment. Similar knowledge about the management aspects of capacity utilization was unavailable to irrigation managers in most case studies. Though some ad hoc knowledge transfer was observed to occur between irrigation managers.

An observed exception was a recent publication of the Moroccan ICID on the allocation practices in different Moroccan systems.[201] The publication describes and compares different technical and managerial approaches in Moroccan irrigation systems. The study seems unique, because no similar study could be traced for this study from any other country.

Irrigation managers in Sri Lanka and Philippines were observed to be provided with much knowledge about organizing farmers into water user groups. Yet, the knowledge how to interact with them on capacity utilization issues appeared not to be part of such trainings.

In general, the knowledge about relevant managerial techniques for capacity utilization was observed to be very limited. No synthesis or systematic exchanges of experiences by different irrigation managers were apparent in all case studies, except the Moroccan. Nothing was observed to be known about managerial techniques and attitudes that have proved more or less successful in reaching mutually acceptable seasonal allocation decisions in different irrigation systems under different water availability scenarios.

Especially the technical and managerial knowledge of coordinating the gate settings along main systems were observed to be a blind spot in all case studies. Such knowledge could be developed through trial-run techniques in different systems. Or, through the application of simulation models to experiment with different operational methods and procedures for flow regulation. Some earlier described innovative action research with flow simulation models by IIMI and the Sri Lanka's Irrigation Department tries to fill this gap of flow regulation in one specific system. Still, this remains a meager effort compared to the size of this professional gap.

Several authors have observed such missing knowledge in the past. One is Chambers, quoted below:

> "To my knowledge, though, there is no source book of methods for working out schedules for different conditions, and no textbook or manual for scheduling and delivery. Nor will compiling such a textbook or manual be easy, for it to be realistic it must tackle problems of inadequate information-scheduling with few facts and poor communications. But since scheduling and delivery are at the core of main system management, and main system management is the key to improved performance, those who pioneer and develop methods, manuals and training materials for better scheduling and delivery will be at a frontier of immense professional and social significance."[202]

Reducing the listed gaps in knowledge is desirable. On the other hand, the importance of such gaps in canal management must not be exaggerated (as some irrigation professionals tend to do). This may lead to a focus on an improved irrigation professionalism only, while leaving the crucial performance and accountability issues untouched. Weak professionalism seems more a consequence of the weak motivation and accountability, and thus of inexperience, to manage these canals, than the cause of it. Improved knowledge about canal management can facilitate improvement processes. But it cannot be the sole entrance.

Organizational Rules and Structure

Explicit and specific mission statement. Not all studied irrigation agencies had a mission to deliver water. In the Sri Lankan and Philippine case studies[203] the water delivery was not defined as a responsibility for the irrigation agency. Instead it was left to the farmers, or the agricultural agency. The agency's responsibility in those cases, was restricted to the creation of capacity and the opening of the head sluices. Also in India a government commission has found such a basic gap in responsibility and accountability of irrigation agencies, as reflected in the following quotation:

> "..the Indian Commission 1901-1903 . . .opined that the irrigation officers should keep as strict an account of the disposition of every cubic foot of the water entering their canals . . .and it is only by doing so they can . . .prevent an unequal or ineffective distribution of water . . .the Second Irrigation Commission of 1972 considered that it is necessary for the Irrigation Engineer to know how and where water is being used or misused and if he is expected to run the system efficiently he must know the details of the end use of the water which is being supplied and for this purpose the Irrigation Department should be made responsible for the management of water from the sources to the field . . .The National Commission on Agriculture 1976 was of the opinion that the Irrigation Department should be responsible both for efficient conveyance of water from its sources to the field and for fair distribution . . .none of the above mentioned suggestions and recommendations of the three Commissions from 1901-1976 have been processed or implemented by the State Government"[204] (underline added, cn)

Precondition for any improvement of the creation and utilization of irrigation capacities by an irrigation agency is such an explicit mission statement. Only if a mission statement exists, responsibilities and accountabilities of an agency can be defined and monitored.

Accountability. Systematic monitoring of the service delivery was observed in Morocco only. And even there the monitoring was not always that systematic and regular. The observed information exchanges in the other irrigation agencies were mostly ad hoc and reactive to complaints by field staff and farmers.[205] Therefore, the observed systematic monitoring was mainly by farmers. Levine has observed this in India as well.[206]

Such information on system performance in itself is indispensable for any accountability of the staff of a managing agency. Even if higher hierarchical levels do not use it for staff performance assessment and related incentive systems, its availability alone would provide for some accountability and incentive for agency staff. For this obvious reason, it could be observed in most case studies that the few efforts to make such information systematically available met passive and active resistance from irrigation agencies and engineers.[207] Unfortunately, this resistance was rather successful. External monitoring (i.e., by an external party) is then a possible way of making irrigation agencies accountable for its service delivery in a systematic way (if they do not yet financially depend on the quality of their services).

Especially if there is a link between the budget for the agency and such audits, the use of neutral "external water auditors" may be useful.

Literature on irrigation management provides several references to the nominal function of monitoring systems for system operation amongst others in Morocco, Indonesia, India and Sri Lanka.[208] Amazingly enough, this has seldom led to the conclusion that a monitoring and evaluation system alone does not necessarily make an agency more accountable in a systematic way. Only Wade has explicitly recognized this. He has suggested therefore the introduction of external public monitoring of irrigation agencies to enforce more systematic accountability.[209]

Several countries practice such external monitoring. In the USA, for example, the General Accounting Office monitors and evaluates the performance of irrigation agencies.[210] Also Malaysia's Prime Minister's Office currently tries to initiate a similar process. In both cases, the central government supervises this external monitoring, which is probably the best possible guarantee for its neutrality.[211]

Central versus local control. Another structural issue is the degree of centralization of irrigation agencies. The sections on the management conditions Human Resources and Provision of Information touched upon this issue already.

In all case studies, the irrigation agencies were formally highly centralized. Only in the Moroccan agencies several responsibilities were more decentralized from the central to the authority level. Despite this formal picture, the processes of capacity utilization described in this chapter demonstrated a weak central control. Only in Morocco the decentralized authorities resulted in a stronger control at field level.

The observed weak central control seemed related to a certain degree to the so-called "soft" states[212] of most LDCs. Only in Morocco, the state did not refrain from enforcing certain regulations. These "soft" states make a stronger control with the traditional organizational set ups unlikely. To a certain degree, the weakness of the central control seems also more likely for the irrigation subsector than for other sectors for such reasons as the great variability in local conditions and needs of farmers, and the large physical distances in most systems. This may be the reason Maass and Anderson have observed that also in countries where the state was much stronger at irrigation system level, the central control appeared to be limited:

> "...formal centralization of authority, where it has occurred, has not meant substantial loss of local control de facto. General administrative, legislative, and judicial norms laid down by higher authorities have not negated customary procedures . . .authorities do not seek central controls but acted rather as adjuncts to traditional cellular irrigation authorities"[213]

Limited control seems a fact of life in most irrigation systems in LDCs.[214] The information required for increased control over local units is available only at the local level. Increased control over local units can therefore only be expected if the local managers have sufficient incentives 1) to provide a level of service delivery that is satisfactory to these local units; and 2) to represent the system-wide interests against localized interests.

Improved control seems therefore to require an increased decentralization of most, presently centralized irrigation agencies. Although a "central coordinating unit" should be maintained to represent the system-wide interests along the main system, and to regulate the flows along it. Naturally, such decentralization only works with performance-related incentives for decentralized decision makers.

Potential and logical units of decentralization are the subsystems served by one or more main, distributary or lateral canals. Such generalizations about the appropriate level and size for decentralized units are difficult to make, however. It depends on such system-specific factors as the size of the main system, the intensity of flow control structures (and other design characteristics), the number of farmers, and the size of complexity and uncertainties of the cultivation. But also the envisaged level of water-delivery service, the acceptable quantity of slack resources, the motivation and incentive systems for agency staff and farmers, and even the political and socio-economic situation of the system and farmers may be factors influencing the appropriate level of decentralization.

The presently centralized organizational structures of most irrigation agencies in LDCs originate often from, and correspond to, the information requirements during colonial, or other centralized control-oriented governments. The following quotation of Levine reflects this: "To a large extent the flow of information was downward, with relatively little of an operational nature moving upward. Since the operations were considered to be governed by fixed rules, monitoring was only to insure the rules were carried out."[215] Performance improvements require different information processing (e.g., also upward), and thus different organization structures.

Separate structures for main system regulation. The section on Flow Regulation Processes shows that this management concern was done in Sudan at a comparatively high level of sophistication. The observations suggested the following structural influences. First, a separate organizational structure was responsible solely for conveyance along the main system, and delivery to the minor systems (i.e., the Sudanese tertiary canal). Secondly, the agency had a certain financial accountability for the delivery toward the agricultural corporation (agency staff tended to receive annual bonuses from the agricultural corporation). Complaints about the quality of water delivery to the minor systems--the formal transferpoint of water from the irrigation agency to the client--by the powerful agricultural corporations and tenants' union forced the managing agency to pay comparatively more attention to the regulation.

The interaction between these two different organizations at the transfer point between main and minor system, makes the quality of the deliveries more transparent than it would have been if only one agency managed the water from the source to (groups of) farmers. In the latter case, as observed in the other case studies, it appeared very difficult for (groups of) farmers to trace and recognize the actual flow regulation due to the continuous fluctuations of water levels. Recognizing whether a certain actual delivery was the result of an allocation decision or of imperfect regulation in an upstream canal was impossible for them. Moreover, farmers' groups could complain but were too weak to enforce a *systematic* quality improvement.

Although the positive evidence comes from this one Sudanese case only, the related logic suggests the following conclusions. A separate structural unit[216] for managing the flow in the main canal may benefit the quality of the flow regulation of the main system. Precondition for success of such a "regulation unit" is a clear transfer point of the service delivery to other units. In addition, the latter also must have enough power to keep them accountable, for example, through payment for the delivered services.

This "regulation unit" must be the same as the earlier mentioned "central coordinating unit", though the two units satisfy different management requirements. The latter's objective is to represent the system interest versus localized interests along the main canal, i.e., an allocation concern. The former's function is to make the quality of the flow regulation along the main system more transparent, and thus become accountable for it, i.e., a regulation concern.

Such a separate unit can, in principle, be provided with incentives to improve its performance by making them profit centers. Such profit centers would buy water from the source and sell it to other units. This set up can be found in France. There, irrigation companies exist that provide such regulation services to irrigation systems. One such company even offered the farmers--who own the large-scale system--to try to manage the system by themselves, or to try finding another company that could deliver the service at competitive terms. Initially, the farmers tried by themselves but eventually they gave up, and decided to hire again the fore mentioned irrigation company. A superior example of a merit-based, and thus professional, irrigation agency.

Water user groups. The introduction of water user groups (WUGs) was observed to be a standard ingredient of irrigation projects during the past 15 years. The main rationale seemed that only WUGs can make irrigation agencies accountable for the quality of design and construction and for system performance. Another important reason was that the modern design concepts assume farmers to share water along a field canal, and WUGs supposedly would facilitate this process. The following observations on the functionality of WUGs were made in the case studies.

For a seasonal decision it appeared comparatively easy to get all farmers on a common line through WUGs. In Morocco, it was even possible without them, because the scheduling system allowed to a certain degree the incorporation of individual preferences. The farmers' individual seasonal plans were the starting point for the agency's seasonal planning.

For day-to-day decisions, the required processes were observed to be much more difficult, due to the conflicting interests of different farmers in smallholder systems. No convincing systematic contribution of WUGs in the in-seasonal allocation was observed in the case studies.

Rather than trying to share water to economize water for other subsystems, WUGs were observed to consider it their common interest to claim more water for their own group. This type of group representation usually existed already prior to the official WUGs. During the interviews in the two countries with major efforts to initiate WUGs, Sri Lanka and the Philippines, the impression grew stronger that most WUG leaders were more interested in potential individual or group benefits from a project's financial assistance than in the improvement of the allocation decisions.

The dynamics of main system regulation itself was observed to be another constraining factor for the functionality of WUGs. Virtually no rules and procedures were observed to exist for this decision making, resulting in an "adhocracy" type of regulation by the operators. Combined with the hydraulic behavior of the flows, this decision making was observed to be very little transparent, and thus difficult to influence for WUGs.

For single decisions, like the seasonal plan, however, WUGs may facilitate a certain accountability from an irrigation agency. The attitude of the staff of all observed agencies was such that enforcement of such accountability in a systematic way was extremely unlikely without any administrative authority for, or financial accountability to, the WUG.

The above shows quite some practical constraints for WUGs to function in allocation and regulation processes. The question arises if the discussions on WUGs consider such constraints, and to what extent something can be done to make WUGs work better.

Several authors have argued in the past that the conflicting interests of different farmers along canals impeded the functionality of the WUG concept in many LDCs, especially in social and political environments with values like "grabbing anything one can get away with".[217] Although such attitudes can be considered, of course, a consequence of a lousy service delivery rather than its cause, WUGs are indeed unlikely to change such attitudes and processes.

Unfortunately, the advocates of WUGs seldom seem to consider the consequences of such arguments in their discussions on WUGs. The discussions of the impact of most case studies of WUGs by its advocates and adversaries tend to be equally biased.[218] The advocates have amply documented some perceived successes of WUGs, notably the first system-wide pilot project in Sri Lanka's Gal Oya system. Although the concept has been implemented in many countries since, more systematic and widespread success is not obvious. Despite this void, awareness about the necessity of WUGs has increased considerably during the last decade. Awareness about their precise role in the decision-making processes remains however obscure.

Theoretically, WUGs are a necessity. In the context of our present discussion an effective WUG would require the following two conditions:

1. Irrigation agencies and its staff are only likely to make them functional in the decision-making processes if there is a need to do so. Either because farmers have the administrative authority, so that they can directly influence their incentives. Or, if they have incentives to increase the system's performance, and this were possible only through cooperation with WUGs. Several types of administrative authority of farmers are possible: farmers can own the irrigation agency (e.g., France, USA); they can influence transfer, promotion decisions (USA); they can threaten the financial viability of the organization (e.g., through service fees); or, they may have other administrative authority or influence over agency staff (e.g., Taiwan).

2. The crystallization of conflicting interests between farmers and between WUGs and agency seems to require a long time. Maass and Anderson have derived from history that the usefulness of WUGs for allocation decisions cannot come overnight, as described hereafter:

   > "...the problems of dividing and distributing water are complex, uniquely so for each system. How to manage a distribution system so that each cultivator receives water in the amount and at the time required by his crops; how to divide the water so that each irrigator receives the amount to which his water right or his interest in the system entitles him; and how to organize a force and a system for water delivery that will accomplish these results without great friction, at a cost irrigators will pay, and in accordance with their objectives are questions that no irrigation community has been able to settle except by long and costly experience."[219] (underline added, cn)

Without the above accompanying institutional arrangements and time, the following remark of

Wade seems quite true: "Much of the discussion on 'people's participation generally, and on water users' associations specifically, misses the point."[220]

Agricultural authority set up. Several countries, notably Sudan and Morocco, have extended the tasks of the irrigation agencies into delivering other inputs (e.g., fertilizer) for agricultural production as well. The delivery of these other inputs than water is either to the farmers or directly to the crop. The three perceived advantages behind this so-called agricultural authority set up are the following:

1) the application of these inputs could be better coordinated with the other agricultural practices. Through such a bigger role of the agency, the total agricultural production could be improved;

2) the higher coordination would lead to a more timely implementation of the land preparation, also in view of the design canal capacities, and thus to an improved capacity utilization; and,

3) the other inputs than water would be more readily available, or at lower prices, than in the private sector.

The second issue would tackle one cause of the head-tail problems in irrigation systems, because a delayed cultivation means less cultivation for the tail-end reaches.

Pre-condition for the latter benefits of the authority set up are the means and will to provide a better service of water and other inputs. It also requires the will to interact with field staff and farmers to make them adhere to the system-wide interest to a certain degree, rather than to localized interests only. Observations in all case studies proved these assumptions unjustified.

In the past a certain discipline seems to have prevailed, to a more and less degree, in the Sudanese and Moroccan agricultural authorities. The initial impact in those countries was a considerable adherence of farmers to the enforced cropping pattern and calendar. Over time these were observed to have eroded considerably.

In a newly started authority such as the observed Sri Lankan Mahaweli Authority, a satisfactory service delivery neither such discipline were introduced. The adherence was much less than in the former two countries, and was not much different from the regular Sri Lankan line agency, the Irrigation Department. The functionality of the authority set up toward this water-related objective seemed thus low.

The advantages of an enforced cropping pattern and calendar--originally the case in the Moroccan and Sudanese case studies--are also not that obvious as it seems to many engineers. An advantage for the government is that it can ensure certain quota of crops to be produced. On the other hand, the provision of the different inputs by the state was observed to be highly subsidized and often supply- rather than demand-based.[221] Besides, the opportunities for farmers that the market provides tend to be missed with an enforced cropping pattern.

More recently the limited de-facto impact on the adherence to cropping calendar and pattern has been more widely recognized. Together with the recognition of the high costs to society as a whole, the Sudanese and Moroccan agricultural authorities presently engage in drastic disengagements in these activities. Ultimately they may reduce their activities to those of a regular line agency. This concept of an agricultural authority is thus likely to suffer an early end.

Fake structural solutions. Over time, different structural solutions were observed to have been proposed and tried out in the different case studies to solve the systematic performance deficiencies. Several of these had little chance of success in view of their limited impact on the real management-control problems. A few of them are discussed hereafter.

One such a fake solution was the creation of *a separate structural unit* for irrigation management purposes *without* allocating such a unit any related *responsibility*. Observed examples of such efforts were Sri Lanka's Irrigation Management Division (IMD) and India's Command Area Development Authority (CADA). Both were supposed to improve irrigation management, while the related authority and responsibility remained with the traditional irrigation agencies. This was an impossible solution in view of both the resistance in these agencies to put more efforts in the water delivery, and in view of the absence of accountability for the water-delivery performance of any of these organizations.

A similar mistake was made in the Philippines with the creation of an institutional development division in all offices of the National Irrigation Administration. The division had a completely separate staff to run the water user organizations, and this caused it to remain separate from the agency's core activities.

Another such fake solution was observed to be the hiring of *external water management consultants without any direct authority and responsibility* for the water delivery. Withou such responsibility their function appeared very limited in all observed cases given the persistence of the incentive, motivation and accountability problems in the agencies.[222] This was especially so where their presence was externally stimulated or enforced. It was observed that, most probably because of these constraints, and given the frequent absence of a commitment of the agency to tackle them, the presently hired water-management consultants tended to focus their activities on production of O&M manuals and developing training courses. But these manuals and training did not change the fore mentioned constraints.[223] In addition, the manuals were time- and situation-specific, and became obsolete as soon as the managers or other important factors changed--due to the weak institutional setting, the quality of the individual manager has an exceptional dominant influence on the whole management and control.

External facilitators or consultants are likely to contribute only to capacity utilization if there is an organizational environment that is committed to achieve certain objectives pursued by the external actor. Else they are likely to fill a gap for which nobody in the organization is or will be responsible.

Unfortunately, donor organizations were observed to prefer and push the above fake solutions above solutions that really addressed the accountability and motivational issues of the recipient organizations. Some interviewed donor and government staff were well aware that the donors tended to opt for fake solutions. Most of them acknowledged that donors tended to shy away from addressing the sensitive issues that related to incentive systems and accountability issues. Levine and Heaver amongst others have published similar observations.[224] Chapter 6 elaborates on the related processes.

Given the interests of the irrigation agencies, their staff and the farmers, the above changes probably can be realized only if they get serious support from political and donor levels. Moreover, the above are the required changes in management conditions from the perspective of capacity utilization only. A full management perspective requires the consideration of the capacity creation as well. The next chapter gives this capacity creation perspective. Chapter 6 subsequently integrates the required changes in management conditions from an overall management perspective, and derives the related management-control decisions.

Notes

1. Drucker in "Managing in Turbulent Times", quoted in Mansfield 1989.

2. Sundar 1984 in Nobe and Sampath 1986:114.

3. After an overhead sheet of Kampfraath.

4. E.g., Levine, Chambers, Murray-Rust, Diemer, Martin, Yoder.

5. In December 1988, all irrigation professionals based in IIMI's headquarters were asked how they defined "distribution". Some used it for the distribution on-farm, while others used it for the distribution from the main system to offtaking canals. None of the definitions were similar.

6. Cornell thus considered decision making and conflict management as different management tasks than allocation and distribution. Yet, allocation itself requires decision making, including conflict management. A good example of the confusing influence of structure-based definitions.

7. Uphoff 1986.

8. E.g., Wade and Chambers 1980; Bottrall 1981b.

9. For example, IIMI 1989 and Chambers 1988. Chambers has used the following more process-based definition for capacity utilization that corresponded more to the allocation-regulation definitions used here: "Scheduling refers to planning--making calculations, drawing up allocations and timetables, and deciding adjustments to these; and delivery refers to implementation--opening and closing sluices, operating controls, and the resulting arrivals of water at and through outlets." (Chambers 1988:125) Although Chambers has used the word distribution frequently in this book, he remained vague about its relation to scheduling and delivery.

10. Frederiksen 1989:6.

11. The term playing "safe" has been borrowed from Valera 1985.

12. One exception of this desire to reduce uncertainty and to play "safe" is described by Wade for South India. There, system managers accepted and demanded bribes before allocating water to farmers. Rumor mongering about water scarcity initiated by system managers increased the uncertainty of water supply, and thus the relative value of the water and the size of the bribes (Wade 1982b). Similar examples exist probably elsewhere, but in most cases system managers try to reduce the cultivation risks rather than increase them.

13. Implicitly or explicitly, this water duty refers to the water delivery performance in terms of adequacy, timeliness, responsiveness, predictability, delivery performance ratio, operation efficiency and equity.

14. These design objectives were determined more than a century ago by the British colonial administration, and have not been changed since.

15. Levine 1985:96.

16. E.g., Doorenbos and Pruitt 1977.

17. Nijman 1992a:A2.

18. Nijman 1991:180-182.

19. E.g., Sakthivadivel in an IIMI Technical Staff Seminar on 25 May 1990.

20. ANAFID 1990.

21. This despite the fact that the government till recently prescribed and, for certain crops, forced farmers to adhere to certain cropping patterns.

22. See, for example, numerous operation and maintenance manuals, department guidelines etc.

23. For example, Carruthers and Clark 1981:43; Palmer Jones 1988:1. Palmer Jones has correctly remarked that while Carruthers and Clark (1981) have argued that the theoretical crop water requirements assume a "maximizing" of irrigation water efficiency without optimizing costs, so far economists have failed to provide an alternative concept (ibid:2). Also, Maass and Anderson have made an indirect reference to this problem as follows: the uncertainties and variabilities of water supply itself, especially in the drier climates, "make for a highly stochastic production function for irrigation agriculture rather than a deterministic one, and they induce a general sense of insecurity that is important in determining the relations among those involved in the process." (Maass and Anderson 1986:366).

24. Seckler 1985:9. Many of these crops need a smaller total volume of water, though this volume must be spreaded over more frequent irrigations. This higher frequency of smaller doses increases the absolute cultivation risks.

25. Repetto 1986:25.

26. Repetto 1986:13; IIMI/World Bank 1991:55.

27. See, for example, for Sri Lanka Abeyratne and Farrington 1986; and for Tamil Nadu Elumai 1982:77 in Chambers 1982:19. This conflict had been recognized in Indonesia already in the nineteenth century (Weys 1898:197 and Lamminga 1905:762 in Ter Hofstede and Van Santbrink 1979:31). In Sri Lanka they were mentioned by an Assistant Government Agent as important reasons for delays of the cultivation season (Harriss 1977:368).

28. Slabbers 1989:678. He has stated literally that irrigation water is "competing with rainfed agriculture (per labor-day, irrigated agriculture must produce at least the same as non-irrigated production)." (ibid). Slabbers based his paper on case studies from Senegal, Peru, Bolivia and Mexico (ibid).

29. Oad and Fowler 1983:15.

30. Government of Andhra Pradesh 1982:78.

31. This conflict between farmers' and national interest was also clearly demonstrated by the officially used "scientifically" determined water requirements of plantation (i.e., sugar) and farmers' crops in colonial Indonesia. These were changed from 1:1 to 1:1.5 between 1910 and 1920, and were even considered to be 1:2 during periods of water shortage (Ter Hofstede and Van Santbrink 1979:65). Ter Hofstede has remarked correctly that, even while no research had been done in that area yet, these water requirements were in fact the first steps of yield-response relations (ibid:66).

32. "Economic growth, however, is in the case of irrigation agriculture so competitive with other objectives that farmers typically refuse to treat water as a regular economic good, like fertilizer, for example. It is, they say, a special product and should be removed from ordinary market transactions so that the farmers can control conflict, maintain popular influence and control, and realize equity and social justice. Furthermore, since progress is commonly associated with efficiency, to the extent that irrigation communities, limit efficiency by pursuing other objectives they have been "unprogressive"." (Maass and Anderson 1986:5)

33. Ibid:366.

34. Researchers have concluded this also for Indonesia during the colonial administration. For example, an experiment in Pategoean demonstrated large variations of seepage and percolation, and related variations in water requirements. Agency staff were reportedly unable to make such estimates. This makes participation by farmers in this demand assessment an absolute necessity (Ter Meulen 1918:4 in Ter Hofstede and Van Santbrink 1979:111).

35. The Dutch administration in Indonesia, for example, adopted this strategy by hiring a common irrigator (i.e. ulu-ulus) (Paerels en Eysvoogel 1926:269 in Ter Hofstede and Van Santbrink 1979:155; Paerels en Eysvoogel 1926:280; Graadt van Roggen 1932:123 in Ter Hofstede and Van Santbrink 1979:161). Also the British administration in Sri Lanka hired the so-called common irrigator (i.e. Vel Vidane).

36. Numans 1916:342 in Ter Hofstede and Van Santbrink 1979:153.

37. Radosevich 1986:476. Though the subaks in Bali seem an exception, as far as they can be considered agency-managed.

38. No examples were observed of an engineer proposing cultivation risks lower than 100% success, unless he was forced to present such a plan.

39. For example, in Sri Lanka's Uda Walawe.

40. Observed in, for example, Sri Lanka's Kirindi Oya system; in Morocco's Gharb system and in the Philippine case studies (see also Julian 1986). Only in Kirindi Oya, the theoretical requirements were adjusted to correspond better with gross duties.

41. For example, in Sri Lanka this meeting of the so-called Sub-District Agricultural Committee is presided by the (Assistant-)Government Agent; in Philippines by the Governor.

42. For example, the Resident Project Manager in the Mahaweli Authority of Sri Lanka, or the Director in the regional authorities in Morocco. In the latter, however, the Governor presides several seasonal planning meetings with all involved institutions if water shortages are expected.

43. The more passive attitude of the observed agencies in the Philippines originated probably from the specific nature of most systems of the Philippines. They were river diversion systems, which made the cultivation progress and seasonal plan more vulnerable to fluctuations of river inflow than the reservoir-based Sri Lankan systems. This made the planning more prone to changes. On the other hand, the reduced physical control over water provided an additional excuse to the Philippine engineers to refrain from managing the seasonal cultivation.

44. Officially the irrigation agency was supposed to control the cropping pattern. In practice, they only restricted the total area cultivated by the water-intensive citrus crops.

45. E.g., ADB 1982; Nijman 1991.

46. According to IIMI colleagues this was also the case in Indonesia.

47. ADB 1986:1. The author observed this same practice in South India's Thamrivarani system as well. There, many small intermediate reservoirs in the main system, however, invited for some agency and especially political intervention.

48. Chambers 1982:18.

49. Chambers has referred to this as "involuntary staggering", because head enders force the rest of the system to stagger (Chambers 1982:19).

50. Consequently, canal capacities could be reduced also in Indonesia with an estimated 10% (Van Maanen 1924:22; and Nugteren 1970:39 in Ter Hofstede and Van Santbrink 1979:39).

51. Chambers has mentioned these two arguments as well (Chambers 1982:19). Similarly, Chambers has proposed for the warabandi system in North-West India the staggering of the frequency of water deliveries. This would stimulate farmers to stagger their individual cultivation to match peak demand with the smallest intervals (ibid).

52. Van Maanen 1924:22-25; Nugteren 1970:39 in Ter Hofstede and Van Santbrink 1979:39. Ter Hofstede has argued rather theoretically that the efficiency advantages of organized over "involuntary" staggering were unproven. However, organized staggering can certainly improve the match between a concentrated discharge and power and labor availability. Thus water can be used more efficiently during land preparation, and thereby accelerate the implementation of the season and extend the total irrigated area.

53. Ter Hofstede and Van Santbrink 1979:42.

54. Murray-Rust pers. comm.

55. Even in Philippines staggering seems to be implemented in new, large systems.

56. Murray-Rust 1983.

57. Murray-Rust and Snellen 1991:69.

58. Replogle 1989. Replogle mixes the different types of rotation with their being "demand", "arranged" (or "modified demand"), or "continuous" which is rather confusing (ibid:128). "Arranged" is according to him a flexible rotation, which is not necessarily true. "Arranged" can be a very rigid rotation, which has resulted, however, from negotiations or requests from farmers.

59. Ibid:121.

60. Ibid:125.

61. Ibid.

62. However, another and more important reason for the Moroccan government was the achievement of a stable supply of a variety of crops for the local market, among others sugar beet and sugar cane for state factories. The government thus forced farmers to grow certain crops, instead of relying on the price mechanism.

63. Chambers 1982:18.

64. See, for example, GOAP 1982; Berkoff 1990.

65. Ter Hofstede and Van Santbrink 1979:43.

66. Widely stimulated by agencies in Sri Lanka at present times, though Harris mentions that this occurred already during the 1920s (Harriss 1977:368).

67. Bloemen and De Moor 1983:620.

68. E.g., Kelley and Johnson 1989:531. Similarly, a consultant writes that "every farmer can instruct every operator, if present, discipline is completely absent" (Nedeco 1979:1 in Ter Hofstede and Van Santbrink 1979:189). And, a World Bank discussion paper: "field evidence has long suggested...that, more often than not, the formal processes, even if ostensibly followed, differ --often significantly--from what actually happens in the field." (World Bank 1990c:5) The paper demonstrates that while "The levels of sophistication in Indonesia's irrigation infrastructure (hardware) and Indonesia's underlying principles of water management (software) are some of the highest..in South and Southeast Asia...." at the same time, if any of the assumptions regarding planted area for different crops and crop stages, discharges, losses and timing of gate settings "are violated, the operational method is liable to error" (IIMI 1987:E-2 in ibid:6). Under colonial rule such failures did not concern the sugar interests, but the rice only. The pasten system's function was securing water for sugar during a short annual period of water shortage, rather than saving water.

69. E.g., Chambers 1982:20.

70. Chambers 1982:20. Such examples seem only transplantable to large-scale, agency-managed systems, if the water saving system is acceptable to all farmers, and if the introduction is done through an intensive and serious effort by the managing agency.

71. An exception may be trickle irrigation that has almost no flexibility at all.

72. Verdier (1987) and Plusquellec (1988) have given good overviews of design options and related information collection, transfer and processing options (like remote controlled actuators and sensors, teletransmission systems and data processing by micro-computers) for more sophisticated flow regulation. Some engineers may feel these options should be introduced more widely without delay, because of its potential for water saving or service delivery improvements. This potential will not always be utilized, however. Such options seem to require an appropriate management and political environment, which is problematic in many systems (conform Chambers 1988:127).

73. The term "slack" is used in this text, because the term is commonly used in management science. It refers to the phenomenon of preventing an information overload at higher hierarchical levels by reducing the required level of performance through adding additional resources such as physical infrastructure and water (see, for example, Galbraith 1973). It is amazing, that though slack is a pervasive phenomenon in irrigation, the only irrigation professionals that seem to have used this term to date are Wade and Chambers (e.g., Wade 1980:157; and Chambers 1981:12).

74. Farmers in rice-based system in Asia tend to prefer continuous issues to their fields. In practice, in systems designed for variable flows, such continuous issues represent also demand-driven allocation.

75. In downstream control systems, hydraulic behavior of the flow thus replaces information. In upstream control systems the needs for information exchanges are often reduced by creating slack resources, i.e., extra water in the main canal.

76. Own observations; ANAFID 1990. Only, during peak demand periods, when the demand exceeds the main canal capacity, the duration of one scheduling period had to be extended from nine to twelve days, thus necessitating a somewhat more "modified demand".

77. E.g., Barnett 1977; Levine and Bailey 1987.

78. Moore 1987:21.

79. Replogle 1986:131.

80. Conform ibid:129.

81. In Sri Lanka this 30 l/s is assumed to be used simultaneously by two farmers. Apparently, engineers of the Indian colonial administration have introduced this 30 l/s mainly for reasons of convenience in their calculations (30 l/s is one cubic feet per second or cusec).

82. Internalized modifications exist probably in most demand-driven systems. Accepting internalized modification as modified demand would mean that demand-driven in its pure form is non-existent.

83. IIMI 1989.

84. See, for example, the operation and maintenance manuals of Kirindi Oya (AHT/SCG 1987) and Uda Walawe (MMP 1986) and design manual of the Sri Lankan Irrigation Department (Ponradjah 1989).

85. Measurement structures at the head of the main canal are only in exceptional cases allotted a function for [modified] demand-driven allocation. See, for example, for Gal Oya (Murray-Rust 1983).

86. See note 74 of this chapter.

87. Horst 1983a:26.

88. ICID 1989:27.

89. Steiner and Walter 1988:69. Operational procedures were divided in demand-driven and rule-driven. This is a structure-based division. It ignores the frequent non-functionality of rules and is a division between two theoretical extremes only. The combination of these three classifications into an operational typology adds little value to the individual ones, and its purpose remains unclear.

90. Chambers 1988:126.

91. Replogle 1986:124.

92. Ibid:124.

93. Replogle has also used "schedule" somewhat different than in this text, because it referred to the schedule for a whole season, rather than a new schedule for every week, ten days or so. Flexible thus meant that the whole schedule could be changed during the season. This text uses flexible for the possibility to change the schedule regularly during its implementation, something which Replogle's terminology did not consider at all. These different definitions are of minor importance compared to the unique effort made by Replogle.

94. Conform Chambers 1988:126.

95. ICID 1989:30.

96. See also, ANAFID 1990.

97. Murray-Rust 1983.

98. Replogle 1986:120.

99. For example, in Kirindi Oya, Uda Walawe and many other Sri Lankan systems, and in Philippines.

100. This problem was also explicitly recognized by the colonial administration in Indonesia (Numans 1916:342 in Ter Hofstede and Van Santbrink 1979:153).

101. Nijman 1992a.

102. Conform the following quotation of Chambers: "It is also not surprising that water control staff, in these circumstances, weigh up the situation, in the absence of countervailing incentives, decide to choose a quiet and perhaps modestly profitable life. The simplest course for them is to follow the policy of, to quote one observer:"You open the sluice and go to sleep"." (Chambers 1977a:108). See also Moore 1980:106; and Levine 1985:96.

103. Wade 1982a:300.

104. Ibid; The Economist 1991b.

105. Own observations. This point is better not proved here. Neither does it have to be proved as *most* irrigation and development professionals know it. The author as well as many other professionals tend to refer to this incentive as, for example, the construction-biases of irrigation engineers. These biases are partly professional. To a major extent though they also relate to the overall priorities in irrigation agencies to do contracts, and to obtain funding for it. Read here for construction-bias thus contract-bias. Some brief references to the internal dynamics of this system can be found in later chapters.

106. Chambers 1980:345; Wade 1980:A-111.

107. While quite a few irrigation professionals are aware of such active resistance, only few have reported upon it. Repetto has been one of these few, as reflected in the following observation: "operators have reportedly opposed and circumvented efforts to publicize the operating rules and schedules of the system because publicity makes irregularities easier to detect and limits their discretion to reallocate water in exchange for favors." (Repetto 1986:25). Other examples of the few literature references of such explicit resistance by engineers exist for the Sudan (Barnett 1977:10), Sri Lanka (Murray-Rust and Moore 1983:293 in Chambers 1988:131), and Pakistan (Mohtadullah 1982:175). The latter has stated it for public enterprises in LDCs in general:"One reason is that we in the public enterprises ourselves like to leave things ambiguous for obvious reasons" (ibid).

108. Murray-Rust and Snellen 1991:19.

109. Radosevich 1986:476.

110. Ibid:497.

111. Maass and Anderson 1986; for Indonesia, Radosevisch 1986:497.

112. Maass and Anderson 1986:372.

113. Murray-Rust and Snellen have recently argued that an agreed contract between agency and water user was an absolute necessity and minimum. They have even listed the minimum contents of such a contract (Murray-Rust and Snellen 1991:16).

114. For example, Coward 1986:501.

115. Maass and Anderson 1986:424.

116. Murray-Rust pers. comm.

117. For two weeks reduction per season, the related benefit-cost ratio could be as high as 192, provided that the water would be used for additional cultivation. The related benefits could be as high as a 3-month-salary-worth bonus to all employees, or a 12-month-salary-worth bonus to the water management related employees (Kikuchi in Nijman 1991:52).

118. Levine 1985:94.

119. Repetto 1986:30.

120. Ibid.

121. Ibid.

122. Paerels and Eysvoogel 1926 in Ter Hofstede and Van Santbrink 1979:157.

123. Ter Hofstede and Van Santbrink 1979:157. Some monitoring of the cultivation progress was apparently practiced in colonial Ceylon as well (Harriss 1977:369).

124. IIMI 1989:144.

125. This seems to have been overseen or ignored by some writers on water pricing and metering like Moore 1987:20.

126. Moore has made a mistake here by stating that smallholder irrigation systems, unlike electricity/domestic water supply systems, are not "demand scheduled" (Moore 1987:21). His argument that even Taiwan does not schedule volumetrically did not prove his point, only that Asian countries apparently have so far not introduced volumetric delivery and charging. Underlying reasons may have been, for example, that so far the economic, social and political pressures on water have not necessitated this, or because reliable volumetric charging is considered technically and/or managerially too cumbersome, or a combination of both. The Mediterranean countries have a longer history and more experience with scarcity and economizing of water, and thus introduced volumetric charging at an earlier stage. The increasing competition in Asia for water may lead to a similar scarcity value of water, and thus possibly to volumetric metering.

127. Repetto 1986:30. If correct, this kind of research seems indeed one of the priority topics for irrigation management research. Repetto also argues that a kind of approximate volumetric pricing, and thus monitoring, is possible on the basis of the number of "turns" that farmers take or receive if some stability in flow rates can be achieved through design improvements. He quotes a project in Pakistan, Gujarat and some districts in Mexico where this system is apparently used (Repetto 1986:31). Moore does not agree with the examples, which Repetto used to prove that wholesaling of water did exist already. The Gujarat case is apparently a persistent myth, which reality and spreading were documented by Chambers. However, Moore does not elaborate on his objections to Repetto's Mexican example (Moore 1987:25).

128. This was apparently the case with the proportional weirs in Indonesia (Ter Hofstede and Van Santbrink 1979).

129. Chambers 1980:27; Moore 1987:26.

130. Wade has found similar resistances (see also note 107).

131. This has been found also in, for example, India as follows: ""It may not be wrong that the areas are overstated because no one being really responsible...and no one would like to report figures which might cast a reflection of his performance." (Government of Andhra Pradesh 1982:22)

132. On the other hand, Wade has reported on cases of positive water-related incentives through straightforward rent-seeking in the water allocation.

133. Levine 1985:96.

134. See also Kirindi Oya where the efforts of a motivated individual were effectively neutralized by his colleagues and superiors (Nijman 1992a).

135. Gunadase has described a good example of this in his case study of Sri Lanka's Kimbulwana system (Gunadase 1989).

136. Wade 1982b:177.

137. Chambers 1980:359.

138. Nijman 1991.

139. Their solutions to regulation problems are thus typically always in the form of other regulation structures or concepts, rather than a different practice for the operator.

140. Unlike the other three studied countries, the Moroccan irrigation systems were rather heterogenous in their physical infrastructure and related management control systems. The generalized picture as given could still be derived, however. Also the Moroccan ICID committee has tried this in a recent publication on its capacity utilization practices (ANAFID 1990). This publication is unique in that it is one of the only, if not the only, where managing agencies themselves have described and analyzed their capacity utilization practices. Unfortunately, also this publication has not described the managerial aspects of flow regulation.

141. The following quotation suggests that the operation in India is probably quite similar : "The operation of the canal system, both the main canal and minors, occurs without specific regulation of discharge, elevation, timing or duration, and with no consistent criteria for decisions, record of water levels, nor any knowledge of the flow rate at any point in the system." (WMSP 1983a:33 in Chambers 1988:128)

142. IIMI 1989.

143. The informal part consisted in Rahad of an annual financial bonus paid by the Rahad Agricultural Corporation for services rendered by the individual main system managers (who were formally employed by the Ministry of Irrigation).

144. The agricultural corporation was financially and otherwise powerful, because it effectively controlled a large part of the agricultural processing and marketing in the system.

145. E.g., Nijman 1992a.

146. Measured in Kirindi Oya (IIMI 1989) and observed for the United States (Replogle 1989:805).

147. Despite the extremely complex hydraulic reality of this design concept, most designers tend to assume, rather dogmatically, that such canals are operated under steady flow conditions. A more pragmatic assumption for designers would be to assume that any gate envisaged in the design of a main canal, whether meant for purposes of operation or maintenance, introduces unsteady flow. And introduces thus a need for management inputs by higher level staff to get

it stabilized!

148. On the other hand, it was observed that if farmers were dissatisfied with the arrangements, they could damage the gates of the modules rather easily, and thus obstruct the system management.

149. See, for example, IIMI 1989.

150. Replogle 1989:806.

151. Ibid.

152. Ibid.

153. Such systems are operational in France, Morocco and Greece.

154. The only example of a management intermediate traced during this study was the practice of "timed gate operation" used on the California Aqueduct (Burt and Lord 1981:153).

155. E.g., Malaterre 1989:18; Nijman 1992a:60. Also, in the main systems of Morocco's Basse Moulouya and Sudan's Rahad system, operators used such informal margins.

156. Nijman 1992a:61.

157. Moore 1980 in Chambers 1988:129.

158. Cases of knowingly overloading of the canal while simultaneously spilling or draining at a downstream location were observed in Morocco's Basse Moulouya and in Sri Lanka's Kirindi Oya (Nijman 1992a).

159. E.g., ibid.

160. Consultants seemed to have often few realistic ideas about this flow regulation as well. In Uda Walawe, the water management consultant omitted this crucial issue completely in the operation and maintenance manual (MMP 1986 in Nijman 1991). In Kirindi Oya, the instructions and procedures proposed were highly theoretical and unrealistic, both in a managerial and technical sense (AHT/SCG 1989 in Nijman 1992a).

161. Kampfraath pers. comm.

162. The term "control" refers in irrigation engineering to the definition of a hydraulic control (see Annex 3). This is a confusing concept in an environment where management control is often more important than any physical control.

163. Chambers 1988:182.

164. Ibid:182. Chambers referred to contributions by Bottrall 1981a,1985; Kamalpuri 1986; Moore 1980, 1981; Pant 1981; Ramamurthy 1986; and especially Wade 1981, 1982a, 1982b, 1984, 1985.

165. For example, for Indonesia under colonial rule as follows: "...the water delivery at tertiary and quartenairy block level depends actually completely of the way the responsible person (the ulu-ulu) executes his task......requirements, which can hardly be expected of rather little educated and lowly paid employees." (Haringhuizen 1931:351 in Ter Hofstede and Van Santbrink 1979:152).

166. Conform Mohtadullah 1982:176.

167. Chambers 1988:206.

168. Conform Chambers 1988:181.

169. Chambers 1981:17.

170. In the Philippines, each contract was observed to provide even a contribution to the agency's general overhead. This five per cent overhead on each donor-funded project was observed to be an important source of its income (see also NIA 1990).

171. For example, such negative incentives underlied also the following remark by Bottrall: "Good water distribution...requires...a management system which will make it rational for officials to deny extra water to the more powerful and better located, despite the unpopularity and loss of 'unofficial income' this will entail." (Bottrall 1981a:13).

172. Chambers 1988:132.

173. Conform Wade 1982a:302.

174. E.g., IIMI/DID 1990; IIMI/BADC 1991.

175. For example, Wade 1982b:180.

176. Chambers 1975, 1980:360; Kelley and Johnson 1989; and Development Finance Consultants (DFC) 1990:I.2.

177. Easter and Welsch 1986:36.

178. The scope for motivation of agency staff and farmers through mainly "negative" incentives like the enforcement of system-wide economic water use seems to be rather limited for the water allocation. In colonial settings, enforcement was usually translated in the disciplining of field staff and farmers (e.g., Indonesia and Sudan), but only in those situations where colonial commercial interests had to be secured or favored against water shortage. Nowadays, the effective dominance of such commercial interests versus individual farmers has weakened considerably, to the extent that the weakened discipline has caused most supply-driven allocation systems to shift to demand-driven.

179. Levine 1985:98; Bottrall 1985:17.

180. Chambers 1988:132. Also, similar findings in the Uda Walawe case study on the functionality of water management consultants and operation and maintenance manuals were fully supported by the involved consultant (MMP 1990:14).

181. Ibid; NEDECO 1979:1 in Ter Hofstede and Van Santbrink 1979:189; PRC 1982.

182. Repetto 1986:10. Also Heaver has written extensively on this incentive structure (Heaver 1982).

183. For example, Levine has criticized the World Bank's recent National Water Management Project and US AID's training program, both in India, for "leaving the questions of organizational and physical infrastructure changes to other programmes" and leaving the existing incentive systems untouched (Levine 1985:98). Only seldom these large donors effectively address performance related issues in their investment decisions, other than enforcing perceived needs (ibid) or solutions to solve these performance problems.

184. Levine has observed this also in, for example, India (Levine 1985:99).

185. See Nijman 1991. Also Chambers has reported on similar remarks (Chambers 1988:129).

186. Conform DFC 1990:II.2.

187. Ignoring the cost effectiveness and efficiency of the following technological development, from an information point of view, it is, of course, very promising: computerized control with almost instantaneous information feedback and instructions, also regarding rainfall and water demand and levels. Such a system can achieve the highest levels of sophistication.

188. Conform Levine 1985:100; DFC 1990:II.2.

189. Only in Morocco such decentralization was seriously contemplated. There, the decentralized units were a number of distributary canals (DFC 1990).

190. In principle, this section deals with all material and immaterial control systems and methods other than incentive systems and information systems. The latter two are discussed under the earlier sections on Human Resources and Provision of Information. In practice, only the most important management control system, the financial control, is discussed. In addition, Annex 4 discusses some systems that tend to be considered erroneously as management control systems.

191. Duane 1986:6. The section on Feasible Cost Recovery from Beneficiaries of chapter 5 elaborates on this issue.

192. Ibid:5.

193. Some related proxy to volume can achieve the same effect. Examples are the length of time of delivery, the number of times the crop is irrigated, or the share of the variable water supply a farmer is entitled to (Small 1989a:130).

194. Small has mentioned another option, i.e., different service fees for different types of crops. Though he has added that the difference in water consumption of these crops is mostly too small to have a serious influence on efficiency (Small 1989a:129-130).

195. Bottrall 1981a:12.

196. Moore 1987:26.

197. Duane has generalized these findings to all LDCs (Duane 1986:7).

198. Ibid.

199. Small 1989a:133.

200. Heaver has generalized this to the public sector in all LDCs (Heaver 1982:9).

201. ANAFID 1990.

202. Chambers 1988:127.

203. For the Philippines, see also Wickham and Valera 1976:12.

204. GOAP 1982:xviii. See also Ibid:22,31.

205. See, for Morocco (DFC 1990:II.12); and for Sri Lanka (Nijman 1991; 1992a.)

206. Levine 1985:100.

207. Many irrigation professionals tend to blame the lack of "output" orientation of irrigation agencies to unawareness. Many interviewed engineers were well aware of this, and were well aware of the related active resistance. See also note 102.

208. For example, for Indonesia (IIMI 1989); for Sri Lanka and India (Chambers 1988:129); for Morocco (DFC 1990:II.12).

209. Wade 1982b:180.

210. Burt 1988:37.

211. Amongst others, Wade and Chambers have warned for the risk that such external audits become "part of the system" as follows: "They are, indeed, themselves liable to be part of the system, as instruments of political pressure, and may even make things worse. Who, may it be asked, is vigilant in overseeing Vigilance cells?" (Chambers 1988:193).

212. Moore 1980:6. This term well reflects the weak representation of the national interest by the states of most LDCs.

213. Maass and Anderson 1986:366. Also under colonial rule, this control seems to have been quite different de-facto. See, for example, the following quotation on the British colonial administration in India: "The administrators at the top served the political ends of imperial rule and tried to distance themselves from village politics. The sub-ordinate establishment, on the other hand, was firmly rooted in the political economy and tried to consolidate its position by distributing water based on status, reciprocity, and bribery (Stone 1984)." (Ramamurthy 1989:43).

214. Unfortunately, the slack involved in this limited control is usually ignored by engineers, and the designs of huge main systems usually ignore this organizational reality.

215. Levine 1985:96.

216. A "unit" refers to a (part of a) separate organization, or part of the same organization.

217. Sundar, P.S. Rao and others. For example, P.S.Rao has warned against organizing WUGs in countries with "exploitative social structures" in (Jurriens, Bottrall et al. 1984:19). Gupta has critized the "naive view that farmers can form an association around a commodity like water which will not have conflicts between big and small partners." (ibid), and Khan the notion that the "human skills to co-operate and manage do not come naturally but have to be imparted." (ibid:20).

218. Levine has remarked in this respect that the role of WUGs is determined on the basis of "a priori judgements rather than by analysis of potentials and trade-offs." (Levine 1980:15).

219. Maass and Anderson 1986:366.

220. Wade 1982b:181.

221. Conform Frederiksen 1987:5. It is somewhat ironical to see that the World Bank initially pushed governments to adopt such an interventionist approach toward irrigated agriculture (e.g., De Leeuw 1985:298), while at present they push them to disengage again.

222. Ter Hofstede has quoted a letter of a Dutch consultant, NEDECO admitting that "the proposed management can work only if "we" supervise it permanently...and O&M long termer" (Ter Hofstede and Van Santbrink 1979:191). Even if this may be "the purest form of neo-colonialism" (ibid:192), as Ter Hofstede argued, it seems the only workable mode for a water-management consultant. Though only if the consultant becomes accountable to the water-delivery

performance.

223. See, for example, page 103.

224. Levine 1985:98; Heaver 1982.

CHAPTER 5

Results : Capacity Creation

"The average congressman can re-dedicate the same dam for four or five consecutive elections. First, he dedicates the ground breaking. Then he dedicates the land purchases. Then he comes back and dedicates the flood abutments. And then he dedicates the flagpoles. A congressman's future in many parts of the country, as the saying goes, is written in concrete."[1]

"The problems of professional bias are not limited to economists. Most practitioners are trained and must develop their careers within a particular discipline (engineering, agronomy) and this predisposes evaluators to see problems in sectoral terms . . .The whole tradition of technical assistance reinforces this tendency, since the assumption behind [technical assistance] is technical ignorance, and as soon as the problem is defined in these terms, the prescription of a sector expert follows naturally. The wrong definition of problems through approaches concentrating on sectoral/technical symptoms contributes to the neglect of management root causes."[2]

"Seckler's image of canals rolling up behind as new ones are rolled out in front then becomes a metaphor for the whole development administration."[3]

"When the King says it is midnight at noon, the wise man says behold the moon."[4]

THIS CHAPTER ATTEMPTS to provide an objective perspective in both diagnosis and therapy of the creation processes of irrigation capacity. Apart from providing an innovative perspective on capacity creation, this chapter identifies the related opportunities for improvement.

The first step of the development of a management perspective in this chapter is the definition of the key decisions of the capacity creation (i.e., only for the strategic management, and not for the capacity management as explained in chapter 3 and on page 121). These key decisions are the desired objectives, the feasible objectives and the functional requirements of the investments. They are the basic orientation points of the diagnosis and therapy. This set of key decisions is already different from topics normally studied by most irrigation management professionals.

For each defined key decision, the actual processes of decision making as they tend to occur in the case studies are described and analyzed. No comparative assessment of the levels of sophistication is given as the political nature of this decision making makes a quantitative comparison between different countries less appropriate. Instead, this chapter gives a broad quantitative judgement for the capacity creation based on the four criteria underlying the concept of the levels of sophistication.

The concluding parts of the chapter use these analyses and performance assessments to derive opportunities for performance improvement. Improvements are suggested in an integrated manner in terms of requirements for 1) the decision-making processes (step 3 of Figure 3 in chapter 3); as well as, 2) the management conditions (step 4). Chapter 6 discusses the related management-control decisions (step 5).

Like in chapter 4, the case studies in Sri Lanka, Morocco, Philippines, Sudan, India, and Malaysia are the main basis for the generalized picture. These comparative case studies included interviews with numerous agency staff in these countries and with staff of two donor agencies, the World Bank and the ADB. As the findings of the two in-depth case studies appeared sensitive to some involved parties, this chapter refers more (than chapter 4) to similar findings in the literature or other formal documentation on the performance of investments in irrigation.

WHAT ARE THE KEY DECISIONS FOR CAPACITY CREATION?

Prerequisite for a focus on decision-making processes in this chapter is a very precise and mutually exclusive definition of what key decisions have to be taken for irrigation capacity creation. Capacity creation may involve new construction, rehabilitation and maintenance activities. For simplicity reasons all these activities are called here "capacity creation". This analysis focuses thereby more on investment in construction and rehabilitation than in maintenance, as described in chapter 1. In line with Kampfraath's definitions of management concerns, this group is divided below into two management concerns, the "strategic management" and "capacity management".[5]

Strategic management covers three key decisions. The first is the determination of the the desired objectives for irrigation investments. The second is the matching of these desirable objectives with the resources available for investment, i.e., the decision on the so-called feasible investment objectives. And the third is the determination of the functional requirements for the envisaged irrigation investments. These three are described below.

Desired objectives. An irrigation investment always intends to achieve certain desirabilities. These are defined here as the desirable objectives. This definition of desirable objectives excludes their feasibility as such, which is per definition part of the key decision about the feasible objectives.

Examples of the desirability for an irrigation investment, whether implicitly or explicitly stated, are such objectives as an increased agricultural production, the alleviation of poverty, the reduction of unemployment, the settlement of landless people, the appeasement of political supporters or geopolitically sensitive areas, the saving of foreign exchange through increased exports or reduction of imports, the sustainability of the environment, and the like. These desired objectives evolve from the related objectives of different stakeholders such as the national government, the politicians, the donors, the local community and the beneficiaries.

Feasible objectives. As soon as these desirabilities are matched with the available resources, another key decision comes into the picture, i.e., the decision on the so-called feasible investment objectives. Resources can be of a financial nature, but may refer also to the staffing capacity and capability, or to different physical resources. Examples are such objectives as the area to be commanded (by irrigation water at a certain time), the different crops to be grown, the cropping intensities, the acceptable cultivation risks, and the predicted water-delivery performance.

Prerequisite for the determination of the feasible objectives is the making of certain preliminary assumptions about the future functional requirements for the investments. In irrigation this is sometimes called the feasibility-level design.

Functional requirements. Given the outcome of the decision making on the feasible investment objectives, further specifications of the functional requirements for the investments have to be set. Obvious examples are such straightforward requirements as the required water levels to command certain areas, and the required canals to maintain these water levels. Examples of more performance-related requirements are the required structures to control water flows and levels, the required storages to collect and store water from the catchment, and the required intermediate storages either for the collection of runoff, or the reuse of drainage water, or just an increased responsiveness at those locations. Also the required management capacities of agency staff and water users are part of the functional requirements.

Capacity management is the management concern for the setting of the technical requirements for the investment. The functional requirements are thereby considered as fixed as they are per definition the outcome of the strategic management. Examples of technical infrastructure requirements are the different technical standards to be used such as the densities of engineering materials, the coefficients of expansion and shrinkage, the permissible concrete stresses, the seepage gradients and uplift or protection. Examples of technical staffing requirements are such requirements as the selection criteria and professional-development programs.

Tendering of contracts for construction, rehabilitation, and maintenance is part of this capacity management. And so is the monitoring and adjusting of the actual acquisition of the irrigation capacity.

This study does not discuss the processes of capacity management as it would also require detailed descriptions of the more informal processes of the creation of irrigation capacity. The detailed discussion of, for example, the mechanisms of corruption in construction and maintenance contracts, the political interference and nepotism in the hiring and firing of people are too sensitive to incorporate in this text. Especially, if the text is to remain acceptable and accessible to a wide audience.

Planning-Design-Utilization-Performance Interaction[6]

The previous chapter's observations on the interrelation of capacity utilization and performance are an input for this chapter's analysis of the consideration of performance achievements in investment decisions. The planning and design decisions are thus evaluated here toward their consistency with local management and performance experiences. The analyses of the few existing studies on planning-design-utilization have not integrated the actual decision-making processes. Instead, they usually related to the design and performance only, thereby implicitly assuming certain management practices. Assuming certain utilization practices implies simultaneously assuming certain functionalities of the design. Yet, the latter should be the outcome of the equation.

DESIRED INVESTMENT OBJECTIVES : PLANNING-UTILIZATION INTERACTION

This section gives a generalized picture of the actual decision-making processes in irrigation systems for one of the three basic orientation points of this chapter, being the desired investment objectives.

Political objectives tend to dominate the desired objectives for irrigation investments. Sometimes these objectives are stated, but often they are not. The most relevant perspective for this study is to consider all these influences on investment selection decisions, whether stated or unstated.

Stated Investment Objectives

The following stated objectives were observed in the case studies:

1. An *increase of the national food production* was an explicit objective of irrigation investments in all case studies, both for self-sufficiency in food production as for the production of cash crops. Similarly, Small has found this objective to be underlying irrigation development in many countries.[7]

2. Providing *food and income to subsistence farmers* was an explicit objective in the case studies in the Philippines, Sri Lanka and Sudan. In Morocco, such welfare objectives were explicitly important only for two major irrigation development projects in the poorer regions situated in the South-eastern parts of the Atlas mountains. Also, such poverty alleviation has been reported as major objectives for irrigation development in India and Pakistan during the late 19th and early 20th century.[8]

3. In all case studies, the irrigation investments were complemented with other investments for *regional development* such as infrastructure, rural water supply, facilities for marketing and food processing etc. Often irrigation systems included land settlement. Much of the irrigation development in Sudan, Morocco and the Dry Zone of Sri Lanka were observed to pursue such regional development and land settlement. Similar objectives have been reported as major objectives for the irrigation development in the western USA.[9]

4. In the Sudanese case study, the government in addition pursued *an increase in government revenues* through its control over the agricultural production and its marketing. In several other African countries this is a well-known and explicit objective for irrigation development. Similarly, Small has reported this to be one of the two major objectives of irrigation development in India and Pakistan during the late 19th and early 20th centuries.[10]

5. In all case studies, the donor documents also mentioned the *saving of foreign currency* through import substitution as an important reason for the irrigation development.

6. Another objective of the governments and the international development banks was their desire to make a *"decisive move"* in achieving the above objectives, though this objective was not always that explicit.[11] This objective implied a preference for capital-intensive investments, i.e., large investments in a relative short period.[12]

Unstated Investment Objectives

At least as important as these stated objectives for irrigation investments were the unstated objectives. Though this can be said for most development investments, it appeared to apply even more to irrigation investments given their political visibility and their capital-intensive nature. The following unstated objectives for investment in irrigation were observed in the case studies:

1. *Political and geo-political objectives*. Recipient governments are almost always pursuing political and geo-political objectives with irrigation investments.[13] Also in all case studies such objectives could be observed. Sometimes these were stated, but mostly they were not. For example, in the Sri Lankan case studies the handing out of irrigated land to political supporters was observed to be a dominant objective of irrigation investment. Geo-political motives were observed to be important for the case studies in the Philippine Allah system and the Moroccan Basse Moulouya.

   Many literature references to such objectives exist as well. For example, literature references have demonstrated the frequent geo-political backgrounds for projects in Africa and Asia.[14] Similarly, a recent task force of most western donor governments (to evaluate the effectiveness of aid) has reported that most donor governments tend to pursue either geo-political or their own interests, rather than the purely "altruistic" suggestion implied in the word aid.[15] Apart from these geo-political motivations, several researchers have remarked that investment objectives in irrigation "normally have a political background".[16] Just like politicians in developed countries tend to perceive that dam projects "win votes",[17] they tend to do so in LDCs.

2. *Rent-seeking*. In all case studies, rent-seeking was observed to be a dominating incentive for considering irrigation investments desirable. Apart from personal financial gains, the irrigation agencies as a whole benefitted financially from large irrigation investments. They were observed to benefit either 1) through payments of a regular overhead to the supervising agency; 2) through all sorts of investment-related facilities such as cars, per diems, buildings, and training funds; or, 3) through the reduced necessity for recurrent investments (strengthening again the tendency to defer maintenance). The last two benefits applied to the investments of all observed irrigation agencies, including the semi-private irrigation corporations in Morocco and the Philippines, as none of them had to repay (a part of) the capital costs of the investments. The first benefit was observed for the Philippine National Irrigation Administration (NIA) that earned a 5 per cent overhead on all externally-funded projects. Such overhead gave them an additional interest for investment through projects over recurrent investments from their regular budget.[18] In addition, NIA was observed to benefit from the bank dividend on such funds.[19] Even national governments seem to be rent-seeking if they use the available foreign exchange for irrigation investments for relieve of balance of payments problems.[20]

In all case studies, the irrigation agency appeared a comparatively powerful agency. Researchers have also remarked that the lobbies of irrigation agencies worldwide were traditionally very powerful and effective in securing projects.[21]

Though references to personal financial gains are sensitive, some examples in the international literature generalizing about the existence of such incentives in the irrigation subsector are the following:

> "Because water supply decisions are largely made in the political arena rather than in the market place, there is great incentive for special-interest groups to obscure the real issues involved in government-subsidized water projects and to exploit public romanticism for "making the desert bloom even as the rose", thus obtaining public support for their own financial gain."[22]

> "...in a political environment where politicians are interested less in long-term development goals than in the disbursement of short-term material benefits to those who support them, the consistent political commitment to irrigation investment . . .needs explaining . . .the answer has something to do with the way in which irrigation investment does provide an abundant stream of short-term material benefits able to be profited from by politicians and state officials."[23]

The high subsidies on irrigation investment, and related horse-trading, have also been reported to have inevitably bred corruption in rich countries like the USA.[24] In LDCs, the checks and balances on corruption are per definition much weaker--or themselves incentives for corruption--, and organized corruption has thus more potential.[25]

Comparatively little documented is the size of this skimming of irrigation investments for personal financial gain. The few figures available and observations for this study suggested percentages between 30 and 70 per cent.[26]

3. *Engineering prestige*. Another observed objective underlying certain irrigation investments was the prestige of the irrigation agency to build a huge dam, canal or system. For example, in the Sri Lankan case studies such objectives appeared important.

Besides the above, the following unstated investment objectives were observed to be relevant for development investments in general:

4. *Policy reform*. Increased influence and leverage of donor organizations on the recipient organization and government to adapt better policies were observed to be important objectives of any development investment for the international development banks. References and internal documents of development banks have remarked this as well.[27] To further increase such influence (or leverage), the international development banks have introduced such funding techniques as the "carrot and stick" mechanisms in their sector and subsector loans. The latter provided the government with more freedom in resource allocation in return for the simultaneous introduction of certain policies.

5. *Fund-channeling from rich to poor countries*.[28] Fund-channeling from rich to poor countries was observed to be an important objective of the international development banks, and of their investments. In combination with all above reasons, this fund-channeling function of donors led often to supply-driven investment decisions.

   Supply-driven investment selection, or a bias for investment "quantity", can easily lead to, and was observed, to conflict with the "quality" of the investment decisions. As quality and quantity are important concepts in this chapter they are elaborated upon here.

   "Quality" is used in this text as an image for the quality of the investment decisions, both for the substantive and managerial quality of the decision. A higher quality of the investment decision means that it envisages a realistic level of the water-delivery performance of the agency staff, that it envisages a realistic level of maintenance, that it envisages a realistic level of service fee collection, and that it is likely to be functional during its lifetime.

   The quality of the investment decision is not the same as its performance. The performance of capacity creation decisions are the effectiveness and efficiency of taking decisions about the feasible objectives or the design as such. The cost-effectiveness and cost-efficiency of the investments are not part of the performance of the capacity creation decisions, but are part of its quality. The quality of the investment decision has a direct influence on the performance of the capacity utilization through its influence on the capital and recurrent costs. This image of quality is used as the opposite of "quantity" that is often used as the image for the fund-channeling function of the donors of development aid.

   Also an Expert Group on the evaluation of the effectiveness of aid on behalf of the Development Assistance Committee (i.e., the Joint Ministerial

Committee of the Board of Governors of the World Bank and the IMF) has identified in 1984 the bias for investment quantity as a serious threat to the quality of investment decisions.[29] And two World Bank documents have admitted, though somewhat implicit, the World Bank's bias for quantity in the early 1970s, and the related risks for quality of investment decisions, as follows:

"For the Bank, [1968-1980] was a period of ambitious growth in lending, driven by a humanitarian concern with poverty alleviation . . .It was perhaps inevitable, for both borrowers and the Bank, that many of these outcomes would be difficult to predict and plan for."[30]

"...the very range, nature and objectives of Bank lending in the 1970s raised the risk of failure".[31]

Irrigation investments seemed thereby a privileged solution for the international development banks. Several interviewees of national governments and donors suggested that a lack of alternative opportunities for large-scale, capital-intensive investment in many LDCs cause the supply-driven investments in development to turn often to irrigation. Irrigation lends itself well for capital-intensive investment either as large-scale new construction or rehabilitation projects, or as packages of small-scale systems in a short period of time. Some researchers have suggested that the professional backgrounds of important staff in donor organizations also contributed to irrigation as a "privileged solution" for development.[32]

The Observed Management Processes

Decision taking on the desirable investment objectives was often observed to be done single-handedly by national politicians. Usually, donor staff in consultation with consultants and agency staff prepared such decisions. The preparation of such decisions usually left little time and room for manoeuvre for participatory processes with other interest groups. Moris and Bottrall have found a similar picture of decision taking.[33]

Politicians often determined such politically relevant aspects as the site identification and the selection of beneficiaries. The political pressure thereby caused the professional guidance sometimes to become ineffective or rather one-sided. This was observed, for example, in the Sri Lankan case studies for the selection of site and beneficiaries. There, the determination of the dam site was based on an engineering rationale, against the interest of both local and national community. Also Moris has reported such one-dimensional biases for the site selection for Kenya's Bura scheme as follows: If professional guidance for site identification was available, it was often based on "the assumption that a site that was attractive from an engineering standpoint was the *main* requisite for a successful project design. As the Bura case illustrates, knowing the 'solution' in advance made it unnecessary to learn about local soil conditions, existing resource utilization, optimal crop combinations, or farmer's interests. The commitment to irrigation occurred before local costs and impacts could be evaluated, and continues despite adverse experience."[34]

The acquisition of external funding was observed to be the prevalent political and agency priority. It dominated the other desired objectives, other than those of political importance. As a result of this priority for external funding, the donor agency had, in principle, and in practice, a large influence on the determination of the desirability of the remainder of investment objectives. Thus, the desirability of such investment objectives as the project size and the performance of the water delivery and agricultural production was largely at the discretion of the donor staff or consultant in all case studies.

As a result of this priority for funding, also the interests of farmers and other local interests, were unlikely, and were observed not, to be adequately represented in the decision making on the desirable investment objectives.[35] Often the desirability from the farmers' perspective was considered equal to the maximum funding level as the funds were perceived as "handouts" to localized voters. Bottrall has generalized this latter phenomenon for LDCs, while Laycock has described such attitudes for irrigation investment in the USA.[36]

Uncoordinated watershed development resulting from political dominance of this decision taking was observed in Morocco and Sri Lanka. A politically relevant location for a new upstream reservoir resulted thereby in a reduction of the water supply to an existing downstream reservoir. Obviously, these were not very desirable investments from a local perspective. Yet, most interviewees considered such political priorities as absolute, not withstanding possible institutions for watershed planning.

In combination with the fore mentioned supply-driven availability of financial resources for irrigation investment, such politically dominated processes and related attitudes worked against less capital-intensive, more effective investments in, for example, water management and conservation. This applied to all case studies. Sheridan has described similar processes and consequences for the USA, while Repetto and Moore have generalized them for LDCs.[37]

Though the major gap in this decision making seemed the observed absence of an *explicit* definition of the desired performance levels for the new investments. The widespread and long-established experiences with ineffective capacity utilization in irrigation made this absence even more amazing. Even if donors, government or consultants were aware of the unlikeliness of the assumed performance improvements for a specific system or project, they were observed to ignore them in the investment considerations. Assumed performance targets of irrigation investments were always kept implicit. Bottrall has found this as well.[38]

The likely commitment of such stakeholders as the national politicians, government and agencies to such implicitly defined performance targets is almost nihil. The more so given the lack of incentives to achieve them, while ample incentives were observed to relate to the acquisition of new investments (in an environment with abundant availability of financial resources for irrigation investment, as described before). In all case studies, the commitment of staff of the national planning, irrigation ministry and irrigation agency toward performance improvement was observed to be almost absent. The widespread underutilization of irrigation capacities in the past does not seem to have led to a stronger conditionality toward the performance of sequential investments. The underlying reason was described above.

The donor-driven decision-making processes sometimes led to cases where the desirabilities of donor and recipient were conflicting. And it sometimes led to investments that the involved national stakeholders such as the government or the agency considered undesirable. A reputed example is the repetitive investments in the rehabilitation of earlier disappointing investments with cycles of 15 year or less (vide also Seckler's quotation at the beginning of the chapter). Such iterative rehabilitations often served merely the cover up of a disappointing economic viability of the preceding investments. The related internal donor justification processes thereby were observed to have a tendency of creating their own momentum of investment desirability. This was observed in both Sri Lankan case studies. Frederiksen has made generalizing statements in this respect.[39]

INVESTMENT FEASIBILITY ASSESSMENTS : PLANNING-UTILIZATION INTERACTION

This section provides an insight in the decision making on the chapter's second basic orientation point, the feasible objectives for investments in the irrigation subsector. Such objectives tend to be determined during the feasibility and appraisal phases of the project cycle of investment decision making. Most aid donors and recipients use this project cycle.

Feasibility assessment relates to the *economic* feasibility and the national investment opportunities. Besides, it relates to the *technical*, *managerial* and *political* feasibilities of the underlying assumptions. Examples of underlying assumptions are the parameters of the investment's physical performance such as the available water resources, the irrigation requirements, the size of the command area, the water-delivery concept, and the cropping patterns, calendars, intensities and yields. Other important underlying assumptions are the recurrent costs and the related life span of the investments, the cost recovery and the implementation schedule. This section analyzes all these aspects of the feasibility assessment.

Available Water Resources

The available water resources are a basic input for the feasibility assessment of an irrigation investment. They are also a major factor of its technical feasibility.

Yet, irrigation agencies often appeared to treat the hydrological data for feasibility assessments rather nonchalant. Partly, such assessment appeared based on inadequate data due to the hurry to get loans processed. In some other cases, their assessment was biased toward project feasibility. The latter was observed in the Sri Lankan and in one Philippine case. The size of the overestimation in one Sri Lankan case was between 40 and 60 per cent.[40]

Others have observed the overestimation of the available water resources as well, and it seems therefore systematic. For example, Chambers has suggested its endemicness as follows: "Less water entering systems or captured by them than planned is probably common."[41] Also several evaluation reports or publications have mentioned individual examples of disastrous overestimation--though seldom of underestimation. A committee of the government of Andhra Pradesh (GOAP) has reported overestimations of 53 per cent in South India.[42] An impact survey by the Asian Development Bank (ADB) in nine Philippine irrigation systems has found that in six systems the river flows appeared less than expected due to inadequate and/or unreliable hydrological data during project preparation.[43] And the following comment of a World Bank division on the conclusions of four impact studies in Philippines and Thailand has generalized the insufficiency of data in its feasibility assessments, and provides also an impression of the related pressures:

"The 30% shortfall between planned vs. actual river discharge is likely the consequence of inadequate data. The Bank/borrower has often pushed projects (and still does) before the basic resources were adequately known. And hydrological measurements with 15 to 25% error, as well as, far too short periods for collecting hydrological records have been accepted in the rush to begin work . . .The cost to Bank projects of an insufficient data base is a matter that should be flagged by [the Operations Evaluation Department]. It's ignored repeatedly by the Bank."[44]

Despite the frequent overestimations, the studied agencies, governments and donors were not observed to set criteria for the required dependability of the water availability for certain regions or countries. These criteria were left to the involved specialists. Also, if a water balance was made, the related likely number of crop failures was seldom stated explicitly.

Overall, the assessment of available water resources tended to be done in an unprofessional and nonchalant manner. Yet, major mistakes in the hydrological data had serious and direct implications for an investment's feasibility. They resulted in water shortages, or no water at all for parts of the system, and the related wasted investments.

Some interviewed Sri Lankan and Philippine engineers remarked that for certain projects the hydrological data were manipulated consciously and considerably to fit project feasibility. Also Chambers has referred to the occurrence of "deliberate falsification to overestimate water supplies", and has quoted two Indian examples described by Wade. Also in Wade's examples pushing politicians had prompted the overestimations.[45] Such incidents demonstrate again the strength of the pressures on the involved decision makers to comply with the priorities of the agency, the politicians and the donor (vide, for example, the above quotation of the World Bank) to realize the pursued project funding.

Physical Performance Assumptions in Feasibility Assessments

Several assumptions in feasibility assessments relate to the expected levels of service delivery, or the water-delivery performance. Examples are the feasible levels and magnitude of the irrigation requirements, the command area, the cropping intensities, and the cropping pattern and yields. These are crucial assumptions for investment feasibility as they are core determinants of the investments' output and benefits.

Level of service delivery, irrigation requirements and efficiency. Sequential feasibility and appraisal assessments in 1977, 1977 and 1986 in Sri Lanka's Kirindi Oya system were observed to show departures from local performance achievements of 86 per cent, 9 per cent and 56 per cent respectively. No justifications were given in 1977 for the probability that an 86 per cent performance improvement would be reached in the planned system. No reference to, neither justification for, the sequential variations were given in the appraisal reports as well. Observations in the other Sri Lankan and one Philippine case study were similar. (In the other case studies in the Philippines, Morocco and Sudan, no such detailed observations were done.) Thus, these observations suggested a systematic, unjustified overoptimism of the assumptions of the water-delivery performance. The level of assumed improvements in feasibility and appraisal reports were thereby kept implicit.

Other comparative studies have shown similar overoptimistic assumptions. Most relevant generalizations are the comparative studies of project performance audit reports (PPAR), and the impact studies of irrigation investments. During the last decade, several such studies were undertaken. Some of those that included a comparison of the planned and achieved irrigation requirements and efficiencies are cited hereafter.

A proper understanding of the figures in this chapter though requires a short qualification of "achieved". In a project audit report "achieved" refers to either the moment of project completion, or one or two years after it. Yet, in a project impact study, "achieved" relates to at least five years after project completion. Of course, the figures of the latter type of studies are more relevant for evaluation purposes.

Comparative World Bank *audit studies* in a number of South Indian systems have found systematic overestimations of water efficiencies, and thus of investment benefits, of 50 per cent to 100 per cent.[46] An evaluation study of the US Department of Agriculture in nine major systems (i.e., new irrigation projects in Asia, Africa and Latin America), has found shortfalls in the actual irrigated area with an average of 33 per cent.[47] Similarly, the Commission for Irrigation Utilisation of the Government of Andhra Pradesh (GOAP), India, has found in 11 studied systems underestimations of the actual requirements of between 19 per cent and 83 per cent.[48]

In all case studies, peak demand was observed to be underestimated. Others have observed this as well. A World Bank staff member, for example, has remarked on South Indian irrigation that "the duties adopted . . .have not only been optimistic but have tended to reflect average water needs rather than peak requirements ("the trap of averages")".[49] Also, the Study Team of the Consultative Group of International Agricultural Research (CGIAR)--investigating in 1982 the need for an international institute specialized in irrigation management--, has generalized this as follows: "Canals are often of inadequate capacity in relation to peak demand."[50]

The first ADB *impact survey* of irrigation investments was in ten major and five communal Philippine irrigation systems. It has shown actual irrigation efficiencies of around 35 per cent against planned efficiencies of 65 per cent, or a difference of almost 50 per cent. Also, an average shortfall of the irrigation coverage of 40 per cent was found in the same systems,[51] while "in all cases it was concluded that appraisal estimates of project-induced production were overoptimistic".[52]

The next ADB impact study in 1990 on 12 other projects in different countries has even acknowledged the systematically theoretical nature of this feasibility assessment: "In the past, design assumptions, including conveyance efficiencies, were seldom based on actual assessments of local capacities to operate the systems, and were generally too optimistic."[53]

The only similar impact figures compiled by the World Bank so far, have found that actual water efficiencies in nine studied systems in Mexico, Morocco, Sudan, Colombia, Philippines and Thailand were on average 69 per cent lower than those estimated at appraisal.[54] The reports on Morocco and Mexico have generalized "a tendency in the Bank to make over-optimistic projections as regards water use efficiency".[55]

Cropping patterns, calendars, intensities and yields. In the Sri Lankan case studies, the cropping patterns were based on the requirements of the economic feasibility, rather than on their actual feasibility, and even after such unfeasibility was proven. (In the other case studies, the cropping patterns were not studied.) Assumptions about cropping intensities of an unrealistic 200 per cent for Sri Lanka's Uda Walawe system implied improvements of 64 per cent in 1979 and 38 per cent in 1984. Likely improvement through the investments appeared less than 20 per cent. For the Kirindi Oya system the assumed improvements were of a similar magnitude (i.e., up to 200 per cent) compared to the average achievements. Also for these assumptions the level of assumed improvements in feasibility and appraisal reports were kept implicit. No related justifications could be observed.

The following quotations from three paragraphs of the first ADB impact study of irrigation investments give an impression of the reliability of such assessments:

> "The [Project Evaluation Missions] concluded in all cases that appraisal targets of production were overoptimistic. "With project" estimates were lowered by 8 . . .and 17 percent . . ., while "without project" estimates were raised by 40 per cent and 44 per cent . . .apparently [Project Evaluation Missions] were quite optimistic about the future since . . .less than one-half of the revised incremental production targets had at that time actually been achieved . . .The sharp upward revision of "without project" production targets was . . .intended to correct a consistent downward bias in appraisal estimates of yield per ha without the project."[56]

Comparative studies have shown the assumptions on cropping intensities to be just as heroic as those of the irrigation requirements and efficiencies. For example, the fore mentioned long term *impact studies* of the World Bank have made the following observations: "The cropping intensity was lower than projected at completion in 18 projects (about 85 per cent) . . .the average cropping intensity of the sample was 106% at the time of impact evaluation, compared with 135% and 146% expected respectively at the time of completion and appraisal."[57] Similarly, an impact evaluation by the European Economic Community of 11 African projects has found that all, except one, assumed at appraisal a cropping intensity of 200 per cent, while the average achieved by ten of them was only 110 per cent.[58] Again, a World Bank report on the recent impact evaluations has blamed this tendency of the operations' divisions of the donors to overestimate yields and cropping intensities at appraisal, and even at project completion, for the disappointing achievements.[59]

Several studies have suggested even a neutral or negative impact of irrigation capacity creation on cropping intensities, though they were not quantified. For example, Diemer has remarked that, for example, the Senegalese government by constructing infrastructure additional to the existing village irrigation, it attained, in practice, the reverse result, i.e., a reduction in the cropping intensity compared to the pre-construction situation.[60] Similarly, unpublished results of the ADB impact study of 1986 have also found unchanged and reduced cropping intensities in several studied systems.[61] Also in India, cropping intensities have been said to remain unchanged or to decrease sometimes after the creation of the irrigation "potential".[62]

On the other hand, it is unlikely that the underutilization is really that large. Though, it remains difficult to assess due to the observed tendency to manipulate virtually all assessments of the benefits "with" and "without" the project.

Another, more technical deficiency observed in this feasibility assessment was the omittance of the probabilities of the available water resources in the assumed cropping intensities. For example, an 80 per cent probable water resource obviously requires a diminution of the likely cropping intensity with 20 per cent, but this link was not made in the Sri Lankan case studies for example.

Also cropping patterns and yields were observed to be manipulated in the Sri Lankan case studies to make the projects economically feasible. The following three quotations from the report of a government commission in India suggest that overestimation through manipulation of cropping patterns is even easier than for water efficiencies:

> "The Irrigation Department has been planning irrigation projects on the basis of a designed cropping pattern to give a favorable benefit cost ratio."[63]

> "The Commission has not been able to investigate the rationale behind some of the rules issued on localisation . . .No one examined by the Commission has been able to throw any light on the rationale of all these decisions or for the deviations from these principles in actual implementation. All these rules and actions appear to be highly arbitrary and inequitable and have resulted in large scale indiscipline amongst the farmers who though within reach of the water at upper reaches were denied any share in the water as the localisation policy preferred the tail-enders to the total exclusion of the top enders in some cases. The assumed cropping pattern adopted only to achieve a favorable benefit cost ration was so unrealistic that the farmers did not adopt it."[64]

> "The "design cropping pattern" of the Irrigation Department serves only to determine the water demand for designing the capacity of the irrigation canals, and estimating the benefits from irrigation. "It bears no relationship to actual cropping patterns adopted by the farmers from time to time according to various constraints and compulsions . . .the Agriculture Department has not been able to perform its legitimate role in the development of irrigated agriculture and the Irrigation Engineers continue to function in the same manner as they used to, before the Department of Agriculture was created."[65]

Carruthers has indicated that cropping patterns are often fixed at an early stage of the project preparation as the input for many calculations. The required iterative planning is usually not done, according to him.[66]

The above Indian government commission has also observed that the farmer that seemed to them "the best judge to decide which crops are suited for the soils in his holding", was typically "not at all consulted in the matter of the cropping pattern".[67] Tiffen has observed that although this cropping pattern has a major influence on the farmers' income, feasibility assessment procedures of the World Bank and others do usually not assess the farmer's likely income.[68] Or, they consider it subordinate to the income impact for the national economy.[69]

The relative impact of the manipulation of cropping patterns on the total underutilization is more difficult to estimate in a generalized way than for the irrigation efficiencies, intensities and yields. In one case, it has been calculated for 11 projects in South India to have caused between 10 per cent to 55 per cent of the total underutilization.[70]

The mechanics of the over-optimistic performance assumptions. All the above comparative figures and facts elucidate that feasibility assessors were generally not at risk for overoptimistic assumptions. On the contrary, they seemed often encouraged to make them. The mechanics of this process are described hereafter.

The importance attributed to theoretical concepts about crop water requirements and related "possible" irrigation efficiencies was observed to facilitate partly the above systematic over-optimism about feasible performance targets. The mentioned Indian government commission has observed this as well.[71] Consequently, these concepts have made irrigation efficiency a controversial and confusing issue.

The theoretical concepts on crop water requirements were developed in the early 1970s. Since then they were much researched upon and applied for project planning and design.[72] Levine has published as early as 1977 the following criticisms on the neglect of the "human factor" in these conceptual definitions of irrigation requirements and efficiency:

"(1) Our knowledge of the interrelationships between water and plant growth far exceeds our knowledge of the inter-relations between water and the human element in delivery and utilisation: in other words, irrigation engineers face the same social problems, as say, veterinary surgeons.

(2) The efficiency concepts used in irrigation system design tend to understress the human component as a factor in water use crop production.

(3) Irrigation systems, on the one hand, and the farmers they serve, on the other, have criteria of optimal efficiencies of water use which may not coincide. When they are far apart there is friction between the system and the farmers and/or between the farmers.

(4) Within the resources available to the farmers and to the system, the operational optima for both parties can be brought closer together by effective liaison, e.g. feedback and response mechanisms.

(5) As a result of (1) to (4) above, it is usually better for the irrigation engineer to 'recognise' probabilities initially and strive, through reasonably acceptable change, towards possibilities."[73]

Many others have made similar remarks about the theoretical formulae since that time.[74] Yet, despite these efforts, efficiency estimates during planning and design continued to rely mainly on theoretical formulae rather than on Levine's recommended no-nonsense "probabilities" and "possibilities".

This persistent use of theoretical efficiencies, against the odds, was observed to be less a matter of coincidence, than of complicity of the different involved actors. The frequent references to the over-optimistic nature of the assumptions already suggest this. "Over-optimistic" implies a tendency to be more optimistic than justified. Some interviewed professionals in Sri Lanka and the Philippines confirmed their awareness during the 1960s and 1970s that the new scientific estimates of irrigation requirements and water efficiencies were much lower than the traditional gross estimates, though the related modern design concepts would not necessarily lead to such maximum efficiency. More recently, a senior official of Sri Lanka's Irrigation Department has remarked during an IIMI seminar on the Kirindi Oya case study that the "major reason we do not measure actual seepage and percolation values is political; not one project would be feasible."[75] Some interviewed engineers and donor staff in the other case studies voiced similar arguments. And almost all interviewed donor staff acknowledged off-the-record the hypothetical value of the performance assumptions.

Explicit references to this complicity of decision makers are few. An exception is Heaver's description of the decision-making processes up to Cabinet level for Sri Lanka's Mahaweli project.[76] The Commission for Irrigation Underutilization in Andhra Pradesh, India, has been very explicit in, for example, the reference of page 131, as well as in the following:

"At present the area to be irrigated is being decided on the basis of a rough assessment of the proportion of the black soils and red soils in the project command area . . .The proportion of wet and [irrigated dry] is being decided on an ad hoc basis, keeping in view broadly the localisation pattern in the earlier projects. This proportion undergoes changes in an arbitrary manner to achieve the desired benefit cost ratio for the schemes."[77]

Yet, implicit references are almost as many as the papers on irrigation underutilization. Also the small number of impact evaluations done until the mid-1980s (i.e., despite the widespread disappointing utilization of irrigation capacities) seem to demonstrate more than pure coincidence.[78]

The persistent theoretical assessment was observed to have a major impact. The justification of a high physical performance and high investments in any system was observed to be a typical consequence of this persistent use of the theoretical assessment of project benefits. This appeared possible for the national agency, donor staff and consultants even for a system like, for example, Uda Walawe, that was nationally, and even internationally[79], reputed for its weak management. There, although the basic cause for failure of an earlier investment was explicitly recognized as weak management, the government, donor and consultants could respond with a purely physical rehabilitation to pursue the original water efficiency targets.[80] Such reasoning seems possible up to the present.

Another typical consequence of the theoretical assessments was that recipient governments and agencies obviously have never felt any commitment to achieve performance estimates that were set in such a supply-driven mode. The following quotation of a senior staff member of the World Bank reflects this:

> "A recent review of 30 audits by the Bank's Operation Evaluation Department revealed that most project agencies were not prepared to undertake system operation after completion of construction . . .Some project analyses have indicated that more attention to O&M could easily add at least 10 per cent to the amount of land capable of being irrigated with existing systems."[81]

The earlier quoted government commission on Andhra Pradesh, India has made similar statements.[82]

Feasible Maintenance and Related Life Span of Investments

The sufficient availability of maintenance funds is the key assumption for the justification of a certain feasible life span of irrigation investments. The availability of sufficient funds for maintenance was observed to be problematic in all case studies (like it is for almost all public sectors in most LDCs). Despite this, the observed donors typically assumed a feasible life span of 50 years for new construction and of 30 years for a rehabilitation. An over-optimistic life span would increase the prospects for an investment's economic feasibility, though its influence is minor compared to the influence of the other factors discussed in this chapter.

Yet, in practice major rehabilitation of the downstream development of many irrigation systems is often necessary approximately every 15 years. Some recognition of the highly unrealistic nature of the assumed levels of maintenance funding has recently gained influence within some donor organizations like the ADB.[83]

The typical approach of appraisal missions to circumvent this questionable assumption seemed the explicit discharging of the related responsibility[84] to the national government in the so-called loan covenants on O&M budgets and cost recovery. The interviewed donor staff and government officials tended to designate these loan covenants as a "ritual" justification as both sides were well aware that many of these covenants would not be complied with for all sorts of reasons (see also the next section). Reviews of the World Bank and ADB of the compliance with such covenant have observed similar attitudes.[85]

The fore mentioned problematic nature of the availability of maintenance funding as such was observed to have three reasons. First, the recurrent budget problems of the responsible governments in general were an important reason. Secondly, it was due to the government's incapability to ensure that the few available money was really, at least partly, spent on maintenance. Howell has argued similarly, and so did a discussion during an IIMI/World Bank seminar.[86] And thirdly, the available project- or sector-based funding for rehabilitation and maintenance also encouraged it. Also this argument has surfaced during the IIMI/World Bank seminar.[87]

The feeling of development professionals that "Maintenance is commonly deficient in part because engineers, civil servants, and donors find investing in new schemes more attractive."[88] has in recent years led to more project-based and sector funding for maintenance. This seems a simplified and short-term solution as it solves the first problem, but not the second; the lack of control on effective utilization of the recurrent budget is likely to remain a dominating factor. Thus, the present sector loans, essentially meant to solve the first reason in the short-term, do not tackle the second reason, and are likely to worsen the first point in the long-term.

Several senior officials of the World Bank have argued in the past that the lousy construction quality--an implicit reference to corruption--is the major determinant for the deficient maintenance.[89] Though construction quality was often low, a good construction quality is unlikely to replace fully the need for maintenance funds. In Sri Lanka and South India, where the actual available maintenance funds were observed to be not much more than the money for the salaries of the operational staff, an improved construction quality is unlikely to solve all maintenance deficiencies.[90] Besides, as follows from the third reason above, the same corruption and non-commitment causing low construction quality is likely to cause low maintenance quality as well, if the money were available.

Feasible Cost Recovery from Beneficiaries

More than any of the other investment-related issues, the issue of cost recovery in irrigation was observed to be extremely complex and a subject of controversy within the World Bank, and between the studied development banks and its borrowers. A World Bank review of its experiences with cost recovery has remarked this as well.[91] The following citation from this review confirms this study's observations in all case studies, except the Moroccan, of the related disappointing experiences:

> "Overall, the cost recovery record in irrigation projects has not been good. Frequently, the Bank's requirements as expressed in loan covenants, particularly with respect to recovery of investment costs, have been so vague that compliance or non-compliance is difficult to determine. In at least two-thirds of the projects reviewed the covenant requiring that cost recovery satisfy O&M funding has not been complied with. The proportion of O&M costs recovered was frequently between 15% and 45%. In addition, there were very few cases where capital costs were recovered."[92]

Similarly, Repetto has stated that the average cost recovery in irrigation projects in a sample of countries in which the World Bank invests in irrigation was only 7 per cent of project costs. (He also remarked that usually the treasuries collected them rather than the managing agencies.)[93]

In contrast to such low figures, the donors and recipient governments were observed to have spent considerably more efforts in enforcement of the cost recovery of irrigation investments and recurrent costs (i.e., O&M funds) through service fees than in any other quality-related aspect of the decision making about the capacity creation. The origins and intentions for this seem to have been the implicit assumption that irrigation agencies would thus be provoked to operate as public utilities.[94] Until a recent policy change in the World Bank, this cost recovery issue had apparently become over the years an ideological issue at Board level[95] in the World Bank. This caused the World Bank's continuation of the enforcement of cost recovery and its comparatively large efforts to make it more successful,[96] despite the widespread skepticism of its feasibility and functionality among staff of the World Bank and the recipient governments.

Such skepticism was observed to relate to political, managerial and even technical constraints to cost recovery. Technically, service fees are only useful for performance improvement if the water delivery can be measured volumetrically. This was only observed in the Moroccan case studies. Moore, Levine and Wickham have generalized its absence for Asia, the continent with by far the largest area under irrigation.[97] Managerially, the usefulness of service fees for "efficiency" purposes seem to depend also to a large extent on the degree of the financial independence of the managing agency; as long as the budgetary allocation by the government remains important, the incentives to make serious efforts for improved service delivery seem limited. Increased financial independence, in its turn, appeared controversial in Morocco, Philippines and Sudan, and beyond imagination in the Sri Lankan case studies. In all case studies, governments and politicians seemed to prefer a high level of central control. Duane has generalized this for all LDCs.[98]

Most important source of resistance to the introduction of service fees was observed to be political, especially in the Asian case studies. This political resistance appeared to have such different backgrounds as the government's welfare policies (e.g., in India and Sri Lanka), the strategic subsidizing of the local food production (e.g., in Malaysia), the government's indirect or direct tax income through levies on, for example, land, crops and fertilizers (e.g., in the Philippines and Indonesia). Despite such an explicit difference in priorities, the international development banks "continued to invoke in its legal documents the need for stronger recovery efforts."[99]

Most interviewed staff of donors and governments remarked the symbolic interaction in this respect. Similarly, the recent reviews by the World Bank and the ADB of the compliance with such loan covenants have remarked the inadequacy of the dialogues between government officials and bank staff and the whole preparation of the formulation of loan covenants. Thus no mutual agreements evolved, according to the reviews. So, despite the loan covenants, the reviews have found the prevalence of a lack of abiding commitment of the recipient governments toward cost recovery.[100]

A demonstration of the little serious nature of such dialogues is the problems faced by the fore mentioned World Bank review to figure out at all if governments had complied with loan covenants or not. The following citation reflects this:

> "Most of the covenants on investment cost recovery were quite general, with nearly half of them containing wording pertaining to recovery levels such as "as much as is practicable" or "a reasonable portion of capital costs". Some merely stated that a study should be undertaken to determine what should be done. There were very few cases where significant capital costs was recovered. Nonetheless, in view of the wording of covenants, it is not possible to state categorically that these covenants were violated."[101]

Not amazingly, this World Bank review of compliance in 48 irrigation systems had to confirm "the conventional view that covenants are seldom enforced, often relaxed and sometimes ignored."[102]

The cost recovery issue shows a centralized, directive type of decision making in the major policy-making development institution, the World Bank, without an accountability for the related performance consequences. It shows the substantive influence of a dogmatic perception of the Board of Governors of the World Bank on actual investment decisions and policies in recipient countries, even against widespread negative experiences and skepticism of its own staff. The observed consequences of such centralized, directive decision making were a waste of efforts by its own staff and of the recipient governments to implement policies with little relevance for project performance. Even worse, it seems to have diverted for a long time the attention and efforts from the real performance-related issues. Duane, a senior staff member of the World Bank, has made the following, similar observations:

> "...such a notion--that irrigation finance can mimic the public utility model and obtain some of its benefits without the necessary institutional reform--has had three consequences. First, it has delayed the proper (Bank) recognition and enforcement of stronger, more direct covenants that Borrowers should finance O&M properly, without regard to sources of revenue. Second, it has obscured the need to interpret and apply Bank policy on overall recovery (concerning O&M and capital costs) according to the varying motives upon which Borrowers base both their support of public sector irrigation and their recovery of associated costs. And third, it has fostered a myth that inadequate O&M is somehow the fault of inadequate cost recovery. Given the institutional arrangements that are typical for public irrigation, poor O&M reflects simply the low priority accorded by most Governments and their irrigation agencies to O&M relative to capital expenditures for new projects."[103]

Only after approximately two decades of pushing cost recovery, the World Bank has abandoned it after a process of gradual policy changes. Only in the mid-1980s, the World Bank's focus in cost recovery made a first shift away from the perceived functionality for the economy of the resource allocation. It was a shift toward cost recovery to obtain maintenance funds.[104] More recently, the World Bank has decided finally that service charges would only be necessary if wanted by the recipient government itself. To make the interaction with governments on policy issues like the cost recovery more effective, the donors increasingly try to have so-called policy dialogues that are in principle less tied to a specific project or loan.[105]

Fortunately, the persistent and dogmatic pressure from top levels of a major development institution of an issue like cost recovery has ultimately moderated itself toward arguments from real-life. Yet, the cost recovery issue has shown the very centralized nature of such development bureaucracies, as well as the big time gap between feedback on the quality of the interventions and some related accountability. Such type of directive operation has important drawbacks for developing far-away countries, and seems to bring along high risks of retarding local processes and opportunities.

Feasible Investment Cost and Implementation Schedule

Assumptions about the feasible investment cost and implementation schedule have a major influence on an investment's economic feasibility.

The observed discrepancy between planned and actual performances was also observed for the implementation of the investment projects and the related costs. In all case studies, considerable time and cost overruns were observed. In the observed Sri Lankan Kirindi Oya system the cost and time overruns were as high as 104 and 100 per cent respectively. Two important publications on irrigation and development respectively have made the following generalizations that delays of project implementation and cost overruns are more rule than exception:

> "Irrigation projects probably suffer neither more or less from problems in construction phase than other civil engineering problems. Evaluations [including non-official World Bank and US AID confidential reviews] reveal that almost all irrigation projects suffer from delays and cost overruns. The regularity of both occurrences makes the coincidence of planning forecasts and actual construction duration or cost a remarkable matter for congratulations, even astonishment. Perhaps it is time to review the assumptions on these issues in project appraisals. It is estimated that realistic cost and time assumptions might take 5-10% off the internal rate of return to projects."[106]

> "Three near-universal aspects of the execution of irrigation development are time delays, cost overruns, and under-funding of key components . . .An obvious inference from this experience is that at the appraisal stage planners should be much less sanguine in their assumptions about implementation and the immediate impact on production, especially where projects are large and complex."[107]

Carruthers thus suggested these completion delays and cost overruns to apply to almost all development projects, and not just to irrigation. Project audit data of two major donors compiled since then, and given below, support his observation.

In the period 1974-1988, 88 percent of all 1,627 evaluated World Bank projects were found to have an average *time overrun* of 69 per cent.[108] Implementation delays for all 313 evaluated ADB projects between 1973 and 1989 were observed to average 72.5 per cent.[109]

Similarly, in the period 1974-1988, 63 per cent of all 1,778 evaluated World Bank projects were found to average a *cost overrun* of 37 per cent, while the remainder had an average cost underrun of 18 per cent.[110] An Indian government committee has investigated 64 dam projects and has found average cost overruns of 108 per cent.[111] Average cost overruns of all 313 evaluated ADB projects during the period 1973-1987 were found to average 41 per cent, though since then average cost overruns have decreased considerably to averages of 0.6 per cent and minus 18 per cent for 1988 and 1989 respectively.[112] (The latter reduction is interesting, and is discussed hereafter.)

Despite such high time and cost overruns, all observed donor appraisal reports typically assumed a maximum of one year delay in project implementation, and 10 per cent cost overrun, and, in the best case, a combination of the two. Such practices in contrast to the (long) available evidence, show again the institutional tendencies to give priority to quantity above quality. Overoptimistic assumptions were again the major cause for the time and cost overruns.

ADB's annual review of post-evaluation reports for 1989 has implicitly recognized this tendency toward overoptimism by recommending to "make further improvements in estimating realistic and achievable time schedules with due consideration to historical trends".[113] Apart from an implicit recognition of overoptimism, the following remarks in a note on the effectiveness of feedback of post-evaluation results in irrigation projects have shown some attempts of the ADB to curb this tendency:

> "More careful project preparation has resulted in more realistic estimates of the required implementation period. Compared with the average actual implementation period for post-evaluated irrigation and rural development projects of 7.2 years, the average estimated implementation for the eleven recently approved projects took 5.9 years. This was a distinct improvement over the average appraisal estimate of 3.9 years for post-evaluated projects in irrigation and rural development."[114]

ADB's explicit attempts to relate the envisaged time schedules to historical trends was the only observed systematic check in the scanning of the whole feasibility decision making for this study. Although it is likely that the ADB has implemented a similar check for cost overruns some years earlier. The likely reason that the ADB has introduced such checks only for cost overruns and implementation delays seems that those two aspects of the feasibility assessments were probably considered more a donor-determined than the investment's benefits and performance.

Economic and Financial Feasibility

So far this chapter addressed most assumptions underlying the economic feasibility, the main criterion for investment selection by donors and governments. These assumptions are also the basis for an investment's financial feasibility. The difference between the economic and the financial feasibility assessments lies in the different attribution of particular costs and benefits. In the economic analysis the so-called "transfer costs" such as taxes and subsidies are not considered real costs. Yet, for the financial analyses these are included as real costs for the involved individuals and organizations. Besides, the use of so-called shadow prices in an economic analysis neutralizes the distortions of the market prices. This section examines and generalizes the decision-making processes on both the economic and financial feasibility of irrigation investments.

For the feasibility assessment different methods can be used such as the cost-benefit analysis, the net present value (NPV) and the economic internal rate of return (EIRR). The latter is used most frequently. The EIRR has an advantage over the NPV in representing the purely economic feasibility as the former is neutral toward the scale of a project, while the latter is higher for a larger project.[115]

Economic feasibility. Just like for the underlying assumptions, the gaps between appraisal estimates of the EIRR and the reestimated EIRRs at *project audit* were found to be significant in general, and to be systematically lower at project completion and audit than at feasibility and appraisal. Figure 8 displays the average gap of all World Bank projects approved between 1968 and 1980.

The actual picture is likely to be even worse as the existing *impact studies* have shown. More relevant than the EIRR at project completion or audit (i.e., at most two years after completion of the new construction) are the World Bank's few long-term impact evaluations (i.e., at least five years after the completion) of irrigation investments. These studies have suggested this gap to be even wider than represented in Figure 8, as described in the following quotation from the study: "The unweighed average EIRR was re-estimated at 9.3%, or respectively 53% and 63% of appraisal and completion projections."[116] Also the following generalization in a recent annual report of the World Bank's Operations Evaluation Division has suggested the gap to be wider: " . . .although only a few impact evaluation reports are available, compared with the number of audits, the preliminary findings of several of these reports show that the EIRR tends to decline, rather than rise, in the years after operations are completed."[117]

Other donors and governments have experienced similar gaps. For example, an EEC impact study has found that only one of 11 African projects had an EIRR above the appraisal cut-off level of 10 per cent, while four had even negative EIRRs.[118]

Also two other observed forms of manipulation are likely to make the actual level of the EIRR of the investments even lower. These were the "without benefits" and the sunk costs. Though it was an important distortion in Sri Lanka's Kirindi Oya system and the Philippine case studies, the under-estimation of the "without" project benefits seemed little documented. In contrast, many professionals have generalized the frequent neglect of the sunk costs in investment decisions. For example, a senior World Bank staff member has published the following two strong generalizing statements on its neglect for the rehabilitation of irrigation systems:

> "Sunk costs are a wonderful mechanism to generate high rates of return and justifying pouring more money into a disastrous situation--and a good diversion from addressing the real problem--institutions. And combining this mechanism with an imagined, glowing future for the project, one can have repeated rehabilitation projects on the same site--ongoing work for all--until bankruptcy . . .But it is not fair to the nation or the farmers. Undertaking involving much more sophisticated O&M --airlines, railroads, electrical supply, municipal water are found in these same countries under these same conditions. We should not allow anything less in irrigation and drainage when project upgrading is considered or new projects is undertaken."[119]

> "Rehabilitation project proposals often demonstrate extremely high rates of return, citing sunk cost as though a project virtue--but with no mention of the initial loss or that there is really no reason to believe that it will not happen to this investment too . . .The shocking fact is that the vast majority of these works in need of reconstruction were recently built. Many are only 20 years old. Some are only five years old. Numerous have been partially rebuilt three times in the past 25-30 years. How this incredible situation incurring huge costs evolved, how the responsible agencies can continue to hide it, and how institutions of every type can continue to ignore are baffling. Its a "King's New Clothes" situation. The implications for future food production are and for future demands on funds is frightening!"[120]

Despite irrigation's widespread underperformance, its average EIRR at audit is one of the highest in the whole development business.[121] A possible explanation is following. During the droughts and famines of the 1960s and 1970s rice prices increased far beyond the wildest expectations, and thus probably beyond the appraised estimates. This may have reduced the average gap between the EIRR at appraisal and at audit in comparison to other development sectors.[122]

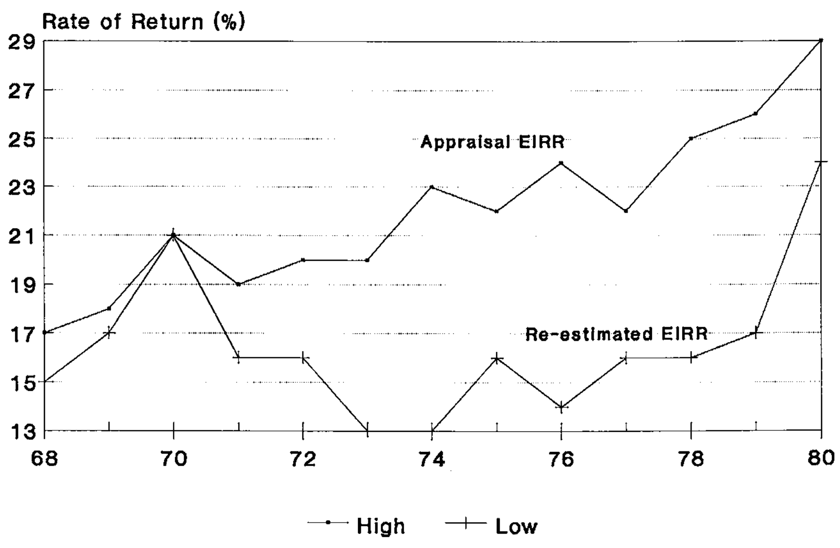
Financial feasibility. Tiffen has reviewed the most influential donor guidelines[123] on their consideration of the financial viability of investments for the individual farmers or their households. The manuals for feasibility assessments in agriculture and irrigation developed for LDCs appeared to give much less attention to this aspect than similar manuals for developed countries. According to Tiffen, if requirements toward this financial viability existed at all, the typical requirement was that:

> "the project provides attractive incomes to the farmers, although low objectives are set for this--the projected net cash income should not be lower in any year than it was before the project (thus disregarding the fact that

irrigation typically requires much more work on the part of the farmer and his family)."[124]

Directly related is the for this study observed tendency to assume the "without" project opportunities for labor, soil, and even the resource water, at zero. While these zero opportunities were incorrect even from a national perspective[125], they were very incorrect for the project's individual beneficiaries or participants.

Figure 12. Gap between appraisal and audit EIRRs of all World Bank projects, by year of approval, 1968-80[126]



According to Tiffen only guidelines developed for the USA and Europe have considered it essential to deal with *private profitability*:

"before making the profitability calculation from the national standpoint. They suggest that farmers will look for double or treble their present cash income if they are to be induced to make the necessary complementary investments and to utilize fully the water provided. They include the calculation of the financial viability of the operating organization where it is an independent legal entity, as it often is in Europe."[127]

Yet, only in the Philippine case studies an assessment of the financial viability of the managing agency was observed to have occurred.[128]

Some Remarks on Missed Opportunities

This chapter's analysis of the feasibility assessment looks at the matching of the desired investment objectives with the available resources. The availability of resources for the irrigated subsector depends, in principle, on their opportunities. This section considers these national opportunities of the resources used for irrigation investment.

Although the EIRR is expressly presumed to assess the national opportunities of the invested money, it appeared incapable to do so due to its systematic misuse. One type of misuse was observed to be the non-consideration of alternative investments in actual practice. Also Tiffen has delineated convincingly that alternative opportunities for the investments are seldom compared at national level:

> "The ability to compare unlike projects is one of the chief theoretical benefits of the EIRR. It should make it possible for a government to decide whether to put its money into a road or a factory or a dam. Actually, it is seldom so used; each Ministry typically compiles its own projects. Theoretically again, it should enable a Ministry to decide which of several projects is the most desirable. Actually it is likely that only one major project is studied in detail at a time, except perhaps in the case of a river basin study. More usually, therefore, the EIRR or [Net Present Value] is used to decide if a project reaches or exceeds the target currently established for project adoption."[129]

Instead, the donor's cut-off rate of the EIRR at appraisal (usually 10 per cent) is meant to set a theoretical opportunity for the investment. Yet, the other type of misuse was the in this chapter described manipulation of the underlying assumptions. And the latter made the EIRR incapable of assessing the national opportunities for the investment funds.

For both types of misuse the lack of political stability seemed an important determinant for the lack of consideration of the national opportunities. It was observed to reinforce short-term interests at the expense of national interests. Also a senior Indian planner, quoted hereafter by Repetto, has observed this:

> "There is also a tendency for political power centres to view and demonstrate their performance in terms of the number of projects they are instrumental in getting approved and started, irrespective of whether the projects are sound and irrespective of the number which can be effectively implemented within the overall resource constraint."[130]

Similarly, an interviewed top-level Sri Lankan civil servant acknowledged that the loans were considered grants for 80 per cent, and that it was thus their objective to acquire maximum foreign funding. Such attitudes suggested that the national interests were thus wasted for 80 per cent from the very beginning. Simultaneously, it showed the difference in stated rationales of the donors and the recipients. Yet, given their coinciding interests for fund-channelling their functional rationales were analogous.

The influence of this political instability was not confined to irrigation investments, but seemed to apply equally to the entire national planning. The World Bank's head of development planning has acknowledged this as follows:

> "Probably one of the best early reviews of the theory and experience of development planning is found in the two volumes edited by Faber and Seers (1972)...They also indicated that the conventional approach to planning assumed existence of political stability, of economic certainties, of political will and of administrative capabilities to carry out the plans. Needless to say, these assumptions [are] seldom obtained in most developing countries . . .the need to move away from the concept of planning as aimed at producing "plans", and towards visualizing "planning as a process".[131]

According to Cassen, many LDCs either do not even have a planning unit at all, or have formed it only recently.[132] It thus appears that no accountability exists for the performance of development investments. Repetto has formulated this as follows: "The main problem is that, unlike in private investment decisions, neither financial responsibility nor the need to repay capital invested in projects imposes a check against inaccuracy and bias in the projected returns."[133]

Thus, although the international development banks have stated to be against subsidies, the precise result of the lack of a national interest and of manipulation of the economic feasibility assessments was a huge hidden subsidy to irrigation investment. These have allowed major investments that only few people had to judge a necessity for development.[134] Especially, in countries like India that spent huge portions of the national budget on irrigation, the wastage of national opportunities seems immense.[135]

The Observed Management Processes

Decision preparation about what was feasible and what not, was observed to be mainly the job of donor staff and consultants. Although in some cases, the preliminary investigations were done by the national irrigation agencies. The data collection of such preliminary investigations was observed to be usually very basic. A request for external funding, whether or not after such preliminary investigations, led in all case studies to decision preparation and taking on the feasibility assessment by donor staff or consultants. The involvement of the national agencies tended to be limited to the provision of data required for the theoretical approaches of different disciplines involved in the project preparation. Though often external consultants also did such data collection.

Although preliminary investigations could sometimes take several decades, in other cases they were completely omitted. The feasibility assessments in most case studies were observed to take less than six months, though in some cases they were done either iteratively or in parts. The investment appraisal assessments by the funding agency that typically followed such feasibility assessments were observed to take less than a month. The latter usually relied fully on the data collection by the feasibility assessment. Both feasibility and appraisal assessments were done mainly by donor staff and consultants.

Supply-driven investment decisions. In all case studies, the feasibility and appraisal assessments were observed to occur after the decision to undertake the project. The different steps and methodologies served merely to justify the decision. Several publications have generalized this justifying mode of the feasibility and appraisal assessments for irrigation and other development investments.[136] In all case studies, the overoptimistic assumptions were usually caused by the manipulation of data that underlie these assessments. Several publications have generalized this manipulation of data for irrigation and other development investments.[137] Also a World Bank evaluation report on 1065 operations approved in the period 1968-1980 has indirectly acknowledged such manipulation as follows:

> "As reported in the past, there is a continuing large difference between forecast and re-estimated ERRs . . .the findings emphasize the importance of using realistic assumptions in the analysis of returns."[138]

Performance targets for the investments were set implicitly during this feasibility decision making. They were not justified and tended to be entirely donor-driven. Not surprisingly, the commitment to, or even awareness of, these targets by the staff of national government and agencies was very low to zero.

Incentives to overoptimize. Many professionals have noted that since the early 1970s capital was less a constraining resource in the development business, than the availability of good projects.[139] This caused probably the non-calculation of the EIRR of capital-extensive investment alternatives (that were observed to be much higher in the Sri Lankan case studies, for example).[140] Donor staff were at the time apparently "desperately keen"[141] to find projects. If they could not find them, they were reproached to be a "negative thinker" or "unrealistic", designations nobody was likely to pursue.[142] De Leeuw has been one of the few to give a detailed description of the resulting processes for his case study of Kenya's Bura system. The case studies and observations underlying this manuscript showed the same pressures and resulting processes to be still at work. A bias for investment quantity was observed to dominate this decision making. Many interviewed staff of agencies, donors, governments and consultants confirmed this bias for investment quantity in their assessments. Several major evaluations of development aid have generalized this bias for investment quantity, and some of its consequences for the quality of the investment decisions.[143]

For example, Cassen has written a consultant report to evaluate the performance of development aid for the Development Committee (the Joint Committee of the Boards of Governors of the World Bank and the International Monetary Fund). In that report he has explained in the following excerpts how this bias for quantity has become internalized in most funding organizations as the major drives for their staff:

> "There is a strong incentive for the staff of donor agencies to 'get the money lent'. In part this results from a creditable wish to get things done--after all, that is what the agencies are there for; but it can also reflect a civil servant's aversion to having his budget reduced because money was unspent by a particular date. And there is a widespread belief that, during the rapid expansion of aid budgets in the 1970s, officers' promotion prospects were strongly influenced by the volume of lending they managed to initiate. The DAC gave this phenomenon a name, 'the fund-channeling function', and identified it as a serious threat to project quality.[144] The danger from it is clear--bad projects may be identified as suitable for support, or projects may be too big to be effectively implemented."[145]

> "Just as the performance of the Agency itself is measured by its ability to spend the funds allocated to it, so too is the performance of its individual staff members . . .There is no incentive to be innovative since innovative projects, as a rule, require more time to plan and implement than do run-of-the-mill activities."[146]

> "Another major problem identified in much evaluation experience is the influence on the quality of aid of the pressure to commit funds . . .Problems only arise if quantity is the enemy of quality. At almost every stage in the processing of a loan, staff in donor agencies have incentives to ensure the loan is made. Career incentives from project staff to senior management are on the side of quantity. So is the annual budgetary process, and its requirement that funds in a given department be committed at the end of the fiscal year on pain of facing budget cuts next year. Obviously, these factors are strongest when an agency is going through a period of major and rapid expansion."[147]
>
> ...It is unlikely, and not obviously desirable, that agencies will abandon annual budgeting for rolling budgets. Nor will career structures be designed in which promptly discharged responsibilities for making loans will dwindle in their influence on promotion prospects. Nor will officers be kept at the same desks right throughout evaluation cycles, which may be of ten years or more . . .Apart from improving the information

flow (see above), the problem can be tackled in two ways: weakening the effect of the quantity incentives or strengthening the quality incentives

...Agencies vary in the extent to which they can escape the inflexibility of annual budgeting processes. In some, the scope is considerable. Within budgeted amounts, departments can shift lending among countries and projects, even among years in certain cases. It helps in this process to have a 'shelf' of projects to be taken up if obstacles are encountered in parts of a lending programme. 'Accordion' projects, which can be enlarged to take on additional components without loss of quality if funds permit, can also help to use additional funds effectively."[148]

There were observed to be several reasons that the decision preparation about an investment's feasibility was mainly the job of donor staff and consultants. Sometimes they were considered more "independent" than staff of the recipient country or agency, in other cases they would prevent likely delays in loan disbursements. Yet, apart from their fore mentioned bias for quantity, it was observed to be very difficult, if not impossible, for them to determine the true feasibility of an investment, especially of the assumed performance improvements. Recipient agency and government staff tended to represent vested interests to realize the funding, and were unlikely to provide any information counteracting these interests. Even in the few observed cases where they were willing to do so,[149] they were usually not asked to by their superiors, or donor staff or consultant. So the coinciding interests of donors and recipient governments encouraged the manipulations. Also the assessment experts and donor staff, who were driven by their organization's targets, appeared not interested in an absolutely neutral feasibility assessment. The following description by Goldsmith et al. fits well the involved interests observed for this study:

"Expertise is as saleable a commodity as gold. The old adage that 'he who pays the piper calls the tune' is as apt today as when it was first coined. Indeed, the record of industry generally is littered with examples of cover-ups in order to justify the marketing of products which are unsafe or suspected of causing harm.[150] Always and everywhere, an 'independent' expert is on hand to tell the public what industry would like it to hear. Nor should that surprise us. Like everybody else, the scientists and consultants who work in industry are ruled by everyday concerns - the mortgage, the need to provide for a family, the fear of failure and criticism. They know that promotion is not won by rocking the boat and that there is little profit in gaining the reputation of a trouble maker. Is it any wonder, then, that many are tempted to cut corners and 'believe the best' for the sake of their companies and their careers?"[151]

No accountability for the quality of investment decisions. In view of the consequences for both the quality of investment decisions and the commitment to performance, one wonders how it is possible that staff of national governments and major donors can continue to justify such over-optimistic assumptions? Staff of national governments in all case studies were observed to lack effective criteria in this respect as the political priority went for the acquisition of foreign funding for the pursued irrigation investments. Also the observed funding organizations appeared to have no effective mechanisms for judging the quality of a feasibility assessment, i.e., to balance the tendency to be over-optimistic.[152] For both parties, quantitative targets appeared to overrule such quality-related issues.

To a certain degree the manipulation of data about the underlying assumptions to justify investments that get priority from an organization's top management tends to occur in many organizations. For example, Galbraith has generalized this tendency for profit organizations.[153] And Dyson generalized the difficulty to present probabilities, risks and uncertainty to senior management during the processes of investment selection.[154] Still, the size and systematics of its misuse in development investment would have made it logical to introduce some related checks and balances. Yet, the absence of such checks and balances was manifest in the case studies where large departures from local performance achievements and considerable variations between sequential assessments were observed. The quotation from the first ADB irrigation impact study on page 131 showed a similar picture.

Donors were observed to be rather passive toward the quality problems of its investment decisions. Although the international development banks must have known since their early days about the "natural bends" of planners and the related consequences (see also Figure 8), they were observed to have undertaken remarkably little "to minimize or at least counterbalance some of the tendency to be overly optimistic". Levine and Wickham have generalized this.[155] Typical in this respect was the remark of an interviewee that it would be interesting to study the donors' starting up processes of projects as they seem somehow unable to stop the ball after it has started rolling. Others remarked that when an identification or feasibility mission goes out for the first time, the decision to do the project has usually been made already. A publication by a former World Bank staff member has generalized this.[156]

Also to date, the observed donors appeared to abstain from requirements about the explicitness and justification of performance assumptions. Only in the ADB, a few recent improvements were observed. ADB's Post Evaluation Office was observed to have explicitly recommended that appraisals make reference to "technical performance and practices in similar irrigation systems in the area."[157] Though this recommendation was apparently not followed.[158] In the World Bank, the only observed check on performance-related assumptions consisted of a "peer review" by colleagues who were supposed to criticize unrealistic assumptions. Also there, the final judgement on the feasibility seemed dominated by the quantity interests in the bank's operations divisions.

The observed development banks seemed to have also a peculiar vision on the performance of its investments. A convincing example was the following excerpt from a World Bank's internal judgement that its loan and credits projects were its most successful, while simultaneously remarking that they lacked insight in the actual loan and cost recovery as follows: "Even for credit and irrigation projects, which have been the most successful types of projects supported by the Bank, their long-term viability could be threatened by poor loan and cost recovery."[159] As long as development banks can get away with such judgments, then it may be true that "rigourous evaluation is generally not in the short-term interest of the operating authorities of the aid donors."[160]

The evolving picture of irrigation investment is a replica of the reputed plot between politicians, farmers and bureaucrats in the USA to build large dams at highly subsidized rates. There farmers pay only 10 per cent of the actual total costs, and water-demanding crops as rice use the scarce water.[161] Likewise in the case studies, staff and consultants of the agency, government and donor connived to accomplish similar objectives, the creation of irrigation capacities at highly subsidized rates.

The suspicious nature of this process itself is less well documented, and probably not evident to all involved actors. Yet, it was there, as demonstrated by earlier quotations on page 133 and, for example, by the following remarks of key decision makers in respectively Morocco and the World Bank:

"En effet, si on se limite un raisonnement financier, il n'y aurait plus beaucoup de projets hydro-agricole rentables et bancables."[162]

"It is, however, necessary to do certain big infrastructure investments for which you have to steal money of the rest of the country."[163]

Subsidies versus performance. Cost-benefit analysis and related sensitivity analysis were not allowed in any of the case studies to classify a project as unfeasible. They seemed therefore to have lost their theoretical functionality for the assessment of investment feasibility and appraisal. Instead, they were used to facilitate subsidies for irrigation investments.

Several professionals have justified the necessity of subsidies for irrigation because of the cyclic nature of the long-term irrigation investment trends.[164] Yet, this subsidy-oriented reasoning seems to have ignored the here observed influence of these supply-driven subsidies on the incentives to perform in the "water-related" decision-making processes. Ignoring these incentives is likely to become a self-fulfilling prophecy: as long as you do not allocate more value to the performance during the capacity utilization by unconditional huge subsidies for capacity creation--through a low quality of the feasibility assessment--, the underutilization of the created capacity make further investments in capacity creation necessary.

The challenge seems to get a process started of both improved capacity creation and improved utilization of the existing capacities. Even, if the likely evolving moderating influence, at least in the short-term, on the quantity of investments, may imply some risks for food security in the long-term. (Yet, this is not a necessary result as there are several other options to increase food security such as direct income transfer to to those who cannot afford it).

One of the few development publications on this linkage between subsidies and incentives in development is a World Bank Staff Working Paper by Heaver. Heaver seems to have hit the crux of the underperformance in development investment by defining the latter as a dynamic process, whereby financial incentives for human efforts cannot be separated from the economic cost-benefit analysis.[165] According to Heaver, getting this dynamic process started requires thus at least a consideration of the probable management performance in the cost-benefit analysis, thus attributing some value to the scarce resource management.

FUNCTIONAL REQUIREMENTS OF INVESTMENTS : DESIGN-UTILIZATION INTERACTION

"..modern irrigation has more than its share of systems designed on the basis of possibilities that were not realized"[166]

"...hardware changes in an otherwise management starved environment are an invitation to disaster."[167]

This section gives a generalized picture of the decision-making processes for the third and last basic orientation point of this chapter, the functional requirements for investments in the irrigation subsector. These requirements are usually determined during the design stage.

Though major decisions are often fixed during the feasibility and appraisal phases of investment decision making because of their cost implications. So several aspects of the functional requirements were touched upon already in the section on feasibility. There, the emphasis was on the impact of certain functional requirements on total costs or benefits, and not so much on the detailed functionalities of the designs. This section elaborates more on such details of the functionality of different design criteria.

Examples of functional requirements are the (peak) irrigation requirements and the related physical control required from the layout, the flow-control structures, and the traits of managers and farmers to achieve a level of service as evolved from the preceding feasibility assessment.

System Layout and Flow Control

Irrigation system layouts in all case studies had adopted during the past three decades the so-called *"rationalized" design criteria* as they tend to be applied in irrigation engineering worldwide. Although the terminology and details varied, the following description of these criteria was generally applicable. The "rationalized" layout consisted of a "regular" hierarchy of main, distributary, and field canals with equal-sized square or rectangular plots situated along them. The areas served by the distributary and field canals were thereby standardized. The distributary and field canals tended to be situated parallel to upstream canals, so that, in principle, the plots only received water from a field canal.

Such a regular layout pattern was generally deemed to facilitate the monitoring and control of water flows. It also allowed to base the farm sizes on such explicit criteria as the land use classification, the cropping patterns, and income. Economic efficiency, the related water efficiency and a desire to control the service delivery seemed the underlying criteria of this design concept.

In contrast, the traditional,[168] irregular patterns of canals and plots had highly variable sizes, discharges and numbers of farmers per canal. Many engineers perceived these traits as a "major inconvenience"[169] for flow control, as a consultant in one Sri Lankan case study argued. In addition, more flexible water delivery, that was generally perceived to be required in the rationalized irrigation designs, required a higher density of canals and structures as well.[170]

Yet, the effectiveness of this "regular" pattern in facilitating monitoring and control, flexibility, and convenience seemed never assessed. Not even its cost effectiveness has been tested to date. This seemed amazing in view of the elevated costs required for the regular pattern. Higher costs were observed to be caused by such related measures as the increased canal density, the higher excavation volumes, the increased concrete costs for structures,[171] the increased requirements of construction quality, the higher operation and maintenance costs, the reduction of conflicting property boundaries, the "rational" water sharing between the water users, and the required higher management capacities and higher inputs of agency staff.[172] These costs were observed to be even more elevated as they had to be introduced in the short time frames available for foreign-funded irrigation projects.

Several drawbacks of this design concept require more elaboration. The rationalized design concept tended to be used as "blueprints" that required only a standardized data collection through surveys to design on a large-scale. These design concepts were observed to ignore usually those criteria crucially important to farmers, such as the future arrangements of ownership or rights of land and water, and the local experiences with the suitability of the soils. Others have remarked this as well.[173] Besides, the field canals, instead of facilitating efficient water sharing among water users, were observed to introduce merely new stresses among the farmers and between the farmers and the agency. Also Levine and Coward have observed this.[174] Moreover, the rational designs assumed that all relevant information about topography, soil suitabilities, drainage conditions etc. required for the determination of an irrigation system's functions, could be obtained through large-scale surveys. Yet, in the observed practices of large-scale irrigation development, these data tended to be of very low quality. Though this appeared to be no constraint for their use in the detailed designs.[175]

Distinct criticisms on the effectiveness of the rational design have been expressed more specifically for flooded paddy cultivation. For example, Levine and Coward have argued that for paddy the traditional field-to-field irrigation "can be as effective and efficient as individual field outlets"[176] in terms of water efficiency alone. Hence, given their lower cost, their effectiveness and efficiency seemed much higher than the rational design concept. Another aspect observed to render heavy investment in individual field outlets and increased canal intensities inefficient and ineffective was the frequent re-use of drainage water in watersheds.

The above observations on the rationalized design criteria did not apply to Morocco. There, the rationalized layout was observed to be functional to a comparatively satisfactory level. This higher level of functionality seemed more due to the higher levels of sophistication of the decision-making processes about the capacity utilization than in the other case studies. This probably would have made any design concept more functional than in the other case studies because of the better match between the assumed and achieved levels of management inputs. (The level of sophistication of the capacity creation in Morocco was observed to be similar to the other case studies.)

How did the drawbacks of these rationalized design concepts compare to the *more traditional design concepts*? Traditional investment planning and design in many LDCs was based on least-cost construction and the maximizing of the re-use of drainage water, rather than on the modern concepts of increased flow control, and, possibly, of reducing seepage by the expensive canal lining.[177] These traditional, least-cost combined with low-performance approaches clearly rooted more in a management reality than the observed rationalized design concepts in all case studies except Morocco. Yet, apart from the role of the disciplinary biases, the rationalized options were stimulated, and in certain cases even enforced,[178] by the supply-driven irrigation investments of the last decades.

Recently the capital-intensive, unsuccessful nature of the modern design concepts seems to get more recognition. Whereby some senior engineers and economists in the World Bank have pleaded for the design of irrigation systems primarily based on re-use of the primary resource.[179] Ironically, similar arguments at the national level in early stages of the determination of the rationalized design criteria were typically ignored; for example, in Sri Lanka the same arguments were proposed unsuccessfully by Farmer in 1957 and Mendis in 1977.[180]

Especially in the design of field canals and tertiary units the rational design approaches were observed to run into trouble in all case studies including Morocco. Prerequisite for design at these levels seemed an interactive process with farmers to obtain relevant localized information. For example, Small has described this for the topographical design aspects as follows:

> "Topographic information available to irrigation agencies lacks the detail and degree of precision needed for designing tertiary systems in a technically satisfactory manner. Furthermore the cost of obtaining the necessary information in a formal manner (using engineering personnel and equipment) would be prohibitive. But farmers have experimental knowledge about local micro-relief, based on their years of farming under a variety of water conditions. It appears that they can play a significant role in providing, in an informal fashion, some of the information needed by the engineers."[181]

Similar arguments were observed to apply to the soil suitabilities, water and land rights and ownership.

Given the quantity and quality of information required, the design for improved flow control at field-canal level appeared much more management intensive, and thus prohibitive, than at main system level. In contrast, important donors in all case studies pushed recipient governments for a long time to apply the conceptual solution of creating increased facilities for improved flow control at field-canal level. Wade and Ter Hofstede have described similar processes between the World Bank and the governments of respectively India and Indonesia.[182] Conceptually the donors apparently considered the "incremental return" of the field-canal level development as high.[183]

The fore mentioned "re-use based" design concept takes *a more integrated perspective* on system layout as it incorporates the prevalent constraints in commitment for increased management inputs.

Diemer has described another example of a more integrated design concept. The French ministry of development cooperation recognized the limited probable contributions of a Senegalese managing agency for local flow control. It therefore initiated the so-called "intermediate" systems, that consisted of a main canal that diverted water from a river by gravity. Separate sub-systems had to pump water independently from this main canal. This physical layout facilitated the subsystems to operate as decentralized "responsibility" centers. Thus recognizing the need for decentralized decision making and accountability by farmers for an improved delivery performance. In a comparable, but slightly different system, the water had to be pumped into the main canal as well. This system worked less satisfactory due to the larger dependence of sub-systems on this centralized water intake, and the related needs for centralized coordination of the main system regulation.[184]

Also many traditional interventions in irrigation in countries such as Indonesia and Sri Lanka had a more integrated approach. This consisted of support for already existing smaller irrigation (sub-)systems, thereby restricting the need for centralized management inputs. Coward has generalized this for Asia as follows:

> "...development of facilities at the lowest unit in a large public scheme (variously referred to as the chak, watercourse, or tertiary unit). Throughout Asia, the customary practice has been to leave development and elaboration of this portion of the system to the local users themselves. However, more recently, a number of states--sometimes with urging from international donors--have extended their investment activities into the distribution network (Levine and Coward, 1984) Results have been mixed, but frequently the outcomes have been underutilization and poor maintenance by the user groups."[185]

Often these units maintained their independent status, sometimes facilitated physically by buffer reservoirs or independent river intakes. Water-delivery arrangements within such units were often left untouched by outside agencies. Only for new system development the "rationalized" design concepts were introduced with the related assumptions of increased agency control over the water delivery.[186]

The rationalized approaches have had a profound influence on the irrigation engineering profession. Since several decades, irrigation engineers have been trained, or rather brainwashed, in one single, "rational" and economic approach of irrigation design (i.e., Diemer's engineering paradigm[187]) that seems very hard to decode. It has stimulated an engineering attitude toward technical design as a "pure" science, that can only be desecrated by the farmers' or system managers' real-life requirements. It has biased engineers to think in terms of large reservoirs with "rational" new downstream development, and to disrespect existing small systems, and more pragmatic and gradual watershed development. For example, in Sri Lanka's Kirindi Oya system such attitudes of agency staff were observed to have caused the demolishment of about 50 small existing systems to be replaced by a more "rational" layout.

The so-called *participative design* appeared therefore a controversial issue for engineers as it conflicted with their scientific approaches. Such consultations were observed to be an exception. Yet during colonial times, rehabilitations in Indonesia, for example, were apparently always discussed with such relevant stakeholders as the agency staff, the operators and the farmers.[188] More recently, such consultations have become part of some "innovative", so-called participatory experiments. Famous example of an innovative approach is the rehabilitation of Sri Lanka's Gal Oya in the late 1970s. Another example is a very interesting article by Meijers on the facilitative role of a design engineer for small-scale system development in Senegal.[189] Eventually, a rehabilitation of the paradigm of irrigation system design may evolve through such "innovations".

Peak Irrigation Requirements

Peak irrigation requirements are a major determinant of the project costs. They determine the required discharge capacities of canals and structures, and thus the size and costs of canal excavation and lining, and of flow-control structures. Peak requirements are therefore a major assumption underlying the absolute project costs and thus the investment feasibility. If the peak irrigation requirements are underestimated, water cannot reach the tail-ends of canals. And if they are overestimated, the construction costs increase unnecessarily, and wasteful discharges may become necessary to maintain enough head in the canals.

Although peak requirements could have been elaborated upon in the section on Feasible Investment Objectives, it is done in this section because of its direct interrelation with other system's functions such as the system layout and the controllability of flow. (To prevent repetitions as much as possible, the peak requirements were not discussed as a subheading of the previous section on Feasible Investment Cost and Project Implementation Schedule.)

The theoretical crop water requirements at field level were observed to be the usual basis for the determination of the canal peak requirements. After the establishment of the crop water requirements, they tended to be multiplied with the field application and canal conveyance efficiencies to arrive at the peak requirements for the different canals. In addition, rules of thumb tended to be used as guidelines for the peak requirements, sometimes as the only guidelines, and sometimes as a check on the theoretical assessment. Murray-Rust and Snellen have remarked these rules of thumb to range between 1.5 and 2.0 l/s/ha for the humid tropics, while for the Pakistani and Indian Punjabi systems in a semi-arid sub-tropical climate they range between 0.2 to 0.4 l/s/ha.[190]

Peak requirements during capacity utilization appeared to deviate considerably from the design criteria in all case studies. For example, peak values measured by IIMI in Sri Lankan systems appeared to be between 3.4 and 11.5 l/s/ha in Uda Walawe and between 2.7 and 3.6 l/s/ha in Kirindi Oya.[191] Overloading of canals was observed in all observed main systems, whether temporarily or permanently. These observations suggest a tendency to underdesign canals, something that seems supported by the worldwide problems to get water to tail-end reaches of irrigation canals, even during peak flows. The following reasons were observed for this gap between designed and actual peak discharges:

1. Their reliance on the crop water requirements was observed to cause the same degree of overoptimism during the design as during the feasibility and appraisal assessments. As mentioned before, the theoretical crop water requirement formulae tended to represent overoptimistic possibilities rather than probabilities, especially regarding the inputs of agency management and farm labor;

2. Directly influenced by these management and labor aspects was the proportion of the rainfall that could be effectively used for cultivation, while saving on the water deliveries by the irrigation system. Often the design assumed the effective rainfall to be the 80 per cent probable rainfall. This was an overoptimistic assumption as there were few, if any, irrigation systems in LDCs that have any contingent management strategies or procedures to respond to rainfall, other than stopping issues to prevent overloading of canal reaches. Besides, if no rainfall would occur during a certain demand period, such a canal was thus underdesigned for the full 80 per cent probable rainfall as the supply from the canal system must compensate such shortfalls. In Sri Lanka's Kirindi Oya system designers were observed to add an arbitrary 25 per cent extra discharge to the designed peak discharge to cover such drought periods. Still, the main canals appeared underdesigned;

3. Also such physical factors as the lateral and vertical seepage and percolation[192] were observed to be very variable. So variable that they could not be determined reliably by formulae or measurement for either a turnout, or even a plot.[193] These seepage and percolation estimates dominate the estimation of the water requirements. This difficulty to estimate them makes the "1 cusec" design concept, used in several Asian countries, of questionable merit. Especially because the size of the turnouts depends in detail on such "measured" seepage and percolation. The frequent unavailability in many countries of reliable soil data aggravates this further. These physical uncertainties were observed to make it

also difficult for designers to determine the size of field outlets without relying on the experience of operators and farmers along a field canal;[194]

4. Although the theoretical water requirements were mostly used to determine the peak requirements, during capacity utilization they were observed to occur during the land preparation. Levine has also argued that in rice cultivation, the land preparation is a major factor for water usage, and that evidence suggests that this relates to the way of water delivery.[195] Even if the requirements during land preparation were used for designing the canal capacities, also these assumptions tended to be over-optimistic. Similarly, unrealistic levels of staff management and farm labor inputs were underlying the always optimistic assumptions of the progress of the land preparation, rotations, and the irrigation efficiencies.

Overall, canals were usually designed for unrealistic efficiencies. Or, as Levine and Wickham have remarked: "Rarely is a project designed for 30% efficiency, yet many are actually operated at that level . . .it goes "against the grain" for an engineer to design an "inefficient" project.".[196] Partly, these unrealistic estimates were observed to find their origin in the fore-mentioned disciplinary bias of the irrigation engineer; assuming no management inputs by agency staff during capacity utilization would be quite realistic, but goes indeed "against the grain".[197] Those unrealistic efficiencies were institutionalized not only in the mind of engineers, but even in the official design guidelines of several irrigation agencies (that evolve from the same engineer's mind).[198] Though the unrealistic assumptions were also observed to be consistently and directly linked to the feasibility-level over-optimistic efficiency requirements.

Like for the feasibility assessment, the peak requirements in the system designs in all case were not related to real-life experiences and requirements. The government committee for Irrigation Utilization in Andhra Pradesh, India has found this as well.[199] Yet, much flexibility to deviate during the design stage from the feasibility-level assessments did usually not exist as it would endanger a successful cultivation of the planned (i.e., the maximum) command area, even in theory. In all case studies, the cost-benefit analysis of the irrigation investments assumed the maximum benefits through assuming the benefits of the maximum possible area irrigated (by that assuming high "possible" water efficiencies). This was observed to create a pressure for designers to continue to design for this maximum benefit, at least in theory, to realize the envisaged EIRR. So, observed design engineers of agencies, consultants and donors in Sri Lanka, Philippines, and Morocco had to work with unrealistic peak requirements against the odds. The Sri Lankan case studies contain detailed descriptions of the related processes.[200]

Coward has recommended to settle water rights prior to any investment in recognition of the frequent existence of customary water rights, and even an "investment history of the locale" (i.e., the existing agriculture). According to him this is usually not so:

> "Often this approach results in a new technological apparatus being placed into a muddled property context. Thereafter, the technology is unused or misused and soon inoperative, bypassed, or, if possible, modified to fit the realities of property rights . . .When doing . . .preproject investigations of the existing situation, effort should be devoted to understanding these established rights"[201]

The big question remains, of course, how to do that other than through time-consuming processes, trial-and-error, and, possibly, increased investments?

An interviewed Senior Design Engineer of Sri Lanka's Irrigation Department remarked that the traditional way of matching canal capacities and the commanded areas in Sri Lanka was by trial-and-error. Ter Hofstede has described this for Bali as well.[202] Despite the many theoretical concepts and formulae related to irrigation requirements, the actual practice in most case studies was still by trial-and-error; the underutilized portion of the created command areas seemed thereby to represent a major, though hypothetical part of the widespread "underperformance" of irrigation investments.

Controllability of Flow

The case studies showed that the choice of all structures was based on implicit assumptions about desired water levels and management inputs. Usually the costs were not compared with the related benefits in water-delivery performance. Related experiences and lessons were never considered. Just like for the system layout, the design concepts of flow-control structures and canals were observed to have evolved over time toward increased flow control, and over ever smaller discharges. As mentioned before, the implicitly assumed increases in management inputs for improved flow control were not observed in any of the case studies. Levine and Wickham have generalized this international tendency toward more flow control, and make similar observations in the following citation on its functionality:[203]

> "Systems are almost always designed with the most modern features currently available and theoretically appropriate, almost irrespective of the current level of agricultural or irrigation practice in the area. Direct service to individual holdings, on demand, with volumetric metering and with high efficiency is considered to be the "ideal", providing the farmer with maximum decision-making independence, and reflecting modern approach to design. While this is not always achieved in design, and rarely in practice, it still reflects the ideal. In striving for this, as suggested in the discussion on operation and maintenance, measuring devices, control gates, modern institutional structures, etc. are incorporated into the design, even when the prospective clients have no experience with these components."[204]

Such modern design concepts required much higher cost per unit area as mentioned before, although this was never made explicit in the observed decision-making processes. The argument that a design concept had to stick to *"conventional engineering"* was observed to be used frequently in reports and manuals. In itself this argument appeared often sufficient justification for the huge extra costs on construction or maintenance. Examples of such justifications were described in the two Sri Lankan case studies. Also the following citation from De Leeuw of a newly arrived consultant's criticism on the previous consultant in Kenya's Bura system gives such "conventional" reasoning:

> "The present designs [i.e., feasibility-level designs of the former consultant] provide for minimal control and adjustment of flows. Although this has the merit of requiring minimum operation and water management, it doesn't confirm with the commonly accepted standards of control associated with irrigation systems involving major investment and high agricultural potential."[205]

According to the new consultant, the changes would not influence the costs. Yet, De Leeuw has calculated the total project cost increases due to such reasoning to be 210 per cent only five years after this denial.[206]

Apparently, this rationale of "conventional engineering" allowed engineers their habit of keeping the underlying control and management requirements and expectations implicit. For example, the requirements for passive and active upstream level control[207] for cross-regulators and offtakes, for sensitivity of offtakes along a canal toward flow fluctuations, for discharge control by capacities of canal and structures, were observed to be kept implicit. Thus they remained at the discretion of the involved designers.

Of course, making these requirements explicit, would probably be a difficult task without any explicit performance targets or envisaged levels of service. Yet, without such explicit objectives and an agency commitment to them, the implicitly used performance targets stimulated and allowed theoretical flow-control solutions for system design. Interaction by designers with system managers and farmers about the level of service, and the related functions of flow control, was consequently unnecessary, and was observed, in practice, more exception than rule.

No explicit definition of performance requirements was observed in any of the case studies. The more recently introduced practice of writing *O&M manuals* before or parallel to system design could, in principle, have facilitated such an objective setting process by the irrigation agency. Especially if the agency would have considered it as a kind of strategic planning. In practice the observed terms of reference, capabilities and awareness of consultants and agency did not go that far. Besides, the interest and commitment of the top management of the observed irrigation agencies to such objective setting was weak.

The debate on flow-control concepts. The prevalent failure in irrigation for the water to reach the tail-reaches of canals has naturally led to a recognition that, apart from management, something must be wrong with irrigation design as well. A paper by Jurriens led to an initial international discussion on this subject in ODI's "Irrigation Management Network" in 1984.

Jurriens pleaded that the irrigation performance problems were less a management than a design problem. According to him, new design concepts were required that would integrate all relevant aspects, including the physical, financial, economic and human. Most reviewers of his paper disagreed on his thesis of design as the sole solution to the performance problem, though many supported the need for new design concepts and analytical frameworks. Suggested solutions by other discussants focused, with few exceptions, on this conceptual need, rather than explicitly on the process of designing.[208]

Several discussants of the paper have remarked, however, that assumptions made by designers in the existing design concepts were almost always unknown and implicit:

> " . . .the evidence is to be found in consultancy reports. These relate to particular contexts, may rarely be explicit about the underlying principles on which their contributions are based, and are not widely available."[209]

Several suggested that this was provoked by the lack of time or money to consider the relevant aspects for conceptual design. Most suggested there were political reasons for the conventional nature of irrigation design as reflected in the following citation:

"...the factors which most respondents saw as being the most difficult to incorporate systematically into a coherent analytical framework were the wide range of potentially relevant political/cultural/institutional/social variables-- no doubt because, in addition to being locale-specific, they are often difficult to quantify and hence appear intangible. For example, Parkes perceived such design information being "subjective or difficult to obtain" and saw this as the major reason the designer is often left to make an "engineering judgement"".[210]

The conventional nature of irrigation engineering seemed to allow several completely different conceptual solutions for a similar problem. The following text from a recent World Bank document has remarked this as well:

"The issues facing irrigation management in Indonesia are far from unique. Smallholder irrigation has faced similar problems in many other Asian countries. Solutions suggested have been varied, ranging from even more sophisticated systems [e.g., automatic downstream control at the block (Kedung Ombo) or farm level (Merriam 1983)], dynamic regulation and remote control, through radical redesign [e.g., lowering canals below ground level with gravity supply replaced by low-head pumping, OED (1989)], to straightforward systems of proportional distribution".[211]

New flow-control concepts. Since the time of the forementioned international discussion in ODI's network, several new design concepts were proposed based on more explicit "programs of requirements" for the levels of service and for the flow control. Earlier, an implicit criterion in the choice of required functions of many modern, flow-control-improving design concepts was the need for more flexibility of the water delivery to farmers. Partly, this function was perceived also a requirement to cultivate other crops than rice (OFC). Nowadays the status of flexibility as a design criterion seems to have become less divine.

Several more recently proposed design concepts contain different degrees of reduced flexibility, while explicitly recognizing the constraints in management capacity of agency and farmers. For example, Horst has proposed less flexibility at distributary and/or field canal level through fixed proportional division. A perceived advantage of less flexibility at that level was more independence of farmers toward "the vagaries of mismanagement of the major system, but they also cause a considerable decrease in the operational manpower requirements."[212]

The World Bank has adopted a similar approach, the so-called "structured" design concept. Hereby, less flexibility was to be achieved through proportional division below a certain level, the so-called "structured" level. Below this level the system was designed to be operated on an on-off basis to provide an "irrigation service" to farmers rather than a specified demand. Only at field canal level, gates were provided for operation by the farmers themselves.

Both the concepts of Horst and the World Bank have assumed that a reduction of the total number of movable gates would reduce considerably the required gate operations and would thus improve the system's "manageability". Although farmers were constrained in their freedom and the flexibility of service delivery in volume and duration, the system was perceived to be more manageable. The constraints were assumed to be "offset by certainty of supply". The critical design decision in the structured design concept was "the level at which the system is to be structured".[213]

Yet, both concepts notwithstanding their potential may have the same drawbacks common to almost all "blueprint" type of design concepts. Horst has not said anything about the process of applying his design concept, and therefore did not exclude the risk of the design concept to be applied as a blueprint. The World Bank's intention it to be applied as a blueprint. Any plan of the future level of service delivery (and the related "program of requirements" for the investments) that is supposed to have "a realistic chance of being implemented"[214] can only be defined by the irrigation agency itself, preferably in consultation with the farmers. Moreover, it requires support from its top management and from political levels. If the proposed design concepts and related "irrigation service" objectives are defined by outsiders rather than by the agency, the commitment of the agency and the farmers can be expected to be very low.

Without explicit performance targets of their own, likely reactions of both the agency and the farmers are to overload the main system permanently, and to operate it on a continuous rather than on an on-off basis. One wonders therefore about the rationale for assuming systems to be operated for variable flows, given the absence in most case studies of any performance targets, and given the difficulty to enforce variable flow through the physical infrastructure alone? For example, for the structured design farmers were envisaged to be able to increase outlet discharges only through major interference (e.g., by breaking the fixed offtakes).[215] Yet, they were likely, and were observed,[216] to do so, conceivably even with support of the irrigation agency. The latter was observed in the two Sri Lankan case studies.

The process of design. Such new substantive design concepts are important, but so are the decision-making processes of the definition of a "program of requirements" prior to a design. Especially the decision-making processes by those who have to make the structures work, the agency and the farmers. Both above examples of design concepts have justified their choice for proportional division based on their extensive and satisfactory application in traditional irrigation systems in Bali, North Africa, and Spain. Such justifications seem to have underestimated that such proportional division was likely the result of time-consuming negotiating processes, resulting in explicit water rights and allocation plans, rules and procedures. In general, conceptual designs ignore the importance of such a process.[217]

The following remarks hold much truth from a process perspective:

> "...most respondents were emphatic that an irrigation system should be designed "from the bottom up" in accordance with the capabilities and needs of the users (eg. Chambers, Framji, Griffith). The alternative approach --designing according to "principles of efficient water distribution" and then trying to get farmers to conform-- "imposes unrealistic demands on the users." [Whithers]"[218]

> "...much of design work falls down because it is adapted to the way in which the designer considers the farmers ought to irrigate rather than the way in which farmers actually irrigate."[219]

What applied to farmers in these remarks applied also to system managers; without their involvement in the definition of a system's functions, or "program of requirements", the pursued performance improvements seemed unlikely to get their commitment.

Not through design only. All the above observations suggest the need for a certain qualification of the importance of design concepts. So far, the importance of the *process* of design has surfaced. Apart from this process, also the actual organization's goals seem a major influence on the usefulness of any design concept in place. Although a system's design is important, without the will to manage, no design concept is "manageable". Similarly, if the objectives are right, every design is to a certain degree "manageable".[220] In a situation where the agency and farmers support the performance objectives, every design becomes to a certain degree "manageable", whether it were traditional, modern, flexible, simple, least-cost, or even dilapidated. Many professionals have argued similarly, and have produced related evidence. A few are quoted below:

> "...very old systems often provide better services than those recently constructed--it is not a technology gap."[221]

> "Proper design is needed today. But again, many systems serving high value diversified cropping in the developed countries were designed and built 60 to 100 years ago. The problem should not be seen as "new technology" that is missing."[222]

> "Old, successful irrigation projects may be readily found. Existing schemes in India, China, Indonesia and in North America, to mention a few, incorporated principles that are still valid today. Many have functioned continuously for 100 to 150 years. A competitive, healthy project agriculture evolved attesting to the effectiveness of the service provided by these systems usually sustained by local entities or by the farmers themselves. If one examines the total irrigation in many countries, more than 50% and up to 80% were built long ago and have been maintained from the onset by the farmers alone. Operable segments of Roman aqueducts remain after 2000 years, most with no maintenance. The design, construction and operation and maintenance were obviously of high quality --all of them-- and that is the key!"[223]

> "It is perhaps fitting at this point to assert that all irrigation systems whether surface, sprinkler, drip, or other, can be grossly mismanaged. Granted some are easier to mismanage than others . . .On the other hand all irrigation systems can potentially achieve high efficiency with expert management and proper design. Thus, it is generally and properly accepted among irrigation experts that well-managed systems produce similar efficiencies of water use. Real tragedies have been installed and more are proposed where the result has been and will be to replace one poorly managed system with another poorly managed system. These usually revolve around replacing canal systems in less developed countries with high-tech drip systems, etc. These have their proven place and can be successful, but hardware changes in an otherwise management starved environment are an invitation to disaster."[224]

> "...it appears that major progress can be made in efficient and equitable water distribution even with relatively deteriorated canals and structures."[225]

> "The very high efficiencies in Taiwan--around 60 per cent in normal water supply conditions, rising to 90 per cent as water comer very scarce--are achieved with physical structures which are not particularly sophisticated, by means of very effective utilisation of those structures, which is a function of management."[226]

These quotations show that with the right management conditions and processes, also the simplest design concepts, and even deteriorated infrastructure, can work satisfactory.

Design and centralization. The above newly proposed design concepts implicitly assumed an exclusively centralized concern for the water-delivery performance. An assumption that most likely evolved from the "through-design-only" approach. Yet, decentralization is an important measure of management control.

Unlike today, in the past decentralization of the decision making was part of the discussion on design and management control. For example, decentralization was the subject of a long debate of the colonial engineers in Indonesia. Ter Hofstede and Van Santbrink have given a very interesting description of this debate, where most engineers preferred more and more centralization to improve the system performance. By the end of the nineteenth century, when the concept of "water management" (i.e., not the practice) still had to be invented, expenditure control arguments of the colonial government led to an open discussion among engineers of the pros and cons of decentralization of the water delivery versus increased centralized control over the water flow. Both sides substantiated their argument with research results.[227] A similar situation in the 1930s, on the contrary, led to a different process; the arguments served merely to legitimize the existing situation (that failed to control the tertiary system), and experiments were not permitted. By that time, only few engineers dared to plead for decentralization along the institutional set up of the Balinese subak, against much social pressure of their engineering colleagues. Decentralization apparently did not match well with the engineering approaches toward increased flow control.[228]

In all case studies, financial resources for irrigation investments appeared not really a constraining factor after the independence. Thus, the natural tendency of irrigation engineers to opt for more centralization was not stopped since. Farbrother has complained about the resulting evolution to design for ever smaller discharges, typically determined by "on high" engineers, in the name of "efficiency" and according to "fashions that have changed over the years". He has also generalized the consistence of this tendency toward centralization over time in the following citation:

> "In the early classical developments in India and Egypt, really sizeable "main" canals were the favoured basic units for scheduling. From about 1920, however, the smaller distributaries and watercourses at about 10 cusec came in, with 4 cusec (in the Gezira) being regarded as the lower irreducible minimum. Postwar developments in India and Pakistan brought in rotational supplies at 3 cusec; then 2 cusec; and finally, the 1 cusec design criterion of the recent [Command Area Development] planning. The current rehabilitation proposals for the Gezira anticipate a reduction from 4 cusec (417 cu.m/hr) down to 1 1/2 cusec (130 cu.m/hr), but this will be shared simultaneously between four or five individual farmers, (say 0.3 cusec each). Elsewhere, we now have the strange spectacle of some engineers apparently agreeing in terms of rotating 0.1 cusec around 5 one-acre holdings -under pressure from the solar-power enthusiasts."[229]

The Observed Management Processes

Decision-making processes about the requirements for the design were observed to occur in all case studies at *conceptual* levels only. Engineers of donors, consultants and irrigation agencies together seemed to determine these concepts and to adjust them regularly. Yet, no interaction with local system managers and farmers was observed for the determination of an explicit "program of requirements". Also the Commission for Irrigation Utilisation in Andhra Pradesh, India, has observed this as follows:

> "All senior staff responsible for designs in Andhra Pradesh are unanimous that there is no feed-back from the field and the irrigation schemes are being planned, designed and operated on certain ad hoc assumptions without testing their validity in actual performance."[230]

The resulting rigid application of the different design "blueprints" with insufficient localized information was observed to be widespread. It led to almost ad random turnout sizes, the use of unsuitable soils and cropping patterns in the design, and the suboptimal use of existing reservoirs and drainage lines. Also during design, the misuse of the theoretical formulae for crop water requirements was found, and sequential assessments were allowed to be inconsistent without any related justification. Thus designs were adjusted to fit the preceding overoptimistic appraisal assessments. In addition, political interference was observed to occur frequently in the design process.

Although substantial opposition against these design blueprints can be found in the irrigation management literature[231], all the observed funding institutions had accepted them. From their perspective, the advantage of the conceptual design seemed that issues such as the service delivery and the agency's related management control could be circumvented, while still having a "solution". Also Wade has found this.[232]

To a certain extent, awareness about the non-functionality of the designs was observed within the case studies. Construction and political priorities in the agencies together tended to resist quality arguments, and to impede changes to more professionalism (as described earlier in this chapter). Considerable political maturity seems required to reverse such processes.[233] Over time, the design seems to have become a routinized, little creative or thought-requiring exercise. Wensley has remarked this for the National Irrigation Administration of the Philippines as well.[234]

The awareness of how the present design concepts have evolved over time was thereby observed to fade gradually away with the younger generations of engineers; the design concepts have become internalized and the question of functionality did often not even arise. After several years of participatory observation of an irrigation engineering faculty, Diemer has also found such internalization of the functionality of irrigation technology.[235]

Yet, the influence of donor staff and external consultants on the formulation of the design concepts appeared tremendous.[236] Wade and Hart have substantiated this also for India.[237] Although the supervision by donor staff was observed to be intermittent and minimal--the World Bank and ADB staff visited a project typically only once a year--, they appeared more responsible for project justification and success, and thus for the project's design concepts, than the local executing agencies and government staff. To justify either new loans or loan continuation, the donor staff or consultants had to come up with solutions. These were necessarily conceptual due to their unfamiliarity with the actual institutional constraints. The local parties, from their side, were observed to agree to almost any solution proposed as long as they themselves did not become responsible or accountable. The actual functionality of the design seemed often a minor concern to governments, agencies, consultants, and donor. Accountability for it was a non-issue in the observed irrigation bureaucracies.

Such processes raise the question if a capital-intensive mode of investment is appropriate for irrigation as it appeared to induce the conceptual design solutions. Levine and Wickham have phrased similar doubts about irrigation design in LDCs as follows:

> "In the context of the developing countries, especially the humid tropics of Asia, it is essentially impossible to design an effective appropriate project before implementation. The design must explicitly include an extended period for feedback and revision."[238]

Yet, the visibility of capital-intensive investments is likely to remain politically attractive. This impetus was probably an important reason for the observed donor efforts to develop ever changing blueprints that were less dogmatic than the earlier design concepts.[239] The tragedy of the donor-driven, conceptual solutions was that simultaneously the donor was observed to become more and more co-responsible for the performance of the new design concepts as they became more and more their intellectual property. Especially because the irrigation agencies were not really responsible or accountable for either the functionality of its design, or for the water-delivery performance.

From the early 19th century, the technical irrigation profession was developed entirely by trial-and-error.[240] Despite the more conceptual approaches that were developed over time, the actual professional development still seems to occur by trial-and-error. The early pioneers experimented on a small scale before applying their concepts on a larger scale. Yet, nowadays the abundant resource availability seems to allow for large-scale trial-and-error, and thus also for large-scale errors.

Some similarities exist with other large-scale facility-engineering disciplines (e.g., for petro-chemical and off-shore facilities) that tend to be created on a trial-and-error basis as well. Though a crucial difference with irrigation is that these other disciplines tend to specify in advance a "program of requirements" for innovative investments, and in a clear and explicit manner.[241]

No lessons were learned from irrigation's large-scale errors, as long as the assumptions about the system's functions tended to remain implicit. Ideally, design should start from an agency-wide assessment of the affordable and feasible "programs of requirements" and levels of service of an investment. Such decisions were currently non-existent in the observed irrigation agencies.

Mutual Adaptation of the Substance and Processes of the Capacity Creation Decisions

So far, this chapter describes the different parts of the capacity creation processes, and separately analyses the related management processes. Several professional approaches such as the EIRR, the theoretical water requirements, and the conceptual designs appear to be less useful than originally intended. This section briefly discusses the mutual adaptation of such professional approaches as the substantive aspects of the decision-making processes, and the managerial aspects of the decision making.

The theoretical water requirements. The section on demand assessment in Chapter 4 argues that in the decision making about the capacity utilization the scientific formulae to calculate the theoretical water requirements have problems to cope with such "soft" parameters as the scarcity value of water and the related inefficiencies of water. The formulae calculate the "hard" demand of crop, soils, and canals, and cannot cope with the "soft" requirements as expressed by people and institutions. Though even the assessment of the "hard" requirements appeared difficult to do accurately for individual farms and small subsystems. It was difficult to assess accurately most parameters required in the formulae, such as the irrigated area, the progress of the land preparation, the requirements for land soaking, effective rainfall, and seepage and percolation rates.

The same problems were observed in the application of the formulae for the theoretical water requirements in the decision making about the capacity creation. The "hard" requirements were observed to be assessed usually in an approximate way only. Though some field testing of the meteorological parameters, and seepage and percolation rates tended to be done during the design stage. The seepage and percolation rates appeared thereby impossible to assess reliably in most case studies. Only in the Sudanese case study, the homogenous soils allowed a reliable assessment of the latter.

In practice, the assumptions about the water requirements were observed to be assessed in an overoptimistic manner to boost the benefits of the investment. The assessment tended to reflect the theoretically possible rather than the probable performance. The assumed performance improvements were thereby kept implicit and were not justified. Involved decision makers in several case studies appeared well aware of this misuse of these scientific formulae. So, worse than the possible technical deficiency of this scientific concept for the assessment of the water requirements seemed its systematic misuse and mechanical application to justify projects rather than to assess their feasibility.

The Economic Internal Rate of Return (EIRR). Figure 8 shows a persistent gap between the EIRR at appraisal and audit. What explains the existence of this persistent gap? Is it the technique of cost-benefit analysis? Indeed, many professionals have criticized the adequacy of the cost-benefit techniques for development investments.[242] For example, Roe has argued that because development investment projections are highly speculative, the venture-capitalist approaches of feasibility assessment would be more suitable than the traditional cost-benefit methods. Such venture-capitalist approaches typically start with an assessment of the proposed management framework and capacity.[243] Traditional appraisal techniques, in their usual application, tend to ignore the existence of such management problems, according to Roe.

Yet, after two decades of systematically disappointing irrigation investments, this study's observations suggest that little speculation seems left for such projections. Especially the performance achievement and the implied management inputs by agency staff can easily be assessed based on their probability in view of related experiences and achievements by the same agency or in the same region (as already explained in the section on Physical Performance Assumptions in Feasibility Assessments).

Heaver has written another criticism of the cost-benefit analytical practices. He has argued that management skills are not considered a scarce resource in any of the investment appraisal manuals of economists such as Squire and van der Tak (World Bank), and Little and Mirless (Overseas Development Administration): "The contention is that as an economic appraisal guide, management is outside its brief; and yet management problems have a direct impact on the IRR."[244]

A senior World Bank staff member has suggested even the existence of an inverse relation between a high estimate of the EIRR and the management capability of the recipient. He has thereby criticized the World Bank's related inability to determine a project's feasibility as follows:

> "...one sees very high rates of return for project rehabilitation--a bad rather than good omen. When one sees a high rate of return one can best become particularly skeptical of the institutions and carefully set forth institutional rehabilitation and change as prerequisite to any system rehabilitation. One does not often find high rates of return for project improvements on well managed projects and there is a reason--sound management prevents massive rehabilitation."[245]

The method of shadow-pricing is another frequent subject of criticism as well. Much effort tends to go into this aspect of the financial feasibility assessments to compensate for distorted market prices "even when the poor quality of the data available makes such refinement often questionable".[246] Carruthers has contended in this respect that progress toward economic efficiency is likely to be slow if shadow prices are used to create a "shadow" world while engineers cannot "lift the telephone and find the shadow price of cement and be confident that there is financial support for shadow pricing procedures"."[247]

Similarly, the sensitivity and risk analysis of the traditional cost-benefit analysis has been attacked occasionally. In all case studies, they did not reflect the probable risks, especially not those implied in the water-related performance assumptions. De Leeuw has made similar observations.[248] Besides, in all case studies the sensitivity and risk analyses were observed to be used at a stage in the decision making, typically at the end of the preparation period, that the results were not allowed to cause a fundamental reassessment of the planned investment anymore. Tiffen has generalized this for the whole development business.[249] Also, several interviewed senior donor staff stated that they did not know of any example where sensitivity analysis had led to a loan refusal.

Another criticism of the cost-benefit techniques is on the financial implications of the project risks for agencies or farmers. These were not calculated in any of the case studies. De Leeuw has observed a similar case in Kenya's Bura system. He has calculated for Bura that the 1.5 per cent reduced EIRR, resulting of the sensitivity analysis, did not show the related 21.5 per cent reduction of estimated farmer income, neither the estimated annual loss of US$ 6.3 million (rather than a profit of US$ 1.4 million) for the managing agency.[250] Such neglect of the financial risks for individuals or agencies seemed caused by the general bias of feasibility assessments toward the economical rather than financial feasibility. Also Tiffen has argued this extensively. She has remarked in this respect that the official irrigation investment manual of the World Bank/FAO Investment Center neglects to look into such financial aspects.[251]

The following quotation of a specialist internal donor review of the risk analysis for investment selection has made clear what the relative value of such analysis is if everybody is geared toward project justification (rather than toward feasibility assessment):

> "Again we may ask, would a Risk Analysis incorporating probability distributions for the major benefit components have served any useful purpose? Read carefully the Appraisal Report presents a cogent case against the project. The base case EIRR barely tops the Bank's assumed cut-off rate of 10 per cent. The Sensitivity Tests indicate that a combination of a cost overrun of 10 per cent and a one-year delay in construction would reduce the EIRR to 6.5 per cent, while the reduction of the urea prices by 10 per cent alone would be sufficient to draw the EIRR down to 7.7 per cent. With this information the decision makers in the Bank could have put together a worst case scenario that would have come very close to an accurate prediction."[252]

Overall, worse than any deficiencies of the technical approaches of cost-benefit analysis seemed therefore their systematical misuse and mechanical application to justify projects rather than to assess their feasibility.[253] Roe's following generalizations are in line with this study's observations:

> "...project appraisal techniques, especially those of cost-benefit analysis, have been more abused than used. No set of techniques can correct for inadequate data or compensate for unreasonable assumptions. No procedure can stop an evaluator from massaging the analysis in order to justify a choice already made using different criteria. Donors need to move money and developing countries try to maximize their presence in rural areas by the number of development projects there. In this view, bad project appraisal and subsequent poor project performance are not so much causally linked as they are both outcomes of a decision-making process

motivated by objectives other than purely those ensuring project success."[254]

The design concepts. The above section on The Observed Management Processes argues that the decision-making processes about the requirements for the design occurred in all case studies only at conceptual levels. Engineers of donors, consultants and irrigation agencies together seemed to determine these concepts and to adjust them regularly. No interaction with local system managers and farmers was observed for the determination of an explicit "program of requirements" in any of the case studies. The resulting rigid application of the different design "blueprints" with insufficient localized information was observed to be widespread. It led to almost random turnout sizes, often arbitrary placement of structures, the planning for unsuitable soils and cropping patterns in the design, and the suboptimal use of existing reservoirs and drainage lines. Although substantial opposition against these design blueprints can be found in the irrigation management literature[255], all the observed funding institutions had accepted them. From their perspective, the advantage of the conceptual design seemed that issues such as the service delivery and the agency's related management control could be circumvented, while still having a "solution".

Although new substantive design concepts are important, so are the decision-making processes of the definition of a "program of requirements" prior to a design. Especially the decision-making processes by those who have to make the structures work, the agency and the farmers. The recent design concepts seemed to have underestimated such required time-consuming negotiating processes, resulting in explicit water rights and allocation plans, rules and procedures. In general, conceptual designs ignore the importance of such a process.[256]

This study's observations suggest also the need for a certain qualification of the importance of design concepts. Apart from the fore mentioned importance of the process of design, the actual organization's goals seem a major influence on the usefulness of any design concept in place. Without the will to manage, no design concept is "manageable". Similarly, if the objectives are right, every design is to a certain degree "manageable". In a situation where the agency and farmers support the performance objectives, every design becomes to a certain degree "manageable", whether it were traditional, modern, flexible, simple, least-cost, or even dilapidated.

Theoretical solutions and commitment to performance. Implicit, and sometimes explicit justifications why an investment would not become another failure were thus observed to be mostly theoretical rather than related to real-life. The different observed conceptual, technical approaches developed to overcome the "management gap" (such as the parallel field canals, on-farm water management, O&M manuals, water-management consultants, farmer participation and monitoring and evaluation) did not increase the commitment to performance of the agency and government as they did not touch upon the performance and accountability issues. In fact, these solutions increased the donors' influence in the actual investment planning and design, whereby the agencies felt increasingly less responsible, resulting in a diminishing commitment from their side.

If the national agency or government was unwilling to adopt such conceptual solutions, the observed funding agencies appeared to enforce them through, for example, the conditionality of loans. In the Sri Lankan case studies this was observed for certain design concepts. Initially, in some cases, the national agencies, or individual engineers, resisted such conceptual solutions based on their real-life experiences with the functionality of the traditional design concepts. Though several interviewed engineers in Sri Lanka, Philippines and Morocco remarked that such resistance in favor of the quality of the investment decisions has weakened considerably in their countries, mainly because of the general priority to acquire external project funding. Thus, sequential conceptual solutions established in a donor-driven mode[257], seemed to have produced progressively less and less commitment to their actual feasibility by the national agency staff.

Incentives for theoretical solutions. Ironically, the systematic tendency to be over-optimistic about investment objectives, and the absence of the related checks and balances, seemed a major stimulus for the development of conceptual solutions. Project officers of donors, consultants and governments continually had to justify technically and economically why a new investment, unlike earlier failures, was likely to be a 100 per cent success. All sorts of theoretical solutions have evolved over time as project justifications. Examples are the on-farm water management, canal lining, modern or simplified design concepts[258], water user organizations, water management consultants, O&M manuals, improved management procedures and institutional development. These solutions tended to be considered managerially and politically neutral, and the implied assumptions of improved management and political inputs were either ignored, or considered unscientific (i.e., not in line with the pure, scientific logic). So quantity appeared supported by a dogmatic application of conceptual solutions.

PRESENT MANAGEMENT PERFORMANCE: THE LEVEL OF SOPHISTICATION

Chapter 4 contains the assessment of the management performance for the capacity utilization in the four different countries. For capacity creation this assessment was done in detail for the Sri Lankan case studies, and appeared to occur at very low levels of sophistication. For donor-funded, capital-intensive investment in irrigation these levels of sophistication can be considered essentially the same in all case studies, as the donors appeared to dominate quality of this decision making. The national inputs to this quality tended to be minimal, as described before in this chapter.

The political nature of the capacity creation processes makes it also less appropriate to make a quantitative comparison between different countries. Therefore this section gives a broad quantitative judgement based on the four criteria underlying the concept of the levels of sophistication. Annex 1 gives the related descriptions of the levels of sophistication for the different key decisions.

Feedback. National politicians tended to take the decision on the general desirability of an irrigation investment. Feedback on that desirability from such stakeholders as the existing local community, the future beneficiaries, the different agencies, the individuals in those agencies, and the local politicians was usually absent or ignored. Similarly, for donor-funded, capital-intensive investment in irrigation, no feedback about the investment's real-life feasibility or functionality was usually obtained from such relevant sources as the involved agencies, related publications, the local communities and the beneficiaries. The generally applied conceptual approaches did not require feedback of any real-life experiences. Overall, a very low level of sophistication (0-20) was observed.

Foreseeing. The establishment of the desired objectives of the investments tended to occur in an ad hoc manner at very high political and donor levels. Usually there was no consideration of the sustainability during the investment's lifetime of such desirabilities of the investment as the cropping patterns, and the areas to be commanded after system degradation. Similarly, the sustainability of the investment's feasibility and functionality during its lifetime after potential environmental changes such as crop diversification or the deference of maintenance and system degradation, was usually not considered. Overall, a very low level of sophistication (0-20) was observed.

Integration. Irrigation investments were often considered a "privileged" solution. The mutual influences between the investment's desirability, feasibility and functionality for irrigation purposes and other interests such as off-farm employment or environmental sustainability, were thereby usually not considered. Also, no integrative perspective was taken in all case studies of the mutual influences on the quality of the capacity creation of different feasibility aspects such as the watershed management, the dam sites, the command area, the suitability of soils, the water-delivery concept, the water efficiencies, the cropping patterns and intensities, and the maintenance and settlement. Especially, the management-related assumptions underlying these feasibility assessments were not considered. Instead, one-dimensional, disciplinary approaches were applied to facilitate "quantity". Overall, a very low level of sophistication (0-20) was observed.

Systematics. A certain routine, and even rules, were observed to exist about the need for an investment's feasibility assessment to consist of the different phases of the so-called "project cycle" (such as the identification, the feasibility, and the appraisal studies). This suggested a low to average level of sophistication (20-60). Yet, no requirements existed toward the more quality-oriented interests. For example, no "remedial principle" tended to be applied. Neither existed any requirements about the involvement, the responsibilities or type and frequency of consultations with the different agencies, the government and the beneficiaries to assess, for example, the feasibility of restricting the excessive water use by a system's head-end reaches. Consequences of the absence of such rules were the inconsistencies in the sequential assessments of an investment's feasibility and functionality, a large room for subjective assessments, and the absence of a matching of the perceived and actual feasibility and functionality. This suggested a very low level of sophistication (0-20). Overall, a low level of sophistication (20-40) was observed.

REQUIRED CHANGES IN PROCESSES TO IMPROVE CAPACITY CREATION

Higher levels of sophistication of the capacity creation would require in all case studies a more explicit incorporation of experiences into the preparation and implementation of the involved decisions. These are likely to enforce some moderation of the dominating influence of the overoptimistic assumptions. Such information would require more related interaction with such stakeholders as the local communities, the system managers, and the farmers, and also would require references to publications on previous experiences.

A higher level of sophistication also would require the decisions on capacity creation to cover explicitly the "program of requirements" related to a pursued level of service and other performance targets for the investments. Without such explicitness, the achievement of the observed implicit assumptions could not be assessed, thus underperformance remained misunderstood, and no lessons were learned.

Higher levels of sophistication also would require the consideration of the mutual influences of the different aspects of the feasibility assessments and the project design such as the dam sites in a water shed, the water duties, the related water-delivery concepts, the cropping patterns, the cropping intensities and command areas, the full reservoir levels and dam heights, the inundated areas, the required resettlement, the maintenance levels and the related life spans of projects. The mutual interrelations of these aspects should be considered, rather than considering only the unrelated outcomes of the tasks of the separate subject matter specialists. More integrated water basin and system development concepts are required without resorting to blueprint approaches that tend to ignore the relevance of localized experiences, information and interests.

Higher levels of sophistication also would require the consideration of the mutual influences between the different design aspects such as the system layout, controllability of flow, peak irrigation requirements, the required management inputs of agency staff and farmers, the non-irrigation system functions, and the time-consuming processes required for adjusting these to each other in a specific location. This again would require interactive rather than conceptual design.

All the above seemed only likely to occur if the staff of the donor, consultants and agencies would not become more neutral in their feasibility assessments. Project desirability from a political and donor perspective should therefore not overrule all other capacity creation decisions any further without taking any consideration of the performance-related aspects. This would require more accountability of the donor, the government and the agencies for the *quality* of the investment decision making, and less influence of spending pressures, i.e., of *quantity* on the investment decision making. It also would require fewer interventions of outsiders in the details of this decision making as this was observed to dilute the local accountability for the success of irrigation improvements.

CHANGES IN MANAGEMENT CONDITIONS REQUIRED TO IMPROVE CAPACITY CREATION

This section identifies those changes required in management conditions that are likely to lead to improved capacity creation processes (step 4 in Figure 3 of chapter 3). The improvements in the processes of capacity creation in the previous section are the basis for the changes in the management conditions.

The following classes of management conditions are considered: human resources, provision of information, financial control systems, provision of knowledge, and organizational rules and structure. A change in one management condition may require complementary changes in other conditions. Overall conclusions and recommendations of required changes are thus best considered in an integrated manner.

In real-life irrigation, the management conditions for capacity creation and utilization are, to a large extent, the same; the same organizations, people, systems for accounting and budgeting, etc. tend to be involved in both areas of concern. Though the requirements regarding these management conditions of the different areas of concern are likely to be different. Chapter 6 integrates the findings of this and the previous chapter. It therefore deals with the required changes in management conditions and the required management-control processes (step 5) for capacity utilization and capacity creation in an overall and integrated manner.

Human Resources

Decisions are always made by people. So people are the most important management condition in an irrigation system, like in any organization. In Chapter 4 it was remarked already that the attention of irrigation professionals for this important factor of management control has come only in the 1980s.

Observed constraints in the provision of staff. Several deficiencies in the irrigation agency's human resources were observed in all case studies. The major single weakness toward improved capacity creation was observed to consist of the low motivation of all staff to put much effort in the quality of their assessments. Just like for the capacity utilization, the tendency of all actors involved in capacity creation was to minimize their management inputs. Simultaneously, they tried to minimize the complaints from the local communities, politicians, subordinates and superiors. The attitudes of agency staff tended to impede effective information exchanges about the capacity creation.

Just like for the capacity utilization, the attitudes and behavior of the engineers toward the farmers tended to be top-down and hierarchical. So the agency staff appeared to discourage such information exchanges. Of course, exceptions to this general picture existed as well. Although the present focus on quantity rather than quality, and the lack of any accountability for performance in the whole process, was observed to sustain, and even to stimulate, such attitudes of the agency and government staff toward subordinates, farmers and other sources of local interests. The same processes seemed the likely cause for the observed arrogant attitude of a considerable portion of the interviewed donor staff, something that a former World Bank Director has remarked to be more systematic.[259] Yet, decisions on the quality aspects of the capacity creation would require more long-lasting, systematic and time-consuming interaction between all involved actors.

An important constraint for this decision making was the observed lack of neutrality and independence of all involved assessors of an investment's desirability, feasibility and functionality (as follows from earlier quotations on pages 143 to 145).

The technical knowledge of the agency staff was observed to be of a sufficient level for capacity creation in all case studies. The technical expertise of expatriate consultants seemed only necessary in capacity creation for very specialized technical issues such as major dam construction.

Motivation and incentives. Heaver seems to have touched the right point when he argued that most development professionals erroneously assume that people "want to but can't" (i.e., are motivated by social responsibility only), rather than the more real-life "can do much better but won't".[260] Chapter 4 has mentioned the multitude of positive incentives for staff to be involved in construction and maintenance, and the negative incentives to be involved in capacity utilization. This chapter has shown that in all key decision-making processes the incentives and motivation in capacity creation were observed to be oriented toward the quantity of output, rather than toward its quality. Any solutions to improve the quality of the capacity creation decisions will have to address this crucial constraint.

Such incentives for short-term quantity targets were observed to be stimulated in all case studies by a similar priority of the donors and the national politicians. Changes by the irrigation agencies, and thus in the management inputs and attitudes of their staff, seemed therefore unlikely without changed priorities from these actors. The required political maturity is not always present in the developed countries, let alone in many LDCs.[261] Yet, donors could be expected to be more prudent in their investment procedures, and by that attribute more value to performance in all key decision-making processes.

The management of human resources. What human resource management (HRM) measures can reduce these deficiencies in managerial attitudes and behavior? Specific management training may be capable of changing such attitudes to a certain degree, or at least increase awareness about them.[262] Improved management skills of above actors are required, though they may not evolve from increased awareness only. The potentially evolving attitude and management changes seemed unlikely to be sustainable without the development of more priority for the quality of the feasibility assessments, and thus ultimately for the performance. And this would require related incentives for all involved staff and/or the farmers.

The introduction of such incentives would require the introduction of more performance-based career and salary systems. Chapter 4 has already discussed the observed constraints in all case studies for the introduction of such systems as the central governments tended to control them. Besides, the central governments appeared unwilling to introduce performance-related salary systems for (only part of) the government apparatus. Still, decentralization of the responsibility for such HRM policies seemed a necessary change in the management conditions if performance improvements were to be achieved in all case studies.

Provision of Information

Information is crucial for effective and efficient management of an organization. Decision making relates to processes in the minds of the different involved actors, that essentially depend on information for its preparation. Decision making involves choices among alternatives, among different compositions of information. A decision is essentially a transformation of information.

Observed constraints in the provision of information. The levels of sophistication of the decision making on the capacity creation was observed to be very low in all case studies. The achievement of a low level of sophistication of the decision making about the desirability of the investments, what their feasibility is, and what their functions should be, all require more explicit provision and incorporation of information on obvious experiences into the preparation and implementation of these decisions. The achievement of an average level of sophistication of this decision making requires a more explicit provision and incorporation of the information on the most important experiences in this respect.

Relevant experiences, preferences and requirements are those related to investment objectives such as the desirable and feasible levels of service, water-delivery concepts, cropping patterns, calendars, and intensities, resettlement and environmental sustainability. Though they also include the relevant experiences with the feasible investment assumptions such as the levels of maintenance, the project implementation schedules, and the life span of the investment.

Relevant experiences, preferences and requirements for the system's functions are the (peak) irrigation requirements, the required controllability of the main system, the hydraulic and managerial responsiveness, the communication requirements, the system layout, the drinking water and bathing requirements, and other functions of the system's canals and reservoirs. Though also those experiences about the necessities required for the sustainability of the system's functions during the investment's lifetime such as the medium- and long-term (peak) irrigation requirements, the passive and active controllability of flow after system degradation, and the long-term flexibility to diversify the cropping patterns.

The achievement of a low level of sophistication (i.e., 20-40, see also Annex 1) also would require information about the convincing mutual influences between different feasibility assumptions such as the dam site and the soil suitability, the dam site and the environmental sustainability, the maintenance levels and project life, the dam site and water duties, the managerial capacity and motivation and the water duties.

The achievement of a low level of sophistication of the decision making on the functional requirements also requires information about the convincing mutual influences between the different requirements such as between the rationalized turnout concept and such others as the organization of water users, the limited peak canal capacities, the improved water duties, and the envisaged command area. An average level of sophistication (40-60) also would require information about the mutual influences of directly related requirements such as the unsteady flow conditions and the management inputs.

The achievement of a low level of sophistication also requires information about the 75 per cent dependable regulated flow, or any other level that is considered feasible to achieve the other pursued investment objectives.

Most of the above information was not considered in the decision making on the capacity creation in all case studies. Yet, most of the above information could be provided by the relevant local communities, the system managers, and the farmers. This is likely to require time-consuming, long-lasting interactions with such stakeholders. It also may require references to publications on such experiences. Some types of the above information would just require the related measurements, or a more serious data processing. Thus, the provision of the above information requires increased management inputs by the responsible staff levels in all case studies. These seemed unlikely without an increased priority of the head office, government and donor for the quality of the decision making about the capacity creation.

Presently, instead of relying on the information from local communities, beneficiaries, and staff of managing agency for feasibility and appraisal assessments, the quantity and time factors were observed to stimulate donor staff and consultants to rely on simulations of reality in their assessments. So they banked on theoretical assessments of water requirements, surveys of soil and topography, and other assumptions underlying their assessments. Of course, it would not be cost effective to collect all possible information required for a perfect assessment, especially in LDCs where "there will never be enough funds or enough scientists to cover all aspects of information needed for thorough prediction . . .".[263] Yet, almost no information reflecting the real-life desirability, feasibility and functionality of the investment is the other end of the spectrum.

Errors. An additional problem for the actors involved in capacity creation was the errors in the available information, and the difficulty to collect higher quality information under the existing time pressures.

Information on the desirable and feasible investment objectives, and what the functional requirements for the investments should be, appeared almost impossible to collect for outside donor staff and consultants in a situation of little commitment to performance targets. Their usual short missions aggravated this. So, their assessments were very conceptual, thereby ignoring the management realities.

Also the physical information required for the conceptual assessments such as soil and topographic data appeared often unreliable due to the low motivation of the involved staff to provide quality, and the difficulty to check that quality. Carruthers and Clark have generalized an extensive list of frequently occurring data errors and insufficiencies, and the related reasons.[264]

Information provision and organizational structure. In all irrigation systems, the required quantity and quality of information about the requirements and opportunities of farmers and agency in the capacity creation seem enormous. This is due to the high variability of soils, topography and socio-economic situations, and the considerable geographical distances. Especially in LDCs, the large numbers of farmers in large-scale smallholder systems aggravate this information load. It becomes even more cumbersome with high intensities of flow-control structures. In practice, the observed low quality of the capacity creation seemed also directly related to the time-pressures under which such information had to be collected.

These huge information needs easily cause information overloads for higher hierarchical levels of staff and consultants. Instead, it has led to the mentioned conceptual solutions that require comparatively little information. The lower quality of the decision was thereby taken for granted; like for the capacity utilization, also for the capacity creation slack resources tended to replace information exchanges and collection. Probably this choice for slack was to a certain degree a conscious one in view of the limited capacity in all case studies to collect such information. Carruthers and Clark have also made generalized suggestions for all LDCs in this respect.[265] Yet, to a certain degree the slack was observed to be hidden behind the conceptual approaches.

These conceptual approaches were also observed to have facilitated a very centralized mode of capacity creation with the center frequently in the headquarters of the involved donor or consultant, rather than at system level. Such centralization in itself was observed to constrain the collection and consideration of field-level information.

Also for capacity creation, the achievement of higher levels of sophistication therefore seemed to require more decentralization of the information collection and processing. Unlike for the present conceptual assessments, lower levels of agency staff should collect such information. In addition, lower echelons of the extension staff, the consultant or the contractors could be involved in such assessments. Although agency staff should determine the guidelines about the feasibility and functionality criteria as they have to make them feasible and functional after the construction anyway.

Potential and logical units of decentralization are either the system level, or the subsystem served by one or more main, distributary or lateral canals. Generalizations about the appropriate level and size for decentralized units are difficult to make, however. Such generalizations cannot depend on information considerations only, but depend also on the coherence of the problem. Some relevant factors are discussed in the section on Organizational Rules and Structures.

Given the likely pressures by localized interests for favors, higher qualities of capacity creation probably can be achieved only if the decentralized units have incentives to achieve them.

Financial Control Systems[266]

Financial accountability for the managing agencies. The observed tendency and attitude of irrigation agencies was to go for the maximum investment they could justify, rather than for the minimum investment to achieve the same objectives. This tendency seemed to be caused mainly by the method of financing the agencies. There appeared to be no relation between their finance, either through the government's budgetary allocation or the "free" loans for capital investment, and the quality of their capacity creation and the ultimate water-delivery performance. Two obvious measures may improve the distorted financial set up for the agencies: 1) the development of a direct linkage between the agency's finance and the quality of the capacity creation decisions, and the ultimate water-delivery performance; 2) the reduction of the proportion of unconditional subsidies as the agency's finance. These two are elaborated upon hereafter.

The most direct linkage between an agency's finance and the quality of its capacity creation can be achieved through *cost-sharing* of the capacity creation by the beneficiaries. This is likely to enforce some financial accountability toward real-life experiences, requirements and preferences. Especially in view of the fore mentioned large quantities of information required to achieve higher levels of sophistication such financial accountability toward the system's clients for the capacity creation seems the most logical way to ensure quality improvements. This is likely to be strengthened if the agency is also financially accountable to the farmers for the the water-delivery performance (e.g., if service fees are a major part of the agency's finance).

Yet, the agency will only become seriously accountable to the farmers through cost-sharing if the current dominance of *unconditional subsidies* on the agency's finance gets reduced. This requires both the reduction of the observed systematic misuse of the cost-benefit analysis, and the unconditional budgetary allocation to the agency. Both are discussed below.

Several evaluators have even recommended to abandon cost-benefit analysis for irrigation investment as this would lead to better feasibility assessments as such, and thus to better capacity creation.[267] Though this may be true in some cases (e.g., under least-cost investment approaches at a realistic implementation speed), abandoning cost-benefit analysis would institutionalize the subsidized nature of irrigation investment even more than at present. Besides, the checks and balances on cost control are likely to become even weaker than observed. Abandoning cost-benefit analysis seems therefore not a good solution either.

Despite the theoretical purpose of the cost-benefit analysis as a guide for substantive choices, its practical role appeared more for facilitating unconditional subsidies for irrigation investments and irrigation agencies. A major challenge seems therefore to reduce the hidden subsidies in the present application of the cost-benefit analysis, and thus to refurbish the cost-benefit analysis as an instrument for feasibility assessment rather than for management (un)control.

The introduction of checks and balances on the reliability of the assumptions underlying the economic feasibility seems the most logical direction to enforce the systematic introduction of more realistic assumptions by investment assessors and designers. It will enforce a more realistic economic, and thus indirectly also financial, value for the created capacity and for the management of the capacity utilization.

Although several senior development professionals have pleaded the usefulness of checks and balances on overoptimism,[268] they were unable to reverse them systematically. The only exception observed during this study was ADB's control in recent years of its hereto average cost overruns. Of course, such control over the average cost overruns does not necessarily exclude further manipulation of the individual assessments, but it showed serious efforts to reverse the tide for this assumption. Yet, the World Bank did not seem to make serious, or at least effective, efforts in this direction.

Given the existing pressures and incentives on donor and recipient actors, how can more realistic assumptions be enforced? An earlier quoted report that had to investigate the question "Does Aid Work?" for the Development Committee (i.e., the Joint Ministerial Committee of the Boards of Governors of the World Bank and the IMF), has acknowledged the systematic over-optimism, and the resulting conflict between quantity and quality. It proposed the so-called "*remedial principle*" to make feasibility and appraisal assumptions more realistic, as described below:

> "Among common deficiencies at the appraisal stage are excessive optimism, against the evidence, over project completion times; poor appreciation of recipient capacity for administration and implementation; over-optimism regarding the time and resources needed by the recipient to take over the project, or for it to become self-reliant; and the lack of proper forecasting of effects on intended beneficiaries. Action should be taken on all these points. On the first three, the 'remedial principle' is once more relevant."[269]
>
> "Strengthening the incentives for quality lies in part in applying the 'remedial principle' referred to above, that new loan preparation explains how problems encountered in old loans will be overcome. This should be observed at all stages of preparation, beginning with design and appraisal. Monitors and evaluators will then have something additional to monitor and evaluate: whether problem avoidance procedures have been followed, and whether they have been successful . . .
>
> Once again, agencies differ in the extent to which the 'remedial principle' is already embodied in their project work. Some agencies regularly include a section on 'lessons of past projects' in appraisal reports, but they are not always incorporated with great seriousness--just as requirements to cover 'environmental impact' of projects are often ignored."[270]

Yet, the above definition of the "remedial principle" leaves open if the problems in old loans can be encountered through a new project concept (i.e., by new approach of the inputs), or by more realistic performance assumptions (i.e., by more value for the output expectations). It seems thereby a vague concept toward the crucial accountability and performance issues.

This study's observations suggest the need for more emphasis on the definition of the output expectations and clarity about the related accountabilities. A systematic way of implementing this type of remedial principle would be the introduction of a *"Performance Improvement Assumptions Balance Sheet"* (or *"Agency Performance and Accountability Sheet"*) in all assessments of an investment's feasibility, loan appraisal and functional requirements. Such a balance sheet would explicitly show the existing and assumed average performance achievements of the involved irrigation agency for key indicators (such as the level of service, the water duties and efficiencies, the cropping intensities, and the level of maintenance service). Such a balance sheet forces assessors to make explicit if they assume a pragmatic 10 per cent improvement, rather than an overoptimistic 100 per cent. The sheet also could make the risks implied in these assumptions for the investment's EIRR explicit. All assumed performance improvements in the investment appraisal would have to be justified based on agency commitments to improve. The way the agency wants to achieve these performance improvements should become completely at the agency's or government's discretion, whether through increased participation, automatic flow regulation, or systematic staff performance evaluation. *What matters is not their achievement to build or implement such measures (i.e., the input), but their achievement of the assumed performance improvement (i.e., the output).*

The achievement of such commitments should be part and parcel of the balance sheet of every successive donor-funded investment by the same agency. So that gradually loan approvals become at least to some degree conditional to the quality of the capacity creation decisions and the ultimate water-delivery performance. And attribute thus at least some value to this quality. The pursued accountability can only work if *all* major funding agencies seriously apply the same performance and accountability balance sheets. Else the credibility of its conditionality can be easily undermined, as, for example, Olivares has described for the World Bank.[271]

Does such conditionality exist yet, and what are the related experiences so far? Some preliminary experiences with such conditionality to performance improvements were traced for this study. US AID has experimented recently in some Indian states with the above type of conditionality for irrigation investment. Its success was apparently modest, most probably because US AID's leverage toward these irrigation agencies has reduced considerably after its decision to stop investment in the irrigated subsector. Yet quite successful was, according to an interviewed US AID officer, the recent conditionality in Sri Lanka's Mahaweli system B of loan disbursements for irrigation construction on the actual implementation of a water allocation schedule in the new canals. US AID checked the latter through random on-site sampling of the actual implementation of the schedule. According to the project officer, this type of conditionality had completely changed certain priorities of the responsible project engineer.

Outside the development business, conditionality of loan availability on performance appeared a standard banking practice nowadays. If a company does not perform well, it appears normal for a bank to make further loans conditional on, for example, a certain level of turnover in the coming year. This type of performance-oriented conditionalities apparently tends to replace the earlier general practice of private banks to intervene more in the client's operation to ensure higher performance[272] . . .the similarities with development banking in this respect seem obvious.

A logical and related effect of the manipulation of the assumptions pertaining to the EIRR is the decreased control over capital expenditures from the national point of view. Also Small has remarked this.[273] Limits on the expenditures per chosen unit were also observed to be non-existent in all case studies. For example, the maximum investment per settler, per increased agricultural production, per unit of volume stored or regulated, per job created, per area commanded were seldom determined. Steekelenburg has observed this as well in all 11 African case studies of the comparative impact study of the EEC.[274]

The absence of any related control was observed to lead to maximizing investment attitudes by irrigation agencies and politicians at great economic loss for the overall country. For example, for the Moroccan irrigation authorities it was observed to be more attractive to modernize an 80 kilometer main canal for US$ 50 million, rather than to hire two persons to manage the existing water flows better and get the same result! Such processes cause excessively high average subsidy levels similar to the 83 per cent of full costs, as have been reported for the irrigation subsector in the USA.[275]

Society has made such sacrifices for the irrigation subsector because many felt that irrigation has many economic spin-offs and benefits that a cost-benefit analysis does not cover.[276] Economists have disputed such reasoning with some fervor as similar indirect benefits evolve from any type of investment.[277]

Aluwihara and Kikuchi have developed a remedy against the impact of overoptimism on the national opportunities. Their remedy moderates simultaneously the size of the unconditional subsidies in the irrigation investments. For Sri Lanka they developed *country-specific norms* in the form of the maximum costs per unit area for new construction and rehabilitation unit. As they were based on the probable performance achievements, they prevented overoptimism in the assessment of the opportunities of the investment funds.[278]

Reducing the unconditional budgetary allocation for investment to the agency by the central government requires more *financial independence* for the agency. Irrigation agencies would then operate like other utilities as those for water supply and electricity. Such financial independence would fit well with the fore mentioned financial control changes of cost-sharing in capacity creation by farmers, and increased financial accountability to the clients for the service-delivery performance. Such financial independence has proven to have impact on the investment mode. For example, after an increased financial independence of the irrigation agencies in New Zealand the investment pattern has apparently switched overnight from a maximizing to a minimizing approach.[279]

Financial accountability of the funding agencies. Related to the implementation of the proposed checks and balances is the question why donors have not done so long ago? It appeared that the donors were not financially at risk, or accountable, for the quality of the investment decisions as well. As the national governments guaranteed the loan repayment to the international development banks,[280] and governments did not make the agencies accountable for repayment, no organization or actor was accountable for the quality of the capacity creation. The accountability for quantity further constrained the accountability for the performance of the capacity utilization. Only the general tax-payers in donor and recipient countries seemed (unknowingly) financially at risk as ultimate financiers of the performance deficiencies in the irrigation subsector. Repetto has generalized this to all LDCs and financing agencies as follows:

> "Even external financing agencies, such as the multilateral financing banks, are not dependent for debt service and repayment on the results of the specific projects to which they lend. At times, large, non-controversial projects that development agencies could support have been scarce, and irrigation projects have accounted for a large, steady flow of new lending. Irrigation specialists within those agencies naturally prefer a high level of activity and engineering consultants and construction firms in the lending countries depend on it (Carruthers

> 1983:96). As a result, financial discipline over investment decisions in public irrigation systems is structurally weak, from farmer to international banker, because no party --except the general tax payer-- is seriously at risk. At the same time, because rents are so large, the pressures for new investments are strong . . .The main problem is that, unlike in private investment decisions, neither financial responsibility nor the need to repay capital invested in the project imposes a check against inaccuracy and bias in the projected returns."[281]

Still, the conflict between quantity and quality is not a new one. Repetto has written about the related lack of accountability in 1985, and Cassen in 1986.[282] At the same time when also Yudelman has made suggestions for more realistic assumptions. Yet, very little action has been undertaken so far, and the same heroic assumptions were observed in the ongoing investment decisions,[283] like they were before. Several interviewed staff members of the World Bank and ADB stated that generally the accountability of the recipient agencies was considered a non-issue in the international development banks. A likely reason is Cassen's argument that they assume that the excellent professionalism of their staff would cover the "quality" sufficiently. The financing agencies thus seemed to bank on social responsibility of their professionals rather than on accountability.[284]

Some interviewed donor staff and others[285] have argued that the divisions of the development banks know a shared accountability for the quality of an investment decision. Yet, they acknowledged that such shared accountability easily evolved into no accountability. They also tended to consider individual accountability inappropriate, and even beyond discussion. Cassen has made this point as follows: " . . .while there are many reasons not to hold project staff personally responsible for the ultimate fate of projects, they could be rewarded when projects go well."[286] Cassen's remark has implicitly referred to the political nature of this investment decision making, which makes it difficult to hold individuals responsible for the manipulation of assumptions. Yet, this does not mean that checks and balances and individual accountability would not be beneficial.

The accountability of the development banks for the quality of its investment decisions would benefit probably from increased financial risks for these banks for the performance of the individual loans. For example, through providing (part of the) loans directly to irrigation agencies, rather than through the national government. Although national governments still may have to guarantee the repayment of loans, the financial implications of low quality decisions are likely to become more transparent.

Policy dialogue. All above financial control issues were stated rather bluntly. Important for such measures to succeed is their support by the national government and agencies, who ultimately have to make it work. This makes it essential to conduct so-called policy dialogues between donors and recipients on the advantages and disadvantages of such measures for the quality of the investment decisions.

Some efforts were undertaken in this direction. In recent years, the donors, especially the International Monetary Fund, have more and more realized that certain changes in government policies were a precondition for effective investments. Therefore, efforts were made to start up the policy dialogues with the national governments. For the development banks such policy dialogue was observed to relate mainly to project-specific issues formalized in loan covenants.[287] More recently, these project-based investments have transformed more and more into sector loans.

Sector loans tend to provide general investment funds for a sector during a certain period, on condition the government commits itself to introduce certain unpopular policies. Yet, accountability for performance achievements was not observed to be brought into this process. The sector loans therefore seemed to cause, to a certain degree, only a strengthening of the bias for quantity, and a further weakening of the accountability for the quality of the decisions about the capacity creation and the ultimate performance. An interviewed senior World Bank staff member argued that the World Bank's leverage toward the large Asian irrigation bureaucracies was too weak to bring performance achievements into the discussion. Though he admitted that it had not been seriously tried as well.[288]

Provision of Knowledge

The irrigation engineering profession was observed to rely for the capacity creation mainly on certain "blueprint" planning and design concepts. The management conditions on which these blueprints seemed implicitly based were non-existent in all case studies, though this gap was much smaller in Morocco. More appropriate knowledge therefore required the development of an engineering profession that does not solely rely on the international reference literature and its generally implicit functional requirements and assumptions. Such new irrigation professionalism should work less with blueprints, and should always test the proposed design criteria and concepts for their feasibility and functionality for specific locations and countries.

Although fewer blueprints seem required, some improved, more appropriate blueprints are likely to facilitate system planning and design. Two specific examples of aspects of more real-life design concepts are the following. A higher level of sophistication would require an irrigation engineering that provides insights on the mutual interrelations between different aspects of a feasibility assessment such as the dam sites in a water shed, the water duties, the related water-delivery concepts, the cropping patterns, the cropping intensities and the command areas, the full reservoir levels and dam heights, the inundated areas, the required resettlement, the maintenance levels and the related life spans of projects. Provision of such system design concepts would require subject matter specialists to work as real teams to identify such interrelations, unlike their present practice to accomplishing each a separate task. A higher level of sophistication of the determination of a system's functional requirements also would require the provision of knowledge about more creative and integrated perspectives on design features such as the system layout, the controllability of flow, the peak irrigation requirements, the required management inputs of agency staff and farmers, and the non-irrigation functions of a system.

The observed knowledge gap of more real-life planning and design concepts seemed caused by the lengthy supply-driven mode of irrigation investment. Initially, irrigation consultants were equipped with knowledge developed during colonial times. Some assumed management conditions of developed countries thus seemed still applicable in LDCs.[289] Though their expertise appeared less applicable nowadays in all case studies, the consultants were observed to play a major role in the development of conceptual solutions. The following processes seemed to cause this. Consultants (and development experts in general) have to sustain their livelihood, and if they happen to get lousy terms of reference, the survival of the company or themselves tends to make them to accept the job anyhow.[290] Similarly, though irrigation investments continued to be disappointing beyond their control--their initial concepts were based on colonial tradition *with* such control--they would always innovate to find technical solutions, ways and design concepts that justified new investments.

Such processes during the past 20 years seem to have slowly evolved into a situation where these consultants and donors together control the current irrigation design concepts, however theoretical they may be.[291] And they were observed to have become more and more theoretical nowadays as the younger generations of professionals, whether consultant, donor, or non-profit, lacked real-life experience in managing irrigation systems.

More appropriate knowledge development requires the development of an engineering profession by the national agencies, that have more potential to determine the real-life feasibilities and functionalities than external consultants and donor staff. Yet, this requires the feasibility and functionality of the investment to become a concern for the national agency rather than these external parties.

Reducing the listed gaps is desirable. On the other hand, the importance of such gaps in irrigation planning and design must not be exaggerated (as some irrigation professionals tend to do). This may lead to a focus on an improved irrigation professionalism only, while leaving the crucial issues untouched. Weak professionalism seems more a consequence of the weak motivation and accountability, and thus of inexperience, to deliver quality, than the cause of it. Improved professionalism can facilitate improvement processes. But it cannot be the sole entrance.

Thus, knowledge must be developed also on how the processes for improved quality of the investment and design decisions could be integrated with the overall financial set up of irrigation investment by the international development banks.

Organization Rules and Structure

Decentralization and the role of the funding agencies. The need for decentralization of the responsibility for the quality of the capacity creation decisions, and the related levels of decentralization evolved from several fore mentioned management conditions. So this section need not repeat that structural aspect. Yet, related to this question of decentralization appeared the present centralized responsibility for the quality--in terms of the conceptual or professional rather than the real-life quality--of this decision making in the development banks.

The role of the international development banks was observed to go far beyond the primary concerns of any normal large bank. Two World Bank staff members have described this as follows:

> "[Other large banks'] primary concern is to provide money for investment purposes, and not to determine whether the technology chosen for the investment makes the most efficient use of resources, whether local people have been trained to master the technology, or whether there has been a thorough assessment of the project on the environment or on the society. What makes the Bank a technological institution is its active role in the choice appropriate to each particular situation and in the mobilization of local technological capacity for the accomplishment of socioeconomic objectives of human development . . .Indeed, we may well be witnessing the beginnings of a new type of technology policy based on financial institutions, unlike our current technology policies, which are based for the most part on research institutions."[292]

Justification by the staff of the observed development banks for their technical interventions was usually the professional quality of their staff compared to the national capacities. Unfortunately, in all case studies the professional donor staff seemed able to address the management bottlenecks only in a conceptual way, through blueprints, and never by location-specific solutions. Besides, the management aspects remained far beyond their control.

These observations suggested that development banks should not really become involved in determining solutions for processes they could not adequately influence, neither could sufficiently understand. "Stick to the Knitting" was one the main lessons advocated by Peters and Waterman's "In Search of Excellence" for successful companies, and this lesson seemed appropriate for the development banks as well. Development banks should stick to banking.

Although as a development-oriented bank they should be aware of an insufficient, ineffective or inefficient level of internal organization, and the related lack of accountability of their clients in an underdeveloped managerial and political environment. Thus, their additional concern compared to a normal bank should be to create and maintain a local and internal concern for performance. This chapter described several related measures, mainly changes in the financial control.

Presently, the interventions of the donors were observed to stimulate the reverse, by making performance increasingly an external concern. Making the specific technological and other choices by themselves as bankers was observed to confuse only the responsibility for the quality and performance by the national parties, and seemed thus counterproductive. To reverse that, development banks could require the national parties to present a fully developed plan, and assess its feasibility in a (quantity-)neutral way. The assessment of the design's functionality would remain a national discretion, although its quality should be enforced through the earlier proposed funding conditionality on performance achievements. And a badly prepared plan would be considered to show a constrained feasibility for outside funding, unless accountability for the quality of the investment decision and the performance were less important.

Such more prudent, essentially economically and financially, rather than technologically oriented funding practices may delay initially the "fund channeling" functions of the funding agencies. But it is likely to sustain a more gradual development that allows the testing of envisaged design concepts and functions. Though such process changes seemed unlikely if donor staff do not become individually accountable for the quality of their investment decisions.

Accountability. Information on an investment's performance in itself was indispensable for any accountability of (the staff of) a managing agency or donor. Yet, the information about the performance of the development investments tended to be confined to the quantity of the actual and target loan disbursements, and the quality of the actual and target project implementation. These performance targets were important for the donors, so the national agencies, government and donors were observed to collect the required information comparatively seriously.

Amazingly enough though, information on the performance of the capacity utilization was not made available in any of the case studies except Morocco. Carruthers has criticized this as follows:

> "...there is a tendency for *ex post* evaluation to be seen primarily as an accounting or audit exercise with a check on the quality of design and supervision. The operation phase is isolated from the main parts of the

project cycle and for various complex reasons, mistakes are covered rather than recorded. In consequence, the learning process, which is conceived to be an integral part of project-oriented development, is very much diminished."[293]

The consequence of the exclusion of the capacity utilization phase from the investment audit was that the project audit at project completion tended to evaluate an irrigation investment and its conceptual design based on its conceptual soundness rather than its actual feasibility and functionality.[294] Only during the mid and late 1980s, the World Bank and ADB have started to assess the performance of their projects five years after their completion. Although donors and national parties alike seemed less good in, if not resisting, the use of such information for improvement of the quality of the decision making about the capacity creation[295], such information's availability is indispensable for the development of any related accountability.

Privatization. One proposed change in the financial control was an increased financial independence for the irrigation agencies. In New Zealand it has apparently reversed the investment pattern overnight from a maximizing to a minimizing approach, as mentioned before. Several professionals have argued that a more financially autonomous status for irrigation agencies is likely to lead to improved investment decisions.[296] For example, Duane has listed the following valid advantages of restructuring irrigation agencies into so-called "public utilities", similarly to such others as the domestic water supply and electricity agencies:

"-avoids a drain on government budgets;
-provides a more certain guarantee (than does benefit-cost analysis) that irrigation investments are worthwhile;
-reduces the political pressures that bias irrigation designs towards maximizing the number of beneficiaries, rather than efficient production; and
-affords more direct public accountability and control over public irrigation agencies and their staff."[297]

As many authors have expressed similar suggestions, the question arises why it did not yet happen?

Irrigation agencies and national planning agencies in all case studies were observed to resist such changes, although this attitude seemed to be changing in the Moroccan and Sudanese case studies. Professionals have reported the opposition to such changes of many lobby groups inside and outside irrigation[298], and so far they were apparently successful. Heaver has described them as the "silent coalitions of indifference"; while internally divided on questions of power and allocation of resources, to the external environment they act homogenous in the collective effort to acquire resources. Simultaneously, they represent the indifference toward the effectiveness of the utilization of these resources.[299]

Another reason the change to utilities was not made so far, seems the fact that the international development banks left the issue to the discretion of the national governments.[300] Yet, more recent pressures on national budgets and on governments by the IMF seemed to induce national governments to take initiating steps toward more financial independence of its irrigation agencies. Given the above resistances Repetto seemed right to have advocated such an interventionist approach by the international funding agencies to break the resistance of the irrigation lobbies in the following citation:

"...strategies for change must either circumvent this coalition by emphasizing private sector irrigation development where it is feasible or break it by imposing greater financial responsibilities, from the top down, on irrigation interests. Rents can only be squeezed out of public irrigation systems step by step--by imposing a repayment obligation for new irrigation and rehabilitation investments on each level of financial authority from national governments to international financing agencies, from provincial governments to and irrigation agencies to the national treasury, from water user associations to irrigation agencies, and finally from individual farm beneficiaries to their water-user associations. If an agency must repay funds transferred to it from a higher level of authority and pay for services it has received, then--like it or not-- it must exert pressure on agencies below to do the same."[301]

Financial autonomy may provide incentives to improve accountability, but does not guarantee it. Without an integrated approach of parallel changes in other management conditions to make the agency accountable for its performance, it also can lead to "adverse incentives". Observed examples in the Philippine case studies were the deference of maintenance, and a focus of management inputs on the cost recovery at the expense of the service delivery itself. Small has also observed these in the Philippines as well as in Mexico.[302] Besides, he reported on other experiences with adverse incentives such as monopolistically high water fees, degrading the environment, or the replacement of recurrent costs with extra capital inputs, if only the latter remains subsidized.[303]

The more independent irrigation government corporations observed in the Philippines and Morocco were not accountable for the water-related performance. Also Korten has remarked this about the Philippine National Irrigation Administration (NIA).[304] They were observed to remain dependent on the government budgetary allocations, and accountabilities for the (partial) repayment of loans were not enforced. The difference with normal line agencies seemed therefore not obvious. Svendsen has remarked this for the Philippine NIA as well.[305] The choices for these structural forms were apparently not very serious and probably merely symbolic[306]. These observations therefore supported Heaver's following statements: "structural reform, therefore, is useless unless the incentives exist for new structures to be used effectively."[307]

The above changes in management conditions are those required mainly from the perspective of capacity creation. A full management perspective requires a simultaneous consideration of the perspective of the capacity utilization. Chapter 6 therefore integrates the required changes in management conditions from both these perspectives, and derives the related management-control decisions.

Notes

1. Pring in Goldsmith and Hildyard 1984:259.

2. Heaver 1982:4.

3. Wade 1983:299.

4. Quotation of the Rubayyat of Omar Khayyam by a senior Egyptian official to describe the atmosphere of the decision making process on the Aswan dam in Goldsmith et al. (1984:251). Its figurative relevance for irrigation is displayed by the following quotation of Chambers: "Performance is poor partly when compared with projections made at the time of planning and design; and these were often unrealistically optimistic. Frequently, they were made to achieve the desired internal rates of return and to placate political interests demanding water in more places. Quite often, water supply was planned to places which could not be served." (Chambers 1988:25)

5. Kampfraath and Marcelis 1981:33.

6. Irrigation professionals have often written about design-management interactions as if design did not involve management decisions. To prevent such inconsistency, this text will use the term design-utilization interaction instead. Though the interrelation between design and its utilization is commonly referred to as "interaction", there is a considerable time gap between them. And objectives during the utilization may have changed during that time. "Interrelation" may thus be a more appropriate description than interaction as the latter suggests a simultaneous relation. Still, interaction is maintained here to keep the relation clear with the other publications on design-management interactions.

7. Small et al. 1989:3.

8. Ibid.

9. US National Water Commission 1973:257; and US Water Resources Policy Commission 1950:76 in ibid.

10. Ibid.

11. E.g., Bellekens 1986:38.

12. E.g., Bottrall 1985:9.

13. Kortenhorst et al. 1989:40.

14. Some well-known examples of geo-political backgrounds are the irrigation in frontier areas in Kenya, Ethiopia and Israel (Steekelenburg et al. 1985:18; Carruthers and Clark 1981:205; De Leeuw 1985:137); transmigration in Irian Jaya in Indonesia; the independent water supply for Egypt by the Aswan dam (Goldsmith and Hildyard 1984:252); the Mazaruni dam in Guyana and Jonglei Canal in Sudan (ibid:258); the settlement in disputed regions under the Mahaweli scheme.

15. This is well reflected in the following citation from Cassen: "Motives for providing development assistance vary, not only among countries, but within one country over time. The first and most obvious is national interest. Donors support countries with which they have, or hope to have, strong ties. Those ties may be cultural, economic , political, or strategic. Britain and France give much of their aid to their former colonies; Japan concentrates its aid in the Asian region; political and cultural relations are evident in OPEC's aid allocations; so are the strategic aspects of the United States' bilateral programme. Donors may also expect straightforward economic benefits--through more trade, obtaining supplies of needed resources, and so on. Or they may look for global and strategic benefits--such as the recipient's political or military support for its position. These motives do not necessarily reflect the condition or needs of the recipients." (Cassen 1986:269)

16. Kortenhorst et al. 1989:40. Other references to frequent or predominant political backgrounds of irrigation investments are made by Carruthers and Clark 1981:3-4; De Haven 1963 in ibid; Chambers 1988:25; Goldsmith and Hildyard 1984:247-264; Laycock 1970 in ibid:260; Repetto 1986; Wade 1976b:63; Bottrall 1985; IIMI/World Bank 1991:38; Heaver 1982.

17. Goldsmith and Hildyard 1984:259; Carruthers and Clark 1981:205.

18. NIA 1990 and Moore 1987:18.

19. NIA earned a considerable income this way; i.e., another incentive to go for projects rather than to spend its recurrent budget (NIA 1990:28).

20. Though this was not topic of study, interviewees in several countries and development banks suggested this to be a major incentive for some countries to attract development funds.

21. Often referred to as the "state within the state" (Goldsmith and Hildyard 1984:262). In the USA they are, for example, so strong that even President Carter in 1980, was "forced to lift his presidential veto on a proposed bill which would have sanctioned $ 4,200,000,000 worth of water projects -- a bill he had previously called "a travesty, wasteful, destructive and expensive" (ibid:263). See also the Economist 1991a. And a Division Chief of the World Bank: "Everybody talks of these agencies as if they were weak, while in reality they are probably some of the most powerful agencies in the Asian continent. The leverage of the World Bank on these agencies is very weak." (IIMI/World Bank 1991:39).

22. De Haven in Carruthers and Clark 1981:4.

23. Wade 1982a:317. See also, Bottrall 1985:9.

24. Goldsmith and Hildyard 1984:260.

25. E.g., Wade 1982a:287; The Economist 1991b:15.

26. For example, a third of the multi-billion dollar investment in Sri Lanka's Mahaweli system is said to be spent on bribes (Goldsmith and Hildyard 1984:261); documented cases for maintenance in Pakistan amount to 58% (Resident IIMI staff pers. comm.); estimates of total "leakage" for India are as high as 50% (Prasad and Rao 1985 in Small 1989b:7); construction contracts of the Irrigation Department of Sri Lanka were informally estimated by government officials and IIMI research staff to be skimmed at field level for as much as 70% during 1990.

27. E.g., "Some observers even claim that the most important function of aid may be to induce policy reforms engendering efficient resource allocation and economic growth, rather than to relieve scarcities of domestic savings or foreign exchange." (Cassen 1986:69); and ADB: "..the physical manifestation of each project as such, i.e., the roads, irrigation infrastructure, ports, railroads, power plants, etc., is but one feature of the operation. An at least equally important aspect consists of the institutional upgrading and the impact of the associated policy dialogue which aims at enhancing the general environment in which all development activities function." (ADB 1990a:10). It is also demonstrated in the following case of obvious corruption, where resident World Bank staff were not allowed to intervene because they "were apparently told that the highest Government Authorities in Dacca were involved in placing the contract, and to cancel the whole scheme now would create embarrassing political problems in an area where the Bank hoped to have increasing influence in years to come." (Far Eastern Economic Review February 7, 1975 in IFDP 1979:25).

28. The expression "fund-channeling" has been derived from Cassen 1986:170.

29. Cassen 1986:170.

30. World Bank 1990b:vi.

31. World Bank 1984:v.

32. E.g., for Africa (Moris 1987;Kortenhorst et al. 1989:40); for ADB investments in Asian irrigation were prominent due to "professional backgrounds" of some of its key decision makers (Evans 1984:77 and 81); and more in general (Carruthers and Clark 1981:205).

33. Moris 1987:106; Bottrall 1985:9.

34. Moris 1987:106.

35. "External consultants are usually based in Europe or America, and return to base after each phase in project development. This institutional setting inhibits learning from experience at the local level. By the time feedback from farmers can occur, the physical investments are locked in, and, in any event, the experts in charge of design will have departed." (Ibid:103)

36. Bottrall 1985:9. George Laycock's description of such attitudes in the USA: "The pork barrel has become a way of political life. Politicians...often believe they can equate their own worth to their home districts with the amount of money they send back from the federal treasury. Although there are other cuts of pork, such as post office buildings, the choice ones are the impressive big water projects scattered from Maine to Hawaii. The individual congressman has his eye on the project closest to his heart, which is to say, nearest to his voting booth. He might sense that projects within the bill are a waste of federal fund, but he is reluctant to argue against his fellow-congressmen's favorite dam or canal. To do so is to jeopardize the other's support for his own pet project." (Laycock in Goldsmith and Hildyard 1984:259).

37. Repetto 1986:22; Moore 1987:12. Sheridan's remarks about the extremely water scarce Western en South Western USA: "human systems are exceeding the carrying capacity of their natural life support systems" (Sheridan in Goldsmith and Hildyard 1984:261), and "it is unlikely that any sensible conservation measures will be introduced voluntarily. The reason lies in the availability of federal pork. No one, least of all the farmers in the area, want to be told that they must limit their use of water: instead, they see the solution lying in the massive water projects which the politicians promise to build with federal funds." (ibid). The heavy subsidies in irrigation investment in the case studies caused similar processes.

38. Bottrall 1985:9-10.

39. Frederiksen 1987:15; and 1989:6.

40. Nijman 1992a.

41. Ibid:112.

42. GOAP 1982:43.

43. ADB 1986:27. In three systems this underestimation was of minor influence.

44. World Bank 1990d:36.

45. Chambers 1988:115.

46. Abbie et al. 1982:25 in Chambers 1988:116.

47. Washington: US Department of Agriculture, Economic Research Service, International Economics Division, December 1984 in Repetto 1986:4.

48. GOAP 1982:48.

49. Berkoff 1988:11.

50. Carruthers 1983:56 in CGIAR/TAC 1982.

51. Bellekens 1986:43.

52. ADB 1986:3.

53. Siy 1990:3.

54. Plusquellec et al. 1990:150-7. Note that the 69% is an unweighed average.

55. World Bank 1989a:14.

56. ADB 1986:22.

57. World Bank 1990a:13.

58. Steekelenburg et al. 1985:12.

59. World Bank 1990d:14.

60. Diemer 1990:123. Besides, similar to the Sri Lankan case studies, Diemer has observed that although the current engineering paradigm frames engineers to design for double cropping (i.e., a 200% cropping intensity), he knew of no African example where force was exercised to actually achieve such double cropping.

61. An irrigation professional has remarked the following on ADB's first irrigation impact study: "..the ADB did a impact survey in 7 different systems and found that outcomes were only 15% of what the project documents were saying. Neighboring projects were studied as control areas, and had similar yield increases as the ADB investments. What had been really attributable to the projects was extremely little. ADB did not like the impact study, and censored the report considerably. It shows that vested interests impede honest assessments and evaluation of project results." (IIMI/World Bank 1991:50).

62. E.g., a remark by a World Bank official on Indian irrigation: "Irrigation potential means nothing in reality." (IIMI/World Bank 1991:36).

63. GOAP 1982:3.

64. Ibid:58.

65. Ibid:66.

66. Carruthers and Clark 1981:217.

67. GOAP 1982:56.

68. Moris 1987:116; De Leeuw 1985:280.

69. This World Bank practice contrasts apparently with older guidelines used in the United States and Europe (Tiffen 1987b:15).

70. GOAP 1982:48.

71. It is also one of the few direct references in this respect: "...the reservoir duties are also based on experience in the past. The current trend is to plan irrigation projects on the basis of water requirements of crops on the field for meeting the evaporation demand and provide suitable extra capacity for water application losses and transmission losses." (GOAP 1982:3), whereby "The irrigation Department has been planning irrigation projects on the basis of a designed cropping pattern to give a favorable benefit cost ratio." (ibid).

72. Standard work on these concepts is Doorenbos and Pruitt 1977.

73. Levine 1977:38.

74. For example, Palmer Jones has referred to the irrelevance of the theoretical requirements as follows: "Economists have long pointed out that such a procedure aims to maximize yields and ignores costs [Carruthers and Clark 1980:45]; the economic definition of optimum irrigation capacity, balancing marginal costs and returns from extra water supply or water supply capacity, will prescribe levels of these variables that will not usually be insufficient to meet peak demand and will entail some water stress and consequent loss in yield. However economists have neither provided satisfactory operational definitions of optimal capacity and operating rules to assist designers, managers, and rehabilitators of irrigation systems, nor have they been able to explain actual irrigation capacity utilisation. This makes it very difficult to estimate underutilisation of capacity, and diagnose its causes." (Palmer Jones 1988:1)

Diemer has toned down the perceived underutilization in African irrigation as farmers go for the least-cost production for self-sufficiency (Diemer 1990:70). Slabbers has argued that farmers consider minimizing conflicts as part of irrigation efficiency unlike the theoretical engineering concepts of efficiency (Slabbers 1989:677). Ironically, chapter 4 has shown that the engineers and other agency staff also pursue the minimizing of conflicts during capacity utilization. Only in formal planning, design and utilization procedures they are expected, and have been taught at university, to use conceptual efficiencies.

Wade has referred to the general link between management and irrigation efficiencies as follows: "The recurrent weakness of irrigation project design is an (implicit) assumption that water control is a function mainly, or only, of physical structures; so that if physical structures are greatly improved, one can be sure that water control will improve also." (Wade 1982b:179) Quoting Levine, he consequently has given convincing arguments of the function of management for a system in Iran "which has a full range of modern control structures, measuring devices, organisational structure and 'all the other accoutrements of a large modern system". After six years of operation, average water use efficiency was between 11 per cent and 15 per cent, while nearby traditional systems, with minimal physical control structures, have water use efficiencies of around 25%. The very high efficiencies in Taiwan--around 60 per cent in normal water supply conditions, rising to 90 per cent as water becomes very scarce--are achieved with physical structures which are not particularly sophisticated, by means of very effective utilisation of those structures, which is a function of management." (ibid)

75. According to him, before the introduction of these more scientific approaches, the Irrigation Department used a more gradual approach to irrigation improvement whereby a part of the command area is developed and further developments would depend on the actual remaining amounts of water.

76. Heaver has described the process inside the Mahaweli Authority and the Sri Lankan Cabinet. He showed thereby that all involved parties were well aware of the highly unrealistic nature of the optimistic water efficiency estimates, partly "never before achieved on any major irrigation scheme in Sri Lanka." (Heaver 1979:26-32).

77. Ibid:68. Or, the Chief in charge of Investigation and Planning when asked about the basis on which cropping pattern is decided: "Irrigation projects are being planned as productive projects yielding suitable returns as judged by the benefit cost ration worked out for each scheme. All the projects are being planned for optimum yields of crops with full supply of water as required for such growth...."....The Project Authorities appear to be obsessed with the criterion of benefit-cost (BC) ratio for obtaining clearance of the scheme from the Planning Commission and the Government of India...The project authorities try to work out a favorable benefit-cost ration on the basis of a hypothetical cropping pattern. Simply stated, it means that a larger area than what could possibly be irrigated is presented as the beneficiary area. To achieve this end, it becomes necessary to show that lands can be irrigated for an assumed cropping pattern which in many cases has no relevance to local practices, agro-climatic conditions and farmers' preference. If one cropping pattern does not

result in projecting a favorable BC ratio another cropping pattern is assumed. Similarly, the assumptions for "duty" are generally very optimistic if not unrealistic in order to show that more area can be irrigated under the system than is ever possible in view of past experience. As no monitoring and evaluation of projects is done to find out whether they are performing according to the original promise, new projects are mere replications of the earlier projects with all the attendant deficiencies of the older schemes. The net result is that long stretches of main canals, distributaries and minor canals are built which do not receive any water at all or if they do, the supply is very inadequate and not enough for the growth of the crops planned. Such an extension of the canals is sometimes done for political reasons as well, when farmers lower down in the system demand water and to satisfy them a canal system has to be built." (ibid:69)

A similar manipulation of soil proportions for Sri Lanka's Kirindi Oya system is described in ADB 1977a:XXIX.10 quoted in Nijman 1992a:93.

Ferguson found for the Philippines that only 75% of the service areas are irrigated during the wet season, that design expectations are "rarely attained" and that such overestimation is worse for newer systems. An important factor being the "intentional inflation of service area estimates to improve the project's chances for approval and funding" (Ferguson 1987 in Azarcon 1990:40)

Similarly Moris mentions the Bura system in the lower Tana (Kenya) where the estimated size was adjusted from 100,000 to 120,000 ha to achieve a 10% internal rate of return (Moris 1987:104).

78. The major irrigation donors have undertaken such impact studies only recently. The ADB has published its first in 1986, while the World Bank only in 1989. Also national governments did not take much action, as has been described well by the government commission for Andhra Pradesh as follows: "Yet, in project after project including the latest on-going projects and also those in the pipe line no organised thinking seems to have been done at any level to remedy the earlier defects and to improve the planning, design, construction and management of new Irrigation Projects. The evidence before the Commission shows that all projects are merely replications of earlier projects without any effort at monitoring, evaluation, and rectification of deficiencies in earlier systems. This situation assumes greater gravity when we take into account the massive financial investment made by the State in Irrigation at the cost of other sectors like education, health, social welfare or even in other aspects of agricultural development including systematic follow up action after creating the irrigation potential meant for agriculture....The Commission tried to find out whether any policy paper has been issued by Government but was not able to lay hands on any such document." (GOAP 1982:51) and "No economic analysis has, however, been done of the BC ratio of any project by looking into its final cost and the area actually irrigated and the benefits actually accrued to the farmers from such irrigation and no comparison is made with the original assumptions." (ibid:70)

79. Vide publications by Farmer, Chambers and Moore.

80. E.g., Nijman 1991.

81. Le Moigne 1986:2.

82. E.g., the following quotation: "...the irrigation intensity assumed by the World Bank Team were also higher...The project facilities were proposed to be utilised in Kharif and Rabi seasons. Although the Project Agreement for implementing these changes has been signed by the Government of Andhra Pradesh 1982, no formal orders have been issued so far permitting irrigation in Kharif as well as Rabi seasons instead of following the localised pattern or irrigation for wet and I.D. crops in the Kharif season only." (GOAP 1982:38)

83. E.g., Siy 1990:4.

84. Conform ADB 1987:2 and 4.

85. ADB 1987; World Bank 1986.

86. IIMI/Word Bank 1991:15-16; Howell 1985 in Svendsen et al. 1990:4. Howell has argued that the recurrent cost problem in LDCs "is not **simply** one of limited domestic financing capability", and that increased revenue levels will not necessarily solve this problem (ibid).

87. IIMI/Word Bank 1991:46.

88. Cassen 1986:126.

89. "The rapid infrastructure deterioration.....common to all four projects...has nothing to do with the complexity of technology, it is not obsolete water control, it is not the weather, and O&M funding levels are too easy to use as a diversion from the real cause. All these countries and the major countries where the Bank is supporting "rehab" or "modernization" or "upgrading" work display identical experiences....This is not a question of O&M funding, O&M staff or the nature of the schemes. It is plain and simply a matter of non-enforcement of proper, simple construction methods and practices as specified in the approved construction documents......This is a situation that should receive urgent attention Bank-wide....and it should be placed in its proper perspective--at the top of problems in irrigation" (World Bank 1990d:37) (Original underlining, CN). See also Frederiksen 1989:7.

90. GOAP 1982:86.

91. World Bank 1986:ii.

92. World Bank 1986:iii. The Bank's policy has always been to recover all costs from beneficiaries for all its projects, agricultural projects sometimes being exceptions. However, "as a minimum, operational and maintenance (O&M) costs should be recovered completely." (ibid:4). The Bank's efforts in irrigation have focused mainly on these recurrent costs recovery. Even if there are no fundamental justifications for this distinction in costs of operation and maintenance and capital (Roumasset 1987 in Svendsen et al. 1990:3), Svendsen has argued that "there are practical reasons for it--including the fact that foreign and multilateral lenders will readily finance the former but seldom the latter." (ibid)

93. Repetto 1986:21.

94. This is displayed, for example, in the following citation of a senior World Bank official: "The precise origin of this policy feature is obscure. The most plausible explanation is a fiscal one: namely the concern that project O&M costs should not become a burden on the government recurrent budget. But there has always been the hint of an implicit behavioral assumption: namely, that irrigation project entities could be induced to behave like public utilities --e.g., electricity supply, port, an portable water supply authorities-- which are commonly set up as autonomous agencies, reliant on their own generated commercial revenues." (Duane 1986:6). Duane refers to it as "implicit", because Bank staff always relate cost recovery with "efficiency" (ibid:7).

The same implicit assumptions can be read also in an early World Bank policy document advocating that a low water price would stimulate Asian farmers to use irrigation water (IBRD 1965:25-26)--itself a rather theoretical case given the actual low service fee recovery rates in Asian irrigation.

95. Personal communication with senior World Bank staff. See also, World Bank 1986:43 and 46.

96. Bottrall has stated this as follows: "Much of their [i.e., economists'] efforts have been wasted on elaborate proposals for changes in water pricing policy which have done little except reveal the authors' failure to comprehend the political and social environments in which decisions about water have to be made." (Bottrall 1985:11)

97. Levine and Wickham 1977:74; Moore 1987.

98. "Yet Borrowers' irrigation entities are invariably a part of regular Government departments and Ministries, without financial autonomy, and wholly dependent on the Government budget. Their very existence in such a form --accountable directly to a Government Minister-- is a notable expression of Borrower desire to keep such agencies firmly in the political domain where there is maximum opportunity to exercise discretion and minimum constraint from the rules of commercial undertakings." (Duane 1986:7).

99. Ibid:3.

100. The following four citations have described this very well:"...the wide-ranging social, economic and political implications of tariff/user fee covenants, well beyond the boundaries of the projects, were not adequately studied at appraisal. Perhaps the implications were overlooked or avoided as a matter of expediency. There was hesitation in some cases in addressing such sensitive socioeconomic realities....Many such covenants were accepted without an assessment of the practicability of such covenants, including the requirements of confidentiality. There was consequently a lack of abiding commitment on the part of the borrowers." (ADB 1987:5).

"...borrower or the executing agencies were not fully committed to their objectives. Recognizing that the performance of a project can never be insulated from its external macro-economic environment and sector policies, the Bank has been increasingly addressing such issues through covenants in project and program loans. However, appraisal missions have often to contend with the constraints of time and technical support which hinder a full comprehension or analysis of the macro-level issues and impact involved. Moreover, such an analysis may not always be within the domain of the executing agency." (ibid)

"At the project preparation stage, a failure of the Bank and the borrowers (and all the executing agencies) to have a genuine two-way dialogue and reach a satisfactory understanding on the underlying objectives of the covenant often resulted in the absence of an abiding commitment to its compliance." (ibid:8)

"Comments on this report received from the Government of India are typical of the lack of consensus between the Bank and a government. While the Bank advocates cost recovery as an important means for achieving both sustainability and replicability of irrigation projects, the Government of India states that its policy is different and that it does not expect irrigation projects to generate revenues or recover costs to ensure project sustainability after completion." (World Bank 1986:26)

101. Ibid:9.

102. Ibid:i.

103. Duane 1986:8.

104. World Bank 1986:43.

105. E.g., ADB 1987:6; Cassen 1986.

106. Carruthers and Clark 1981:53.

107. Cassen 1986:126.

108. World Bank 1990b:65.

109. ADB 1990b:22.

110. World Bank 1990b:62.

111. Paranjpye in Goldsmith et al. 1984:270.

112. ADB 1990b:23.

113. Ibid:7.

114. Siy 1990:2.

115. Tiffen 1989:72.

116. World Bank 1990a:14. Similarly, the Tenth Annual Review of Project Performance Audit Results of the World Bank has remarked that of all 25 long-term impact evaluations (i.e., 5 to 25 years after project completion) of projects that were considered worthwhile at audit, half of them were no longer (World Bank 1984:vii).

117. World Bank 1990b:23.

118. Steekelenburg et al. 1985:12.

119. Frederiksen 1987:15. See also Seckler's image quoted in Note 3 of this chapter.

120. Frederiksen 1989:6.

121. Cassen 1986:117.

122. Carruthers 1983a:53.

123. "The Bank-approved Guidelines for Irrigation and Drainage Projects were revised in 1983 (FAO Investment Center, 1983) and those for Agricultural Investment Projects in 1985 (FAO Investment Center, 1985)" (Tiffen 1987a:373).

124. Tiffen 1987a:372-373.

125. For example, Bloemen and De Moor have argued this for water (Bloemen and De Moor 1983:370).

126. World Bank 1990b:23.

127. The US Bureau of Reclamation's manual of 1951 and "The Guide to the Economic Evaluation of Irrigation Projects" by Bergmann and Boussard 1976 in Tiffen 1987a:374-375.

128. This exception was a recent publication on NIA (Svendsen et al. 1990).

129. Tiffen 1989:71.

130. Repetto 1986:22; And Wade has remarked that the state's capability to work in the national interest becomes very weak in a "a state close to a condition of populist anarchy, with the rule of law constantly abrogated by the power of money.....Seckler's image of canals rolling up behind as new ones are rolled out in front then becomes a metaphor for the whole development administration." (Wade 1983:298). Also Carruthers in an IIMI seminar in June 1990 has expressed a similar opinion "...governments in LDCs work seldom in public interest....Apart from population growth, mainly lousy macro-policies in Egypt for the last 20 years have caused it to be importing two-thirds of its food, while it had been self-sufficient for 2000 years."

131. Sagasti 1988:433. For example, De Leeuw has described how the national plans aimed at acquiring as much foreign funds as possible, while ignoring the political realities. Kenya's Ministry of Finance appeared to be well aware of this function of the plan (Holtam and Hazlewood 1976:213 in De Leeuw 1985:123)

132. "...in a surprisingly large number of (mainly African) countries, the government has no central unit with an overview of all aid flows; donors still negotiate with individual ministries. The first requirement for coordination is that the recipient have such a unit negotiating all aid agreements or having negotiations reported to it. Only then can the government link 'upwards' to the higher-level, donor-coordinating institutions, and outward to coordination activities within the country. The recipient should also have effective sectoral coordinating bodies to relate aid projects and programmes to each other and to its own development spending." (Cassen 1986:319)

133. Repetto 1986:22.

134. As a senior World Bank staff member has remarked: "It is, however, necessary to do certain big infrastructure investments for which you have to steal money of the rest of the country." (IIMI/World Bank 1991:50). See also, Repetto 1986:8; The Economist 1991a.

135. See note 78.

136. Levine and Wickham 1977:68; Van de Laar 1979:208 in De Leeuw 1985; Goldsmith and Hildyard 1984:249.

137. Generalizing statements of manipulation have been given by, for example, Tiffen 1989:79; Carruthers 1983; Roe 1985:208; Gasper 1989:30; GOAP 1982:70; and Goldsmith and Hildyard 1984:270-272. The latter have observed 12 types of manipulation to justify dam projects (ibid:272-283). De Leeuw has given a detailed account of manipulations of sequential assessments for Kenya's Bura where "feasible" investments amounted to US$25,000 per ha. Other terms used for manipulation of the EIRR are "fudging" (e.g., Goldsmith 1982:265), "massaging" and "SOSIPing" (or Sophisticated Obfuscation of Self-interest and Prejudice) (Stern quoted by Gasper 1989:30).

138. World Bank 1990b:6.

139. Van de Laar 1979:235-236, Verloren van Themaat 1983:13 in De Leeuw 1985:126. Holtha and Hazlewood 1976:89 and a seminar by a Western diplomat quoted in De Leeuw 1985:127.

140. Donors have even conceptualized this availability of good projects as the "absorption capacity" of LDCs, which is typically lowest in the least developed countries.

141. Gunnell 1983:29; Tendler 1975:90 in De Leeuw 1985.

142. A senior staff member of the World Bank's regional office in Nairobi quoted in De Leeuw 1985:127.

143. See also page 125.

144. OECD DAC 1984c in Cassen 1986:170.

145. Cassen 1986:170.

146. A citation of a Canadian report on Bangladesh in Cassen 1986:172.

147. Cassen 1986:309. To remain fair, Cassen's subsequent sentence should be quoted as well: "But they are omnipresent. Quality considerations enter in mainly through the professionalism of staff, and also through the pressures from the recipients with developed capacity for judging projects." (ibid) To give a complete perspective, Cassen's latter argument on quality inputs by national partners should also have intimated the political pressures on agencies and individuals to keep a low profile towards such quality aspects.

148. Cassen 1986:309-311.

149. As mentioned before, interviewees in Morocco, Philippines and Sri Lanka remarked that the tendency of staff to raise quality related issues in such interaction has declined over time with the persistence of quantity-related interests.

150. For a full discussion of this problem, see N. Hildyard, Cover-up, New English Library, London, 1983.

151. Goldsmith and Hildyard 1984:265. Gasper has also written an interesting sociological perspective on this lack of neutrality of assessors in general: "Formal assessors may sometimes "join the team", even when not employed by the assessed organization--not only through social induction but because of their own interests in not rocking the boat but instead maintaining a steady and predicted flow of expenditure" (Gasper 1989:41), and has referred to some internal

criticisms of the US AID on their evaluations being "...essentially an advocacy process" and "AID analysis in project papers has been overly and unnecessarily optimistic" (ibid). See also Gow 1991.

152. Heaver is one of the few who has written on this: "The history of appraisal has followed a course of concentration first on technical factors; then on economic appraisal, with the rise of cost-benefit analysis: then to an interest in the social effects of projects --on equity, on farmers as groups etc. But no appraisal procedures in standard use seriously set out to assess the management capability of recipient institutions." (Heaver 1979:34)

153. Galbraith 1973:89.

154. Dyson 1990:11.

155. Levine and Wickham 1977:69.

156. Van de Laar 1979:208 in De Leeuw 1985:138.

157. Siy 1990:4.

158. Conform ibid:3.

159. World Bank 1984:50.

160. Carruthers and Clayton, op. cit. 1977 in Carruthers and Clark 1981:229.

161. The Economist 1991a.

162. Lahlou in Eaux et Terres:41.

163. IIMI/World Bank 1991:50.

164. Svendsen et al. 1990; Barker et al. 1984.

165. In the following citation, Heaver has been very critical of cost-benefit analysis in view of their neglect of incentives: "A third reason for neglect is that present techniques and habits of thought were developed largely for a previous generation of much less "management-intensive" projects and programs. The new-style rural development project of the 1970s raised the management problem in its most acute form, with the need for centralized bureaucracies to organize change in areas remote from the capital and poorly served with physical and administrative infrastructure: and within those areas to reach a large, geographically diffuse and ill-educated population. The emphasis on "integrated" development put further stress on management, calling as it did for unprecedented coordination and cooperation between government departments. Project appraisal and evaluation techniques lag behind the requirements of a changing philosophy of development. The evolution of cost-benefit analysis is an example. The main efforts to improve cost-benefit techniques have concentrated on the quantitative pricing of costs and benefits (e.g., shadow pricing and weighing systems), rather than on improving the qualitative assessment of realistic implementation speeds. This is despite the fact that these are not only of crucial social and political importance, but directly affect the economic IRR which has been of so much concern to the analysis themselves.

The preoccupation with allocative efficiency at the expense of organizational efficiency and effectiveness was highlighted by Harvey Leibenstein of Harvard University in a now classic article as long ago as 1966 (Leibenstein, 1966). One reason for relative neglect of the efficiency factor is that closer involvement with management questions, and hence with the control of recipient organizations, raises a host of political difficulties. Corrections for allocative efficiency, on the other hand, are camouflaged by shadow pricing's mystique of figures, and so have been able more quietly to facilitate adoption of the equity-oriented projects of the 1970s. But the major reason for concentration on one kind of efficiency only is the professional bias of economists. The emphasis on quantitative training predisposes economists to refine shadow pricing techniques (even when the poor quality of the data available makes such refinement often questionable) because this is what they are good at. Economists are also trained to see projects in input/output terms, so that the essence of the cost-benefit procedure is an exercise in comparative statistics -- a comparison of the with-project scenario against the without- project scenario. In the cost-benefit calculation, it is as if a series of photographs is taken of the project at successive year-ends, with cash-flows artificially accumulated to these points for discounting. In contrast to this static approach, cost-benefit analysis should be seen as involving the construction of an "implementation model" of the project, stressing dynamics and process as much as statics and quantity...The Little and Mirless manual, for example, is called, all-embracingly, "Project Appraisal and Planning for Developing Countries", and contains a chapter on "Scarce Resources" which does not consider management skills as a scarce resource...The contention is that as an economic appraisal guide, management is outside its brief; and yet management problems have a direct impact on the IRR. The manual is widely distributed for use in developing countries, unaccompanied by guidelines for management appraisal. It can only contribute to the present emphasis on ever more "accurate" economic analysis which is in fact meaningless if implementation does not go as planned...Aid has to tread a narrow line between acting as an agent of change and development and "intervention in the internal affairs of another country." Too much or too obvious concern with the management question can be dangerous from this point of view, since this involves directing the use of local as well as aid-imported resources--and since resources in both these categories are by definition very scarce in the developing countries, the issue of who controls them is a particularly sensitive one. Useful approaches to the assessment and improvement of management performance must therefore take into account the aid agency's limited access and its need to tread carefully."(Heaver 1982:4)

166. Levine and Coward 1989:23.

167. Replogle 1989:809.

168. "Traditional" refers to the design concepts that were applied before the modern design concepts were introduced. The latter tended to occur during the last three decades although many of the principles existed already at the beginning of this century.

169. E.g., SOGREAH 1984:A3.9.

170. Conform Levine 1980:17.

171. Such cost increases occurred in the Uda Walawe rehabilitation, but have not been calculated for the purpose of this study. De Leeuw has quantified these increased costs at 255% for Kenya's Bura scheme (De Leeuw 1985:152). See also note 217.

172. Levine and Coward have given cases in the Philippines, Thailand, Indonesia and Sri Lanka where such constraints have led to considerable deficiencies in design and construction quality (Levine and Coward 1989:11). Wade has given a very convincing description of the conceptual "KOTA" design approach of the World Bank in India, with furrows rather than basins, wide fields, evenly graded fields even where the topography is very rolling, an access road to each field, and boundary realignment and consolidation as a sine qua non. All these measures naturally lead to endless delays. Wade has mentioned the rigidity of choices and "how the choices, where alternatives were open, were made (implicitly) with output maximizing objectives in mind". Even if canals already existed, new ones were built despite long delays and "mainly according to topographical considerations, crossing property boundaries where necessary." Wade criticizes the idea of a "blueprint" approach: "One of the main problems with the KOTA approach is that it assumes there is one method which, with minor variations, can be applied everywhere. Hence one can talk of a KOTA "syndrome". (Wade 1976a:98-101).

173. E.g., Levine and Coward (1989); and Meijers (1990:7).

174. Levine and Coward 1989:11.

175. Conform Ter Hofstede and van Santbrink on Indonesia (Ter Hofstede and van Santbrink 1979:189).

176. Levine and Coward 1989:10.

177. The Uda Walawe case study showed that in the actual decision making about lining field canals, there were no cost factors involved at all (Nijman 1991). Similar observations have been made in India (IIMI/World Bank 1991:41). Typically, the project is a political decision, and no criteria are developed within the project to determine in which cases lining would be cost effective.

178. Enforcement of certain design concepts were observed in the Sri Lankan case studies (Nijman 1991 and 1992a). Wade and Dhawan have given some examples for India. For example, lining was obligatory in projects of the World Bank in India for some time: "The current policy is to line the canal systems--it has become a necessary design component for all projects for which World Bank aid is sought. Canal lining is costly proposition. It is a must in arid areas underlain with brackish waters. But do we need it in areas where the specter of groundwater depletion exists?" (Dhawan 1989:240) Similarly, the World Bank has insisted on a certain land development approach, called KOTA, as Wade has cited as follows: "KOTA or nothing" (Wade 1976a:95).

179. Ibid; Frederiksen 1989:8.

180. Farmer 1957:186; Mendis 1977.

181. Small 1981:5.

182. Wade 1976a:95; and Ter Hofstede and Van Santbrink 1979:182. Wade has given a revealing motivation for the Bank's choice for investment "below the outlet" in the so-called Command Area Development Program in the 1980s, which "was a way by which the Bank could continue to lend heavily for India's irrigation development without having to resolve the thorny ICB [i.e., International Competitive Bidding issue] -since no international contractor would be interested in scattered land levelling and field channel construction. With agreement now reached on ICB, it has been possible to switch back attention to what the Bank is in any case most familiar with-heavy capital investment in the main system." (Wade 1982b:172).

183. Quotation of a 1974 World Bank report in Ter Hofstede and Van Santbrink 1979:1982.

184. Diemer 1990:130-131. Diemer has presented this independence more in terms of a more principal need for independence of farmer groups from state intervention. He did not make a link with the logic of process and control requirements and opportunities as such. Independence seems a more correct description than a "responsibility" center as the latter, unlike Diemer's Senegalese case, still assumes some accountability to a centralized authority. On the other hand, control of expenditures by the community most probably made the independent units function as cost control centers.

185. Coward 1986:503.

186. For Indonesia (Ter Hofstede and Van Santbrink 1979:76); for Sri Lanka (Mendis 1977).

187. Diemer 1990. Endnote 4 of Annex 4 gives a brief description.

188. E.g., Numans 1916:338 in Ter Hofstede and Van Santbrink 1979:184.

189. Meijers 1990. Another author who has proposed different design procedures is Schmehl. He has proposed an elaborate methodology for more "client-oriented" approaches to design, step-by-step approach of diagnosis, design and field testing (Schmehl 1988). Clyma has developed a similar methodology (Clyma 1988).

190. E.g., Murray-Rust et al. 1990:2.

191. Nijman 1991 and 1992a.

192. Though these are mainly physical factors, they have some managerial aspects. Examples are the farm labor inputs to prevent lateral seepage through field bunds, and, for rice cultivation, to prepare the soil to reduce vertical percolation.

193. Also Sakthivadivel has argued this in an IIMI Technical Staff Seminar, 25 May 1990.

194. Apart from the soils properties, the sharing procedures of water among farmers along a field canal appeared to influence the preferred diameter of the outlet (e.g., Nijman 1991:182).

195. Levine 1980:19-20.

196. Levine and Wickham 1977:69. See also Bos and Nugteren 1974.

197. Without any intervention by the agency water will never reach the tail-ends of canals, whatever the design capacity: "In none of the projects the Commission visited, the tail-enders of the system get adequate water or any water at all, unless farmers in the upper reaches condescend to allow water to flow down, or the Operation and Maintenance staff rations water to the top-end farmers." (GOAP 1982:79).

198. For example, NIA's former design guidelines advised a 60% efficiency, assuming 80% farm efficiency, 80% conveyance efficiency in lateral and 90-95% in the main canal, even during land soaking (Iglesia 1979). It should be noted that these estimates were revised by 1987 to more realistic figures of 27-36% (NIA 1987:9). The Technical Guidelines of Sri Lanka's Irrigation Department even estimated the peak requirements on the basis of the crop water requirements alone, while ignoring the practical experience that actual peak requirements always occur during the land preparation (Nijman 1992a).

199. For example, for South India: "Obviously, information on the utilisation of water is not being reported to the Chief Engineers [neither required by them, CN] by the field staff and there is no review by the Chief Engineers for evaluating the actual use of irrigation water in each project with reference to the assumptions made initially while planning the project. This clearly indicates that new projects are being planned as mere replications of the earlier schemes...and therefore, these new schemes suffer from the same deficiencies as the earlier projects." (GOAP 1982:34)

200. Nijman 1991 and 1992a.

201. Coward 1986:501.

202. Ter Hofstede and Van Santbrink 1979:82.

203. This systematic tendency of irrigation engineers, evaluating past experiences, to go for more control has been described for Senegal by Diemer (1990:27). See also Farbrother in Jurriens, Bottrall et al. 1984:21. This bias can also be found in all recent World Bank Impact Evaluation studies on irrigation investment, that --even without considering the actual capacity utilization decision-making processes-- without exception recommend increased flow control and related technological solutions (E.g., World Bank 1989a-c; 1990a-b; 1990d-f.).

204. Levine and Wickham 1977:69.

205. MMP 1977:A-224 in De Leeuw 1985:152.

206. The cost increases consisted of 44% of excavation costs of the main canal, increased concrete costs for structures of 138%, 'stone pitching' of 338% and digging costs of 255%. The donor, the World Bank, did not influence this decision making because it was afraid for further delays, according to De Leeuw (ibid). By 1982, the project costs had further risen to US$ 236 million from the US$ 70 million projected in 1977 and US$ 170 million in 1979 (ibid:153).

207. The terms "passive" and "active" refer to the degree that the control is physical or based on management interventions respectively.

208. Jurriens, Bottrall et al. 1984.

209. Adams, Farbrother, Swan and Withers in ibid:13.

210. Ibid:14.

211. World Bank 1990c:8.

212. Horst 1983b and 1987. In his 1987 paper Horst has confused this independence with decentralization. Yet no decisions are left to anybody with fixed structures.

213. World Bank 1990c:12. See also, Berkoff 1988.

214. Berkoff 1988:14.

215. Ibid:13.

216. By IIMI staff on a mission in India in 1989.

217. Another important difference between these concepts and the traditional design approaches was the latter's basis on least-cost solutions.

218. Jurriens, Bottrall et al. 1984:20.

219. Swan in Jurriens, Bottrall et al 1984:20.

220. The fashionable concept of "manageability" brings along the danger of expecting too much of more manageable design concepts without any related improvements in the management conditions. This confusion seemed the basis of the fore mentioned design concepts with less flexibility, as can be found as such in several recent documents (World Bank 1990c; Murray-Rust and Snellen 1991; IIMI 1989).

221. Frederiksen 1987:14.

222. World Bank 1990c:38. Murray-Rust has argued along the same lines as follows: "Flexibility is often "anarchy". Crop diversification can be reached also in very "rigid" systems. That the agency itself can be flexible in a flexible design is a wrong assumption. Establishment of water rights in France and Spain goes together with inflexible designs. In Asia the farmers will obtain their water informally, if they do not receive it formally. The influence of design on these processes is underestimated. Modern technologies in situations of water scarcity without considering the related real-life operational objectives is undesirable." (IIMI/World Bank 1991:8).

223. Frederiksen 1989:6.

224. Replogle 1989:809.

225. Wickham and Valera 1976:11.

226. Wade 1982b:179.

227. For a detailed description of these experiments, see also Jungeling 1986.

228. Ter Hofstede and Van Santbrink 1979:171-176.

229. Farbrother in Jurriens, Bottrall, et al. 1984:21. Solar-power technology is expensive. So its economic justification creates the need for higher water efficiencies, and, thus, for more control over water flow.

230. GOAP 1982:86.

231. For example, Thornton argued as early as 1966 against these blueprints because "human personality, social conditions and the technical problems of irrigating are too variable for that." (Thornton 1966:155 and 1984:172). And Wade on the World Bank's Command Area Development Approach: "Perhaps the major single weakness of the bank's approach is methodological: the package is to be applied more or less uniformly everywhere, with little research being done to match ingredients against the environments into which they are introduced. This makes for ease of project formulation and lending, of course; but the fate of the Community Development Programme of the 1950s and 1960s, which also applied a standard package more or less uniformly, should warn that such gains may not be carried through to improved canal performance." (Wade 1982b:172)

232. Wade 1976a:103.

233. Conform Bottrall 1981a:62.

234. Wensley has found this for the NIA: "...apparent inertia in applying same design standards in every new construc/rehab project" (Wensley 1989:202)

235. Diemer 1990:183.

236. E.g., a Senior World Bank staff member in a seminar in Sri Lanka: "...the influence of the World Bank on priorities is large....if the World Bank considers land levelling and tertiary development important, than this will be implemented by the Sri Lankan government on a large scale....similarly, if the Bank thinks main systems management or extension through training and visit is important..".

237. "The bank has now softened its earlier insistence on full-scale boundary realignment and rectangularisation of holdings, with wide terraces and large field sizes to make mechanisation of agriculture possible; but the fact that it did attempt to insist on a technique and pattern of land development grossly out of line with India's circumstances does show the kind of thinking of which the Bank's South Asian irrigation division is still inclined." (Wade 1982b:183) See also Wade 1976a and Hart 1978.

238. Levine and Wickham 1977:71.

239. The World Bank, for example, clearly seemed to have problems internally about its response to institutional constraints for irrigation performance. Initially it had recognized the link between management constraints and performance as follows: "The main reasons for poor water management in the set of irrigation projects under review were weak institutional performance, and poor selection of water control equipment." (World Bank 1981:1). Yet, more recently all its impact studies on irrigation investments have concluded that poor performance was mainly due to design flaws. The latter was, probably not coincidentally, a conclusion that was much easier to deal with for a development bank than were the management constraints (World Bank 1989a-c, 1990d-f).

240. E.g., "Sir Arthur Cotton and his comrades were true pioneers in the trade learning as they did, by trial-and-error." (Des Bouvrie 1989:28).

241. Kampfraath pers. comm.

242. For example, Roe has listed some criticisms by other professionals such as "one of the 'bumptious array' of 'elaborate' appraisal procedures smacking of 'folk science'" (Johnson and Clarck 1982), and "'gigantic irrelevancy', where 'elaborate cost-benefit analysis is unnecessary for most projects and for some positively misleading'" (Stevens 1985), "unnecessary, cosmetic and unreal" (Carruthers), or just "impracticable" (Jones) (Roe 1985:210).

243. Ibid:214.

244. Heaver 1982:4, see also Note 178. Tiffen has quoted Roe and Cernea (World Bank) as saying that the present EIRR combined with sensitivity assessments are always assuming good management (Tiffen 1989:7).

245. Frederiksen 1987:15.

246. Heaver 1982:4.

247. Carruthers 1983a:52.

248. De Leeuw 1985:232.

249. Tiffen 1989:79.

250. De Leeuw 1985:315.

251. Tiffen 1987a:372.

252. ADB 1985:30. This example contrasts with the following quotation of an ADB mimeo on project quality: "...the Bank increasingly subjects its projects to rigorous risk assessment with a view of financing only projects that can absorb substantive downward risks without the EIRR falling below the cut-off point established by the opportunity cost of capital." (ADB 1990a:11)

253. "It is perhaps too easy to make cost-benefit analysis a straw man in accounting for poor project performance. It is important to understand that such criticisms as those raised above have as much to do with a "cookbook" and mechanical application as with the technique itself." (Roe 1985:210)

254. Roe 1985:208.

255. See note 231.

256. Another important difference between these concepts and the traditional design approaches was the latter's basis on least-cost solutions.

257. Although such conceptual solutions were sometimes actively enforced on recipient agencies, also passively they seemed to have gradually overshadowed the professionality of the irrigation agencies.

258. Especially the World Bank and several international consultants seem to push such technological solutions like the modernization through higher densities of physical control structures. Yet, already in the 1970s, Levine has argued against the wide spread belief that "irrigation modernization can take place only with radical departures from traditional practice" (Levine 1977).

259. A former World Bank Director has remarked such arrogance of World Bank staff to be a difficult problem (Yudelman 1985:12).

260. Heaver 1982:8.

261. Conform Bottrall 1981a:62.

262. E.g., IIMI/DID 1990; IIMI/BADC 1991.

263. Worthington in Goldsmith and Hildyard 1984:247.

264. Carruthers and Clark have given the following list of reasons for errors in these data or its insufficiency: "Physical data concerning soils, rainfall, river and canal discharge are examples of essential information for planning and operation. Not only are there gaps in coverage but there is evidence of deterioration. There are many reasons for this: decisions to hold inflation by cash limits on recurrent budgets which can affect field supervision; failure to increase the recurrent budget in line with development expenditure; trimming non-salary elements of recurrent budget (e.g., travel); decisions to decentralise without sufficient experienced staff and equipment; increased political influence in technical matters; high priority to project planning as opposed to routine data work; premature change to computer data banks, are all known to the writer of reasons for a deterioration in basic data services." (Carruthers and Clark 1981:47.)

265. E.g, "Often minimum information is absent, inaccessible or in an unprocessed form. We do not urge a purist approach and in fact commend the concept of 'optimal ignorance' given the high cost of data collection" (Carruthers and Chambers, 1981 in Carruthers 1983a:46).

266. In principle, this section deals with all management control systems and methods other than incentive systems and information systems, discussed already under the earlier sections on Human Resources and Provision of Information respectively. Here, only the most important management-control system, the financial control, is discussed. In addition, Annex 4 discusses some systems that tend to be considered erroneously as management-control systems.

267. E.g., "It would be of interest to note that no irrigation scheme has been shelved because of a low B.C. ratio. Such being the case it does not appear to be reasonable to insist on projecting a particular B.C. ration before clearing a project specially with the present method of calculating the benefit cost ration which is unsatisfactory and needs improvement and rationalisation....So long as it is recognised that it is generally possible to construct irrigation schemes (particularly a surface irrigation scheme) at reasonable costs and irrigation would always be beneficial bringing prosperity and happiness in the command area the projects could be cleared on technical considerations and on the financial capacity of the State for investment without insisting upon a particular B.C. ratio. If this be done the overall cost of projects is likely to come down as the irrigation network would then be not constructed over a much larger area than actually justified." (GOAP 1982:70). Similarly, Keller argues against the commercial approach of irrigation investment decisions (Keller 1986:332).

268. E.g., rather implicitly, by a former director of the World Bank's Agriculture and Rural Development Program (Yudelman 1985:23-25). See also Cassen 1986.

269. Cassen 1986:312.

270. Ibid:311.

271. E.g., Olivares 1986:134.

272. Kampfraath pers. comm.

273. Small 1989b:13.

274. "In none of the projects that we evaluated was anything like such an assessment made before funds were committed. The general story is that of a...plain with a river running through it, which according to engineering standards could and should be converted into a "granary" of the country. And so work began!" (Steekelenburg et al. 1985:28-29)

275. Repetto 1986:15.

276. Also donor staff tend to use such inaccurate justifications: "The review shows that a significant proportion of projects with a rate of return, at completion, of below 10 percent (normally the cut-off rate below which projects are considered unsatisfactory) may still generate important nonquantifiable benefits and thus be worthwhile to the economies that have undertaken them." (World Bank 1990b:v).

277. Aluwihara and Kikuchi 1991: Carruthers and Clark 1981; Tiffen 1987a:373.

278. Aluwihara and Kikuchi 1991.

279. Discussions with an involved system manager from New Zealand. See also IIMI/World Bank 1991:47.

280. The banks act as "preferential creditors", which reduces their accountability even more (De Leeuw 1985:318; Payer 1982:84 and Van de Laar 1979:231 in De Leeuw 1985).

281. Repetto 1986:21-22.

282. "The disturbing feature of most of these design and appraisal faults is that they are well-known, yet the evaluation literature is replete with complaints that they keep being repeated. The DAC Expert Group of Aid Evaluation asserted that the lessons 'have frequently not been applied in practice despite the fact that they have long been recognized, with the result that mistakes recur, thereby lessening the impact of aid...'." (Cassen 1986:174).

283. IIMI staff have observed this in several recent World Bank appraisals of large-scale irrigation investments.

284. These attitudes and perceptions of bank staff and most other development professionals confirm Heaver's remarks in the quotation at the beginning of this chapter of the rather sectoral/disciplinary bias of bank staff, and the related tendency to focus on technical assistance, improved professionalism, rather than on the management process requirements (Heaver 1982:8).

285. E.g., Cassen at al. 1986. Cassen's mode of evaluation of the accountability of the development banks suggests that he and his co-writers shared many of the perspectives of the banks toward its accountability, as demonstrated by the following assessment: "In all agencies there are systems of shared accountability in which peer pressures, management surveillance, and the technical work required on projects all combine in an attempt to ensure quality. (Often the value of cost-benefit analysis is the not the rate of return, which is the 'bottom-line', but the fact that it forces project staff to be explicit about critical assumptions, which can be alert management)" (Cassen 1986:311) The starting point of their assessment did not seem very neutral as well as they all declared themselves part of the development clique whose own careers are at stake when evaluating the virtues of aid: they "...shared the view that there is nothing wrong with aid a priori, but that its virtue is not to be taken for granted." (ibid:2).

286. Cassen 1986:310-311.

287. E.g., ADB 1990a:16.

288. See also IIMI/World Bank 1991:35 and 59.

289. E.g., Bloemen and De Moor 1983.

290. This type of attitude is reflected in a letter to the International Agricultural Center (IAC), an advising body to the Dutch Ministry of Development Aid, by the late Professor Nugteren of the Department of Irrigation of Wageningen Agricultural University. In this letter, he has criticized a major association of Netherlands consultants as follows: "...it seems [the consultant] has still not yet seen the light that making a feasibility report without sufficient data and spending

too little time at the project location, is the main source of the difficulty" (Nugteren 1971 in Bloemen and De Moor 1983:320). Of course, the consultant had seen the light, but had to compete with other consultants, and thus went along with the set time for the feasibility study.

291. An interviewed engineering professor from Cornell University confirmed this image when he stated that: "The present engineering designs around the world are determined and controlled by a small number of international consultant and donor organizations." And a staff member, later Director, of the International Land Reclamation and Improvement Institute (ILRI) in correspondence with the International Agricultural Center (IAC) in 1973 has made the following similar remarks: "When introducing irrigated agriculture one always has to wonder what the consequences will be one way or the other. This is the umpteenth case, where one has considered soil and water according to the utility principle, instead of looking from a management perspective. Engineering means that one has to know the consequences of certain interventions beforehand and present these to the decision makers in the form of alternatives. It is somewhat shaming that such an approach has not been followed and one is faced with damage now. In this way, we compete ourselves out of the market, whereby it is a meager comfort that other (foreign) companies do mostly not act otherwise." (N.A. De Ridder 1973 in Bloemen and De Moor 1983:329).

292. Weiss and Jequier 1986:2.

293. Carruthers 1983b:96.

294. The latter makes the typical resistance of operational donor staff toward inputs from the post-evaluation office staff in project design somewhat more understandable.

295. E.g., "...the findings of evaluations do not always carry enough weight in influencing what is actually done." (Cassen 1986:175). See also the previous note.

296. E.g., Moore 1987:3.

297. Duane 1986:9.

298. In general Duane 1986:8; for the USA Small 1989:4; and Repetto in general: "...coalition of farmers, their political representatives, and government irrigation supply agencies is so strong that it has been called "the iron triangle" (Repetto 1986:33)

299. Heaver 1982:19.

300. For example, Duane has phrased as follows their apparent uneagerness to get involved in such issues: "There is no reason why this philosophy of irrigation finance should not sit well with the Bank....if it can find Borrowers who are also willing to try it." (Duane 1986:9). According to him: "...the first requirement--even for experiment--is interested Governments." (ibid:14)

301. Repetto 1986:33.

302. Small 1989b:15.

303. In the USA, subsidies for capital costs have apparently only stimulated "irrigators to select an irrigation method which involves a relatively high capital cost but lower O&M costs, even though such a system may be economically inefficient (US National Water Commission 1973:490)." (Small 1989b:17). Such adverse incentives are not specific for development aid, but tend to be a direct consequence of any competition for aid (Tullock 1988).

304. Korten in Svendsen et al. 1990:95-98.

305. Svendsen et al. 1990:106.

306. Heaver has quoted Pfeffer on the behavior and attitudes underlying such symbolic acts: "If it sounds as if managers (and politicians more generally) are playing an intentionally deceptive game, this is not the point, in that managers and politicians fool themselves as well as each other with their symbolic acts." (Pfeffer 1980:72 in Heaver 1982:7)

Others that seemed to be fooled--or fool themselves--, were the funding agencies. For example, for the Philippines the loan repayment for capital costs by the corporation to the government was temporarily enforced--on paper at least--by the World Bank during a period of severe budget shortages in the early 1980s. Before that the government did not enforce it, apparently because else the National Irrigation Administration refused to do any further major construction, also in view of the government controlled cost recovery options. Such interaction showed again the crucial role that subsidies for major construction played in this game, also at political levels. It also showed the difficulties that donors experience in influencing accountability through intervention in the organizational structure.

307. Heaver 1982:7.

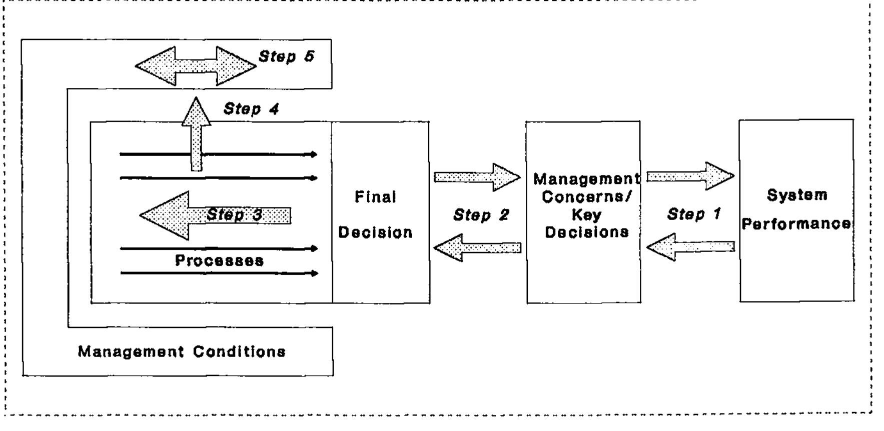
CHAPTER 6

Results: Conclusions and Recommendations

CHAPTERS 4 AND 5 respectively give the generalized descriptions and analyses of the key decision-making processes for the capacity utilization and the capacity creation (i.e., step 3 of Figure 13). The beginning of this chapter presents the main conclusions from these analyses of the key decision-making processes of the capacity utilization and capacity creation.

Chapters 4 and 5 also identify the required changes in decision-making processes and management conditions for performance improvement (step 4). This chapter integrates these requirements from the perspectives from the capacity utilization and the capacity creation into an overall perspective. The final stage of the management perspective is this chapter's discussion of the recommended processes of management-control of the decision-making processes and of the management conditions (step 5, or the C-process of Figure 4 in chapter 3). Also some policy changes are recommended.

Figure 13. Performance- and water-based management analysis



CONCLUSIONS ABOUT THE DECISION-MAKING PROCESSES

Capacity Utilization

Many conclusions evolve directly from the observed *low motivation of staff for performance.*

Staff of all observed irrigation agencies appeared little motivated and committed toward the water-delivery performance during the capacity utilization. This systematic low motivation toward the water-delivery performance was caused by the observed absence of an accountability for the water-related performance of the observed irrigation agencies as a whole. Though the observed low levels of sophistication of the key decision-making processes had also their own momentum, and may thus have caused some of the conclusions to a certain degree as well. Still, the following conclusions evolved mainly from this low motivation.

1. Mainly due to this low motivation for performance, the actual decision making about the capacity utilization was left mostly to the gate operators. Higher level staff tried to minimize their management inputs and tried to keep the farmers satisfied by issuing more slack water into the system;

2. Mainly due to this low motivation for performance, the assessment of the available water supply by the agency staff tended to be at the "safe" side to minimize the cultivation risks and to minimize thus the related conflicts with farmers and politicians;

3. Mainly due to this low motivation for performance, the assessment of demand, the allocation of water, and thus also the regulation, tended to be demand-driven in all case studies. This contrasted with most design concepts and irrigation engineering approaches (except for the Moroccan) that all assumed a supply-driven water allocation and regulation;

4. Mainly due to this low motivation for performance, the management of the main system was an "adhocracy". Operational methods and procedures were determined ad hoc by the gate operators themselves, with no coordination of the flows along the main system. This provided much scope for the favoring of the head-end reaches of the canals;

5. Mainly due to this low motivation for performance, the water schedules were often not adjusted to the actual constraints and opportunities. So they usually played a marginal role in the actual decision making about the allocation and regulation;

6. Mainly due to this low motivation for performance, the monitoring and evaluation of the actual allocation and regulation tended to be absent. Measuring facilities appeared often not functional for such reasons as technical deficiencies, the cost effectiveness of metering, and the absence of a need to use them. Measuring structures, as well as the monitoring and evaluation were observed to be functional only in the Moroccan case study where the water was sold on a volumetric basis, and where such payments were a sufficient incentive for the agency staff to increase its management inputs;

7. Mainly due to this low motivation for performance, almost all professional methods and techniques (such as the theoretical water requirements, the scheduling, the measurement, and the monitoring and evaluation) that were used in the capacity utilization could not and did not contribute to performance improvement. Besides, all these conceptual approaches gave problems to incorporate the managerial aspects of irrigation;

8. The absence of the management of the regulation as a separate discipline in irrigation engineering seemed mainly due to this low motivation for performance;

The following conclusion about the capacity utilization processes did not relate to the low motivation:

9. The scientific formulae to calculate the theoretical water requirements gave problems to cope with such "soft" parameters as the scarcity value of water and the related inefficiencies. The formulae calculated the "hard" demand of crop, soils, and canals, and could not cope with the "soft" requirements as expressed by people and institutions. Though even the assessment of the "hard" requirements appeared difficult to do accurately for individual farms and small subsystems with these formulae. It appeared difficult to assess accurately most parameters required in the formulae, such as the irrigated area, the progress of the land preparation, the requirements for land soaking, effective rainfall, and seepage and percolation rates.

Capacity Creation

Many conclusions evolve directly from the in all case studies observed *low motivation of staff for the quality of the investment decisions*. This systematic low motivation toward the quality of the investment decisions was caused by the observed absence of an accountability for the such quality of the observed irrigation agencies as a whole. Though the observed very low levels of sophistication of the key decision-making processes had also their own momentum, and may thus have caused some of the conclusions to a certain degree as well. Still, the dominating objectives of the agencies, and thus of its staff, appeared the acquisition of the external, and for them "free" investment funding. *This priority for investment quantity appeared to be the main cause for the low motivation toward the quality of the capacity creation decisions and the performance during the capacity utilization.*

Apart from the above conclusions, the following conclusions were linked to this "quantity-at-the-expense-of-quality" incentive system in the observed irrigation agencies:

1. Mainly due to the priority for quantity, also during the capacity creation, the agency staff tried to minimize their inputs in the quality of their assessments and design (i.e., in assessing the actual desirability, feasibility and functionality of an envisaged investment for the farmers, system managers, and local communities).

They thus tried to minimize their management inputs in interacting about these issues with the farmers, system managers, and local communities;

2. The priority for investment quantity thereby prevented the assessment of the real-life feasibility and functionality of the envisaged investments. Determination of the feasibility and functionality was approached in a conceptual way. The underlying assumptions about the physical performance (such as the water duty, cropping pattern, calendar, intensity, and yield), the maintenance levels, the cost recovery, the time and costs of project implementation, and the life span of the investments, were observed to relate to what was "possible" in a systematically over-optimistic direction, rather than to what was "probable". These assumptions were never justified. Performance achievements and experiences were ignored in all case studies. Also the feasibility assessment of an irrigation system's major resource, the available water resources, occurred unprofessionally and nonchalant in all case studies. The available data appeared thus insufficient in all case studies. Staff of the donor and consultant, government and agency all appeared interested in the justification of the investment rather than in its true feasibility and functionality. This led to the manipulation of many assumptions underlying the economic feasibility in all case studies;

3. Decision preparation and often the decision taking on the feasible objectives was usually done by donor staff and consultants. Yet, apart from their fore mentioned bias for quantity, it was observed to be very difficult, if not impossible, for them to determine the true feasibility of an investment, especially of the assumed performance improvements. Recipient agency and government staff tended to represent vested interests to realize the funding, and were unlikely to provide any information counteracting these interests. Even in the few observed cases where they were willing to do so, they were usually not asked to by their superiors, or donor staff or consultant. So the coinciding interests of donors and recipient governments encouraged the manipulations. Besides, also the assessment experts and donor staff, who were driven by their organization's targets, appeared not interested in an absolutely neutral feasibility assessment;

4. The priority of quantity stimulated capital-intensive investments, that again stimulated the conceptual approaches. These conceptual approaches toward the feasibility assessment and the functional design allowed the agency and donor to rely on (unreliable) data (e.g., on soils, topography, geography, and demography), rather than on the interaction with the farmers and system managers, or on other types of experiences in similar irrigation systems. This reliance on data appeared indispensable for investment quantity, as, unlike time-consuming interactive processes, it facilitated capital-intensive investments. This priority for quantity and the related time-pressures were observed to stimulate the controversial status of participative design in irrigation engineering;

5. Mainly due to this priority for quantity, almost all professional methods and techniques (such as the EIRR, the theoretical water requirements, and the design concepts) used in the capacity creation could not and did not contribute to performance improvement in all case studies. Cost-benefit analyses and the related sensitivity analyses were not allowed in any of the case studies to classify a project as unfeasible. They seemed therefore to have lost their theoretical functionality for the assessment of investment feasibility and appraisal. Instead, they were used to facilitate considerable subsidies for irrigation investments. Besides, all these conceptual approaches gave problems to incorporate the management aspects of irrigation;

6. The different observed conceptual approaches developed to overcome the "management gap" (such as the parallel field canals, on-farm water management, O&M manuals, water-management consultants, farmer participation and monitoring and evaluation) did not increase the commitment to performance of the agency and government as they did not touch upon the performance and accountability issues. In fact, these solutions increased the donors' influence in the actual investment planning and design (further strengthened by the donor's leverage, whether passively or actively), whereby the agencies felt increasingly less responsible, resulting in a diminishing commitment from their side;

7. Mainly due to this priority for quantity, the cost effectiveness of the rationalized design concepts seemed to have remained unclear. This, despite a considerable increase of the unit costs related to the shift from the traditional (i.e., least-cost) to the rationalized design concepts. Besides, the latter design concepts allowed to leave out many real-life constraints and ignored such real-life practices as the reuse of irrigation water downstream. The design concepts also ignored the fact that in real-life irrigation, system development tends to occur by trial-and-error;

8. Mainly due to this priority for quantity, the designs had to fit the overoptimistic feasibility and appraisal assessments in most case studies (i.e., this was not observed in Morocco). Much flexibility to deviate during the design stage from the feasibility-level assessments did usually not exist as it would endanger a successful cultivation of the planned (i.e., the maximum) command area, even in theory. In all case studies, the cost-benefit analysis of the irrigation investments assumed the maximum benefits through assuming the benefits of the maximum possible area irrigated (thereby assuming high "possible" water efficiencies). This was observed to create a pressure for designers to continue to design for this maximum benefit, at least in theory, to realize the envisaged EIRR;

9. System rehabilitations often seemed to serve merely the cover up of a disappointing economic viability of the preceding investment. The related internal donor justification processes were thereby observed to have a tendency of creating their own momentum of investment desirability;

10. The assumptions underlying the feasibility assessment and the functional design were kept implicit in all case studies. This prevented any accountability for the quality of these assessments, as well as potential learning processes from earlier mistakes. Especially, irrigation design may benefit from making the assumed functional requirements explicit;

11. The EIRR appeared unable to assess the national opportunities for the investment funds. First, because it was not used to compare investment alternatives. Second, because of the systematic manipulation of the underlying assumptions. In general, there seemed a lack of consideration of the national opportunities for development investments, and a lack of accountability for their performance. This caused huge subsidies for the irrigation subsector and a considerable wastage of national opportunities;

12. These subsidy-oriented practices seems to have ignored the here observed influence of these supply-driven subsidies on the incentives to perform during the capacity utilization. Ignoring these incentives is likely to become a self-fulfilling prophecy: as long as you do not allocate more value to the performance during the capacity utilization by unconditional huge subsidies for capacity creation--through a low quality of the feasibility assessment--, the underutilization of the created capacity make further investments in capacity creation necessary;

Also the observed funding agencies appeared not accountable for the quality of their investment decisions. Despite the extensive awareness of the "quantity-at-the-expense-of-quality" nature of their investments for a long time, they appeared to have made few serious efforts to make recipients accountable for performance. Moreover they appeared to have undertaken little to reduce the negative influence of quantity through the reduction of the related pressures. The observed funding agencies appeared to operate internally essentially as banks, and they thus fueled the pressure for "quantity". The following conclusions are directly connected to this dominant accountability for quantity of the funding agencies:

13. The observed funding agencies lacked effective checks and balances to moderate the influence on the quality of the assessments of this systematic priority for quantity of its staff, recipients and consultants. In none of the case studies the appraisal assessments were based on, or linked to, experiences and achievements of the same irrigation agency (the so-called "remedial principle"). The few existing checks, like the peer review, appeared to be dominated by the interests for investment quantity. Although some interviewed donor staff considered the loan covenants, the EIRR, and the sensitivity analyses as such checks, this appeared erroneous in view of their manipulability. The sensitivity analysis was observed to exclude the real risks intricated in the overoptimistic assumptions, neither did it ever seem to be a basis for a loan refusal;

14. At all stages of the investment decision making, career incentives and the annual

budgetary processes appeared to motivate the involved donor staff to realize the envisaged investment. The observed funding agencies did not keep its staff effectively accountable for the quality of its funding appraisals;

Other conclusions about the capacity creation processes are the following:

15. Although new substantive design concepts are important, so are the decision-making processes of the definition of a "program of requirements" prior to the design. Especially the decision-making processes by those who have to make the structures work, the agency and the farmers. The recent design concepts seemed to have underestimated such required time-consuming negotiating processes, resulting in explicit water rights and allocation plans, rules and procedures. In general, conceptual designs ignore the importance of such a process;

16. This study's observations suggest also the need for a certain qualification of the importance of design concepts. Apart from the fore mentioned importance of the process of design, the actual organization's goals seem a major influence on the usefulness of any design concept in place. Without the will to manage, no design concept is "manageable". Similarly, if the objectives are right, every design is to a certain degree "manageable". In a situation where the agency and farmers support the performance objectives, every design becomes to a certain degree "manageable", whether it were traditional, modern, flexible, simple, least-cost, or even dilapidated;

17. A technical deficiency observed in the feasibility assessment was the omittance of the probabilities of the available water resources in the assumed cropping intensities. This caused a direct overestimation of the likely cropping intensity with at least 20%.

RECOMMENDATIONS: POLICY CHANGES

This study's recommendations start with the recommended policy changes that seem essential to improve the performance of irrigation investments, though most of them apply equally well to other sectors of development investment.

Policy changes are substantive choices about the organizations goals. They are therefore not part of the management-control decisions that deal only with controlling the process of decision making, rather than the evolving choices. Yet, policy decisions are the input for management and control decisions, and are therefore important decisions to achieve performance improvements in the irrigation subsector.

The remainder of this section presents only the main and very broad recommendations about policy changes that evolved from this study's analyses:

1. *"Quality First" (of investment appraisals)*. Major evaluations of the effectiveness

of development aid by the Organization of Economic Cooperation and Development (OECD) and the Development Assistance Committee (i.e., the Joint Ministerial Committee of the Boards of Governors of the World Bank and the International Monetary Fund) have recognized the bias for investment quantity as a serious threat to the quality of investment decisions.[1] The quality of the investment decision has a direct influence on the performance of the capacity utilization through its influence on the capital and recurrent costs. Yet, these major evaluations have not recognized the other major threat of the bias for quantity that was observed in this study; its systematic and long-standing distortion of the performance-related incentives of the recipient organizations and their staff.

The observations suggest the need for a major policy change of the funding agencies of development aid. Improvement of the performance of development investments would require a shift from a priority for "fund-channelling" (or investment quantity) toward a priority to the quality of the investment decisions, and thus for performance. Performance should be made a national concern, rather than only a concern for external parties such as the staff and consultants of the funding agencies.

The ultimate responsibility for investment appraisal would have to rest with "quality" rather than with "quantity" interests. Rather than using the donor's leverage for substantive policy changes, it could be used to require a satisfactory performance of the investments. Also policy dialogues would have to discuss such accountability and performance issues.

"Stick to Knitting" (i.e., banking). This study's discussion of the cost recovery policies have shown the potentially very centralized decision making in the observed funding agencies, as well as the big time gap between feedback on the quality of its interventions and some related improvements. Such centralization seems a consequence of the observed absence of any accountability for performance of the recipients of development aid. Though it simultaneously confuses the related responsibilities of the recipients. Such type of directive operation has important drawbacks for developing far-away countries, and seems to bring along high risks of retarding local processes and opportunities. Besides, the funding agencies appeared to have no control over the actual compliance with such loan covenants, or their effectiveness, due to its bias for investment quantity. In general, such policies seemed the consequence of a confusion about the role of the funding agencies in development. *Rather than enforcing certain policies such as cost recovery and participation or sector-specific measures, the Board of Governors of the funding agencies would have to worry about making the national parties accountable for performance.* Therefore, they should concentrate on making the funding agencies only accountable for facilitating performance improvements as described above;

2. *"Stick to Knitting" (i.e., banking).* Another policy change would be *to require that donor staff and consultants should not be involved in the assessment of the*

desirability and feasibility of such investment objectives as the type of crops, the project size, and the performance objectives. Their involvement was observed to confuse the local responsibilities and accountabilities for the investment's performance. Besides, they appeared less suitable for high quality assessments. They were observed to have insufficient familiarity with the local political and organizational issues in any of the case studies. Neither would it be likely for them to get sufficient time for any participatory processes. Instead, they should be involved only in investment appraisal decisions while neutral toward quantity.

3. Making national parties accountable for performance requires a more tight funding through *a reduction of the (hidden) and other unconditional subsidies.* Though this does not exclude any future subsidies for irrigation investment. Still subsidies may be considered necessary, though they should not bias the agencies toward investment only, and against the quality of the capacity creation decisions and against performance. Subsidies also should be related to the opportunities of providing them to other sectors. Such subsidies thus could be proportional to the investment, or, for example, comprise of an annual lumpsum that is independent of the size of the actual investments. Such types of subsidies would be more neutral toward specific investment choices;

4. Another policy decision would be to require *the water users to pay a reasonable price for the volumetric water use* to enforce more consciousness about the scarcity of the water resource;

RECOMMENDATIONS: MANAGEMENT CONTROL OF THE MANAGEMENT CONDITIONS

Chapters 4 and 5 identify the required changes in management conditions for performance improvement (step 4 of Figure 13). This section integrates these requirements from the perspectives from the capacity utilization and the capacity creation into an overall perspective. The final stage of the management perspective is this section's discussion of the recommended processes of management-control of the management conditions (step 5 of Figure 13 or the C-process of Figure 4). Subsequently, the next section discusses the recommended processes of management control of the decision-making processes.

Financial Control

Conclusions about the required changes. Financial control is not by coincidence the first management condition in this discussion of the related management control. In all case studies the investment funds for capacity creation were observed to dominate the incentives for agencies and the individual staff members. Financial accountability of agencies and organizational units seems therefore the primary starting point to develop some accountability for the quality of investment decisions and for performance.

The main required changes in this management condition were from a perspective of the performance improvement during the *capacity utilization*:

1. a financial control system that *links an agency's finance to its water-delivery performance*, whether through 1) structural solutions (e.g., more financial autonomy), or through 2) different accounting systems (e.g., business accounting, profit/cost centers). The latter solution is only valid if seriously implemented. It requires probably that an agency's finance does not fully depend anymore on the government budgetary allocation and unconditional subsidies, i.e., more *financial independence*;

2. the most direct and refined incentives for an improved service delivery by the agency staff and decentralized units are *the service fees paid by the farmers for the delivered services on a volumetric basis*, especially if the agency's financial viability is at risk for the fee collection as mentioned under 1;

Complementary changes from a perspective of the improvement of the quality of the decisions about the *capacity creation* were the following:

3. several changes in management conditions would contribute to the recommended policy change of more tight funding through the reduction of the hidden (i.e., in the cost-benefit analysis) and other unconditional subsidies. An example is a reduction of the misuse of the cost-benefit analysis through *checks and balances on all performance and other assumptions underlying the feasibility assessment* (e.g., through the remedial principle). Also an explicit commitment to performance improvements could be introduced through, for example, *the consistent use of a "performance and accountability balance sheet" by all major funding agencies*;

4. a direct *link between an agency's finance and the quality of its capacity creation decisions*, and the ultimate water-delivery performance may reduce the observed bias toward investment quantity and against performance. For example, cost-sharing by the agency and the clients is likely to reduce this bias as it makes both parties think twice about the likely benefits of the investment. Other possible measures would be subsidies proportional to an investment's size, or as a fixed annual lump sum that does not depend on the size of actual investments;

5. a direct financial accountability of the agency to the funding agencies. For example, through (partial) *direct lending to the irrigation agencies*. By that the financial implications of a low quality of the capacity creation decisions will become more transparent, even if the national government would guarantee the loan. Though *more financial autonomy* of the irrigation agencies seems the best way to ensure cost effectiveness and efficiency of irrigation investments. Direct

lending also may have the advantage that funding agencies would bear some of the risks, and may thus be more careful about the quality of the investment appraisal decisions;

6. *more individual accountability of donor staff for the quality* of the investment appraisal decisions--even though the time gap to assess the adequacy of the original assessment makes this more difficult--while they should become *neutral toward quantity*.

All financial control changes for capacity creation are complementary to the one for the capacity utilization, i.e., a decentralization of financial control, either through more financial autonomy, or through the creation of cost or profit centers. A serious creation and implementation of cost or profit centers would be a less drastic measure than financial autonomy, and would be the minimum required change. Though increased financial autonomy is likely to be more effective as it touches upon the incentives of the agency as a whole.

The overall recommended management-control processes. Hereafter follows the overall picture of required management-control processes to realize the above financial control changes. Linking an agency's finance to its water-delivery performance (item 1) seemed unlikely to be very effective unless the management-control issues for the capacity creation (items 3-6) were implemented because of dominating influence of the subsidies for the capacity creation on the agency and staff incentives. These observations suggested that the most basic steps required would be to reduce these subsidies. Items 3 and 4 address possible ways of doing that.

Yet, also the observed funding agencies seemed unlikely to initiate such constraints on quantity, as they themselves were not accountable for the quality of the capacity creation decisions and the performance of their investments. Item 4 gives a possible financial control measure to make a funding agency more financially accountable for the quality of its investment appraisal decisions.

Making the quality of investment appraisal decisions, rather than the quantity, the major performance indicators for funding agencies and its individual staff members, may increase the quality-related pressures. Linking quality-related checks and balances toward the individual performance assessment of donor staff members may provide for more quality-oriented incentives. They would provide for professional and legitimate incentives for individual staff members to resist political pressures on investment appraisal decisions. The observed practice of collective performance assessment in the funding agencies circumvented this sensitive aspect, and did not provide pressures on quality-related performance. The overall result was no quality-related accountability, other than conceptual.

Even it could be envisaged to make the funding agencies accountable for its facilitation of performance improvements. The fore mentioned "performance and accountability balance sheet" provides a tool to the governing boards of the funding agencies for making donor staff and units accountable to the quality of their investment decisions. Besides, these sheets can provide a tool for making the funding agencies agency as a whole accountable for their success in facilitating performance improvement, and "getting the performance-related processes started".

Still, getting these processes started requires primarily that the quality of the investment appraisal decisions should be the only performance indicator for a development financier. And to get the process of improved performance started, donor staff have to be impartial to say "yes" or "no".

The above changes in irrigation financing modes are stated bluntly. Yet, the proposed changes toward more accountability are likely to be successful only if the recipients support such changes. Policy dialogues between funding agencies and recipient governments thus should address such accountability and performance issues more seriously than was observed in the case studies.

Provision of Information

Conclusions about the required changes. The main required changes in this management condition were from a perspective of the performance improvement of the *capacity utilization*:

1. improvement of the water delivery would require such an increased level of information provision to the decision making by higher level staff that they are very likely to become overloaded with the information. A possible adaptation in the provision of information would then be to reduce the need for such provision to higher level staff through a *decentralization of the decision making*. Potential and logical units of *decentralization* are the system level, or the subsystem served by one or more main, distributary or lateral canals;

2. another form of adaptation of the provision of information through a reduced need for it would be through *more "management by exception"* in terms of the development of more standing orders for different situations;

3. improvement of the water delivery would possibly also require facilities to provide information more timely, especially for the coordination of the regulation along the main canals. This may need *the application of more on-line communication facilities*;

and from the perspective of the improvement of the quality of the decisions about the *capacity creation*:

4. a higher quality of investment decisions would require an increased provision of information to the responsible decision makers, often the staff of donors and consultants. Sufficient information provision to such external parties seems very difficult, especially related to local organizational issues and requirements and other location-specific information. A possible adaptation in the provision of information would then be to reduce the need for such provision to such external parties through a *decentralization of the decision making*. Potential and logical units of *decentralization* are the agency or project level.

Although both perspectives thus require a decentralization of the decision making, it relates to different levels. The management-control decisions to achieve these different types of decentralization are described below.

The overall recommended management-control processes. Decisions about the decentralization of the decision making, related authority, responsibilities and accountabilities from the national government to, for example, the agency or project level require a political will to do so. The foreign funding was observed to discourage such decentralization as its acquisition appeared to stimulate centralization. Interviewed donor staff confirmed this, and World Bank staff have made similar statements in a seminar at IIMI.[2] The frequently abundant quantity with little political, financial and economic accountability attached further strengthened this intrinsic characteristic of aid to encourage centralization. It biased national politicians and government toward quantity without any need for increased information exchanges, demand assessment and, ultimately, decentralization. Only if the performance considerations become more important for investment decisions as described before, the need of the national parties for demand assessment and decentralization may evolve. Decentralization as a loan condition without a need for performance is unlikely to be successful.

Decentralization of the decision making about the capacity creation from the donor staff and consultant to the agency, requires decisions by the funding agency to make it a concern for the national party. Related measures were discussed before.

Human Resources

Conclusions about the required changes. The main required changes in this management condition were from a perspective of the performance improvement of the *capacity utilization*:

1. *the introduction of more performance-oriented human resource management (HRM) measures*, such as performance-based incentive systems and career development. The introduction of more performance-oriented HRM measures requires a decentralization of the responsibility for HRM from the central government to the agency;

2. *a reduction of political interference in HRM matters* would increase the credibility of merit-based HRM policies. This may evolve from more financial independence of irrigation agencies;

3. *specific management training* may alleviate to a certain degree such constraints as attitudes that impede communication, improve teamwork, and leadership skills. Though these should be complemented with a more operational HRM as described under item 1.

Items 1 and 3 evolved also from a perspective of the improvement of the quality of the decision making about the *capacity creation*. Both the perspective of the capacity creation and the capacity utilization thus require a decentralization of the responsibility for HRM, complemented with specific management training. The possible advantage of a more independent irrigation agency of a reduced political interference would complement the other two changes. The overall picture of required management-control processes to realize this type of decentralization, more financial independence and management training are described hereafter.

The overall recommended management-control processes. In all case studies, the national governments themselves appeared constrained in giving special incentives to one type of (semi-) government agency. Such a move would definitely meet opposition from other interested parties such as government agencies, trade unions and political parties. Therefore, outside pressure or conditionalities from funding agencies may provide for the necessary momentum for the above changes. Decentralization of HRM and more financial independence may evolve if the national government and agency are required to improve the performance of its investments. This brings us back to the already described required changes in the financial control such as an individual accountability of donor staff toward the quality of the investment appraisal decisions.

The current approaches of donors to institution building in the agencies such as training, performance evaluation and monitoring, more staff, manuals, and the provision of external consultants were observed to have little success in all case studies. In general, investments that specifically aim at improved HRM in an isolated way are unlikely to be successful, especially without a need for improved performance.

Provision of Knowledge

Conclusions about the required changes. The main required changes in this management condition were from a perspective of the performance improvement of the *capacity utilization*:

1. the *availability of knowledge about the managerial aspects of main system regulation* (i.e., of the coordination of the gate settings along the main system). No such knowledge appeared available in the observed agencies;

and from a perspective of the improvement of the quality of the *capacity creation* decisions:

2. the *availability of knowledge about real-life planning and design approaches* (i.e., approaches that rely on local feasibilities and requirements, rather than on the international reference manuals with mostly [implicit] requirements unfit for the management situations in all case studies);

3. the *availability of knowledge about more integrated capacity creation concepts* (i.e., concepts that consider the interrelations between such issues as the system layout, the peak irrigation requirements, the required management inputs of agency staff and farmers, and the non-irrigation functions).

4. the *availability of knowledge of performance-oriented methods of irrigation financing* (i.e., concepts about integrating performance within a financial setting dominated by international funding agencies). Currently, the priority for quantity

seemed to have forced the staff and consultants of the funding agencies to interpret quality in terms of their own disciplinary professionalism. Instead, they should focus on performance and thus require the national parties to develop the relevant professionalism.

The overall recommended management-control processes. Major constraint for the availability of the above knowledge is the general absence of the related professionalism. This professionalism is unlikely to evolve without any requirements toward performance. In fact, the absence of such professionalism seemed caused by the absence of a need for it. After several decades of supply- and donor-driven development investments, the applied knowledge necessarily has become more and more theoretical to justify further investment against the odds of extensive disappointments. The justification processes have caused these theoretical approaches to intervene in increasing detail in local planning and design questions (e.g., in the required field level discharges, and the flexibilities of structures).

The staff of donor and consultants were major actors in these justification processes, and so they were in the development of these theoretical approaches. The donor staff and consultants are unlikely to deliver quality for such locality-specific issues. Therefore, the design approaches should become again a local concern. Only if requirements toward performance are developed, the need for such professionalism is created. Such a need is likely to result automatically from the from such a move resulting learning processes by the national agencies and governments, though this may take time. If the need for such professionalism is there, its development can be facilitated by, for example, the funding of related research projects and institutes, by the starting and strengthening of related networks, and the development of documentation of the related experiences. Examples of relevant techniques for the flow regulation would be trial-run techniques, or the application of simulation models to experiment with different operational methods and procedures.

Structural Reform

Conclusions about the required changes. The main required changes in this management condition were from the perspective of the performance improvement of the *capacity utilization*:

1. an improved performance of an irrigation agency's service delivery during the capacity utilization requires *a more elaborate and precise mission statement on the levels of service delivery*. Such an improved mission statement is a prerequisite for an agency and its staff to become responsible for the water-delivery performance, as well as accountable for it. It may also increase the awareness among engineers that a large part of their tasks is managerial;

2. *external public monitoring, or a "water-delivery performance audit", for more systematic accountability* (if no financial or other accountability to the clients exists);

3. an increased *decentralization* of the presently centralized irrigation agencies, as observed in all case studies. Though there remains a need for *a "central coordinating unit"* that represents the system-wide interest along the main system, and that regulates the flows along it. Naturally, such decentralization only works with performance-related incentives for the decentralized decision makers;

4. an improved performance of an irrigation agency's service delivery depends to an important extent on the quality of the flow regulation in the main system. Charging a separate organizational unit, or even organization, with the regulation may facilitate an improved separation of the conveyance along the length of the canal from the localized distribution interests. It also may facilitate an explicit accountability for the flow regulation service, because of the existence of a transfer point from the "main system" unit to the "sub-system" unit. Again, the performance of *a separate "flow regulation unit"* will be best if its financial viability depends on the performance of its service delivery;

5. if WUGs are to be functional, they need a *more powerful position in the water-related decision-making processes* than currently observed in all case studies. This could be achieved either through more administrative authority, or through financial accountability to the WUGs. An ultimate step as the transfer of the ownership of (part of) the system (and possibly the agency) would provide the collectivity of farmers with even stronger powers to make the managing agency accountable for the performance of the capacity utilization;

6. external water-management consultants and separate units for (participation in) irrigation management were observed to serve little purpose if not allocated any related responsibility and authority;

7. more appropriate government regulations and related enforcement to reduce the observed adverse incentives in some more independent irrigation agencies;

and from the perspective of the improvement of the quality of the *capacity creation* decisions:

8. the *decentralization of the responsibility for the quality of the capacity creation decisions*, except the investment appraisal, from donor staff and consultants to national parties--donors and other external parties cannot take up this responsibility--. Donors should make this a local and internal agency responsibility and accountability, and keep it that way;

9. *individual accountability of donor staff for the quality of their investment appraisal assessments;*

10. a *more independent status* of the irrigation agencies, also financially, seems the best way to ensure cost effectiveness and efficiency of irrigation investments.

The above required changes in organizational structure and rules from a perspective of both capacity creation and capacity utilization do not bite each other. More decentralization and financial independence evolved from both perspectives. The following management-control processes are required to realize such changes in the management conditions.

The overall recommended management-control processes. To realize the above required changes it seemed necessary in all case studies to break the so-called "silent coalition of indifference". Donors should provide incentives to agencies and governments to use any new organizational structures in a serious way. Increased financial incentives for governments and agencies to perform seemed the most logical way to provoke such changes to be pushed through the many layers of resistent stakeholders. Without such incentives, structural changes appeared symbolic, rather than functional. This brings us back to the earlier discussed financial control changes.

RECOMMENDATIONS: MANAGEMENT CONTROL OF THE DECISION-MAKING PROCESS

The above mentioned management-control decisions all relate to improving the accountability for performance of the irrigation and funding agencies and their staff. Yet, if such accountability is introduced in the management conditions, higher levels of sophistication of the decision-making processes may not evolve automatically. The control decisions about the management conditions are not enough. This section therefore recommends specific management-control decisions to improve the decision-making processes. These management-control decisions aim to improve the levels of sophistication, and, thereby, to develop, introduce and control performance-related requirements into the decision making about the capacity utilization and the capacity creation.

Management control of the decision-making process refers to the establishment of the pattern of the decision-making processes in terms of the different steps of the processes, the room of manoeuvre for these different steps, the levels of sophistication, and what actors should be involved in the different steps. It includes the related monitoring and evaluation. Although management control thus influences the processes, it does not deal with the actual substantive choices. The latter are per definition part of the decision-making process as such (i.e., the B-process of Figure 4 of chapter 3). This section separately discusses the management control of the processes of the capacity utilization and those of the capacity creation.

Capacity Utilization

Allocation. The following management-control decisions may increase the levels of sophistication of the allocation decision-making processes, and thus may lead to improved allocation decisions, and ultimately to an improved performance:

1. A management-control decision that may cause some balancing of the observed conservative tendencies of agency staff in their assessment of the available water

supply would be to require more *explicit statements of the likely available water supply, and of the probabilities of different supply scenarios.*

Such explicitness may have two advantages. First, it may cause the cultivation risks inherent in the prediction of the rainfall and the inflow to be shared by the other participants of this decision making. Currently, these risks were observed to be the responsibility of the managing agency only. Second, it may cause more transparency to other parties than the managing agency of the climatological and managerial causes of the cultivation's success and failure. And thus of the trade-offs of increased risks and cultivation by more farmers;

2. Making a water schedule or plan as an objective in itself was the observed common practice of higher level agency staff of matching of supply and demand, except for the Moroccan case studies. Such plans had little relevance for the actual implementation. A management-control decision that may enforce a more realistic demand assessment, and match between demand and supply, would be to require *one or more intermediate steps in the allocation decision making* (i.e., before the final decision taking to allow for required adjustments).

   Such intermediate steps may lead to several improvements. They may provide the clients with opportunities to enforce the consideration of their requirements and preferences. So they may balance the presently divine role of the theoretical water requirements in this decision making in most irrigation agencies (compared to important real-life criteria such as the reduction of uncertainty, the minimizing of conflicts among farmers, and between farmers and agency, and the consideration of the income effects for individual farmers). The intermediate steps also may increase the acceptability of the water schedule to the clients, and thus the likelihood of its implementation.

   Different forms of intermediate steps can be imagined. Examples are 1) to require the field staff to make initial demand schedules (instead of the higher level staff); 2) to require a formal endorsement of the plan by (representatives of) the water users' groups (WUG); 3) to require WUGs or individual farmers to sign for the requested water quantity (as was observed in Morocco); and, 4) to require the allocation of quantitative water rights either to the WUGs, or to individual water users. Or, to require the existing qualitative water rights to be fixed in quantitative terms to make them more manageable, and reduce the uncertainty in the whole process. A related management-control decision would be to require meetings to be held with (representatives of) the WUGs and agency staff, or between different levels of agency staff, to discuss the proposed schedules. Or, simply to require the farmers to be informed regularly and timely about the proposed schedules to allow for related feedback;

3. Another possible management-control decision would be to require *explicit statements of efficiencies targeted for the different subsystems, also in comparison with earlier seasons, and the related justifications.* Thus localized norms for efficiencies are developed, for example, for the slack required for the regulation

of the main system. The latter management-control decision may induce agency staff to increase their efforts to interact with the farmers and field staff to improve the match between the supply and demand.

Flow regulation. The following management-control decisions may improve the levels of sophistication of the flow regulation decision-making processes, and thus may lead to improved regulation decisions, and to an improved performance:

1. A management-control decision that may increase the coordination of the gate settings along the canals would be *to require higher level staff to develop standing orders of required gate operations* for all regularly occurring flow scenarios (i.e., management by exception or if . . .then . . .instructions). Such standing orders were observed to be either non-existent, or highly irrelevant in view of the actual choices made by the gate operators in the observed situations;

2. Another management-control decision would be *to require for all other gate settings than those covered by standing orders the timely definition of specific instructions and the related room of manoeuvre.* Specific instructions for gate settings would cover the timing, duration and frequency of gate settings. They also may indicate the margins of allowed flow fluctuations before a new gate operation would be required. A related management-control decision would be to require regular meetings between higher level staff and field staff for the evaluation of these instructions and standing orders. Such meetings may not only increase the quality of the instructions, but also their acceptability for the field staff. In addition, they may increase the field staff's motivation and job satisfaction;

3. Another management-control decision would be *to require that gate operators are informed about the time, size and duration of flow changes*;

4. Another management-control decision would be *to require water levels along the canal to be used as inputs for the above instructions.*

All above management-control decisions are unlikely to be successful without continuous and serious monitoring and evaluation of their actual implementation. Especially for irrigation, with its multitude of conflicting individual interests, it would be required to follow-up on management-control decisions, to enforce rules and to have a decisive managing agency--provided the instructions and decisions are reasonable, realistic and acceptable to most clients and staff.

Capacity Creation

The following management-control decisions may improve the strategic decision-making processes, and thus may lead to improved strategic decisions, and ultimately to an improved performance:

Desired investment objectives.

1. Ensuring stronger professional guidance in this decision making through management-control decisions seems almost impossible given its highly political nature, and the "invisible" nature of the political influence on the professional guidance. Yet, a possible management-control decision would be *to require at least two alternative options of desirable investment* as this would require some justification of the desirability of one option compared to another;

2. The participation of other interested parties than politicians and donor staff in the determination of the desired objectives for investment was observed to be low in all case studies. A management-control decision to increase the likelihood of participation would be *to require a formal forum of public participation* (e.g., public meetings), or *to require the registration of the desirabilities of the clients and local community*, or *to require the registration and consideration of all dissent* with a possible investment in the determination of its desirability. A related management-control decision would be to require sufficient time to organize any participatory processes. Such decisions are, of course, highly political;

3. A management-control decision that may increase the quality of the desirable performance objectives would be *to require an explicit statement of these performance objectives* by the managing agency;

Feasible investment objectives.

4. A management-control decision that may cause some balancing of most assessors' natural bend toward investment justification would be *to require an explicit justification for all assumptions underlying the feasibility assessment*, i.e., to require a feasibility assessment based on explicit probabilities rather than implicit possibilities. Examples are the justifications of the level of dependability of the available water resources, the related number of crop failures, the level of the service delivery, the (peak) water requirements and efficiencies, the cropping intensities, calendars and patterns, the yields, the levels of maintenance, the envisaged life span of the investment, the investment cost and implementation schedule, and the level of cost recovery. Such justifications would also enforce a less divine role of the EIRR and other conceptual simulations of reality. A related management-control decision would be to require that the justification considers all readily available relevant information such as earlier assessments, publications, documents, and obvious local experiences;

5. Related management-control decisions would be *to require the explicit consideration of either at least two alternative investment options, or a more phased option, or a least-cost option to achieve the same objectives.* All these options would facilitate an increased consideration of the real-life feasibility into the feasibility assessment;

6. Another related management-control decision that may balance the confusion of the responsibility for success and failure of specific project components to a certain degree would be *to reduce the involvement of donor staff or consultants in the development of investment proposals and to require the agency itself to become the leading party in their development.* Donor staff and consultants should preferably be involved only in judging the feasibility of a fully developed proposal, i.e., in the investment appraisal;

7. The frequently observed practice of a marginal EIRR while envisaging maximum resource use for maximum benefits at maximum costs caused little room of manoeuvre at later stages. A management-control decision that may increase the flexibility for changes in the investment design and implementation after the initial investment appraisal would be *to require the economic feasibility to be of such a level as to allow for such flexibility*;

8. A management-control decision that may improve the observed opaqueness of the financial impact of investment decisions on the recipient organization and individual farmers would be *to require explicit statement of the financial impacts in investment appraisals and the related sensitivity analyses*;

9. A management-control decision that may ensure a reduction of the observed lack of consideration of the national opportunities of the funds for irrigation investment would be *to require the development of such location-, organization-, or country-specific norms for irrigation investment as, for example, the maximum costs per unit area for new construction and rehabilitation based on probable performance achievements*;

10. A management control decision that may ensure more transparency of the envisaged reliability of the available water resources for a new investment would be *to develop explicit criteria for the required dependability of the inflow* for feasibility assessments for different regions or countries;

Functional requirements for the investments.

11. A management-control decision that may increase an investment design's functionality would be *to require an explicit statement of the "program of requirements"* of the investment. Examples of such requirements are the future arrangements of ownership or rights of land and water, the local experiences with

soils, the performance targets, the management practices, the "investment history of the locale", the cost effectiveness of the individual components, and the reuse of water. A related management-control decision would be to require this program of requirements to be developed and determined by the agency itself, possibly in interaction with its clients, rather than by external actors. Especially requirements such as the controllability of flow, and performance targets probably can be determined only by the agency in a serious way. These two management-control decisions are likely to induce the agency to think about the functionality of its design;

12. A management-control decision that may facilitate more participation by farmers and system managers--and thus the acceptability and functionality of the design--, would be *to require one or more intermediate steps in the decision making to allow for some form of interactive design.* In such steps the clients would have an opportunity to enforce some consideration of their requirements and preferences. And thus to balance the divine role of the theoretical design concepts in this decision making that was observed in all case studies. This management-control decision also may facilitate more flexibility during project implementation, thus reducing some observed negative consequences of the rigid time frames for project implementation. Irrigation capacity creation seemed to need some trial-and-error. Such intermediate steps also may increase the acceptability of the design for the clients, and thus the likelihood of its implementation.

    Different forms of intermediate steps are possible. Examples are 1) to require a formal endorsement of the design and the related "program of requirements" by (representatives of) the WUGs; 2) to require WUGs or individual farmers to sign for the design and the related "program of requirements"; 3) to require a pilot testing of the design, and formal evaluation by agency and clients; 4) to require a gradual development of the command area; and, 5) to require the allocation of water rights to WUGs, or individual water users. A related management-control decision would be to require more or less meetings to be held with (representatives of) WUGs and agency staff to discuss the proposed designs. Or, simply to require that farmers are informed regularly and timely about the proposed design to allow for related feedback.

WHO SHOULD TAKE WHAT MANAGEMENT-CONTROL DECISIONS?

The above management-control decisions are not related to those who have to take them. They are stated as general requirements to improve the management conditions and decision-making processes about the capacity utilization and capacity creation, and thus ultimately the performance. This section contains some remarks about who should control what.

Most management-control decisions about the processes and practices of the *capacity utilization* should be taken by the agency itself, either by the project level, or if not, by the agency head office. The only management-control decision that the central government or funding agency could take about the capacity utilization would be to require performance standards to be developed and used. Also, they could make it policy to let farmers pay for the consumed water volumes.

Only in Malaysia, the Prime Minister's Office was observed to try to enforce some accountability for the water-delivery performance by initiating the definition of performance indicators and the related monitoring and evaluation. The agency seemed to take these performance measurements more serious than in the other case studies because of the simultaneous pressure on the budgetary allocation. In Morocco, Sudan and Sri Lanka such financial pressures were not linked to the water-delivery performance. In Sri Lanka, the central government did not even monitor the water-delivery performance of its irrigation agencies.

In Morocco, the government enforced another way of linking the water-delivery performance to the agency's finance, through its policy of enforcing volumetric water fees from the farmers. Yet, this financial accountability to performance seemed weakened through the observed government practice to allocate budgets independently of the agency's performance, as well as through the hidden subsidies in irrigation investments.

In contrast all management-control decisions about the processes and practices of the *capacity creation* should be taken parties external to the irrigation agency, as the pressure for quantity originates from there as well. In principle, it would be best if the central government takes all these decisions. Though the risk that short-term political priorities overrule such management-control decisions is quite high. So such management-control decisions can probably be introduced seriously only after funding agencies introduce some related financial pressures. Especially, the above management-control decisions 4 and 6 could do this. Serious implementation of such management-control decisions would probably require these funding agencies to become accountable to the quality of its investment appraisal decisions, and possibly for facilitating performance improvements, and not to the investment quantity.

Similarly, all management-control decisions to achieve the required changes in *management conditions* could probably best be taken by the central government, except those that relate to the internal operations of the funding agencies. Examples of some of these changes could be observed in all case studies. Yet, the observations suggested that such changes were only implemented seriously if there were potential financial implications, either enforced by the central government or by the funding agency.

New mission definitions, organizational set ups and other policies for the irrigation subsector were observed to be under preparation in the Sri Lankan government under a US AID-funded project, the Irrigation Management Policy Support Activity (IMPSA). The quality of the policy papers was high. Yet, it remains to be seen to what degree these policies will be implemented and effectuated without financial pressures on the central government or agencies. The short-term political priority for quantity seemed likely to overrule their implementation or impact.

In the Philippines, the central government has forced the National Irrigation Administration (NIA) in the 1970s to become a government corporation. Although it was an attempt to reduce the government budgetary allocation, it was never really enforced financially after the structural change itself. In the early 1980s the World Bank forced the central government to cut its subsidies to NIA for the repayment of its capital costs. Yet, after several years it restarted these subsidies, as NIA refused further capital investment without them. Also NIA was never made financially accountable for its service delivery in any serious way. The above major structural change had little impact without it.

In Morocco, the World Bank's sector loans were conditional to the central government's acceptance and implementation of increased financial autonomy, decentralization and business accounting systems for the irrigation agencies. Such conditionality seemed intended to stimulate the government to commit itself and implement such decentralization. The agencies seemed to support such decentralization. Though the commitment was there, the implementation still has to be realized.

The above type of donor conditionalities often seemed to fail because both parties know that the funding agencies have pressures to realize the loans anyway. This weakens their leverage toward serious changes by the national governments. Not coincidentally probably therefore, the most serious management-control measures were observed in Sudan after the international funding agencies actually stopped disbursements. (Sudan is one of the few countries where this has happened.)

Sudan was the only case study where the government was serious enough about the management-control improvements to start with the issue that matters most, finance. The government there approached the decentralization and increased financial independence by giving the agencies a deadline by which their finance would be cut back.

Overall, the management-control decisions about the capacity creation and changes of the management conditions are likely to require financial conditionality from the funding agencies. Given their important role in the finance of the irrigation subsector in all case studies, only the funding agencies seem able to enforce some accountability for its performance. Though this requires neutrality toward quantity, i.e., the possibility to say "no".

Notes

1. E.g., Cassen 1986:170.

2. IIMI/World Bank 1991:30.

CHAPTER 7

Evaluation of the Research Methodology

THIS LAST CHAPTER evaluates the methodology of the research. Thereto, the chapter evaluates the management perspective on its contributions to the analysis of the underperformance problem in the irrigated subsector. Also some disadvantages encountered in the application of the analytical framework are given, as well as its prospects of further applications. The significance of this study's results for the results of previous research is discussed. And the fulfilment of this study's problem definition and objectives are briefly evaluated as well. The chapter concludes with recommendations for future research that evolve from this study.

THE ANALYTICAL FRAMEWORK FOR IRRIGATION MANAGEMENT

Chapter 3 gives the developed analytical framework. This section discusses the framework-specific contributions to this study's analyses and findings. Besides, the significance of the framework is indicated.

Discussion: framework-specific contributions. The use of an explicit framework facilitated a *more focused data collection and analysis*. It appeared easy for an irrigation management analyst of any irrigation system to drown in the multitude of actors, agencies, interests, and more or less important information in any irrigation system. For example, in the first Sri Lankan case study 17 different government agencies were involved in the irrigation decision making. The explicit orientation here on performance-oriented key decisions facilitated a prioritizing in the data collection and analyses. This saved considerable time, and guided the management analyses to remain structured and consistent.

Another merit of an explicit framework was *its framing of a more objective analysis* of opinions and feelings that people and different professions had about a system, or about irrigation in general. The analyses were also less distracted by the fights among the different irrigation managers, professions, agencies, consultants and donor organizations.

Besides such general contributions of any framework, the following traits, and the related conclusions and recommendations in the previous chapter, can be attributed to the used framework:

1. The framework *facilitated a consistency in analyzing processes*. In the initial case studies it appeared to be difficult to think consistently in processes. The identification of a problem tends to be in terms of such structural units as actors[1],

organizational units or other management conditions. One by that simultaneously excludes certain possible causal factors from the analysis as they tend to remain hidden in these structural units. The definition of a problem in structural units preempts the analysis of the usefulness of these units themselves.

An example was the following. The management analysis of the water allocation processes tended initially toward such reasoning as " . . .the water control center did this . . .". The evaluator was usually unaware that he took the functionality of the center itself for granted. Thinking through and analyzing processes and management conditions required a concentrated effort to get rid of such implicit and hidden assumptions. Several professionals claiming to apply a process-based analysis were observed to make inconsistent analyses.[2]

Structural and systems[3] approaches seem to fall into the same mistakes in this respect. By dividing the world in certain classifications and subsystems, the people using these approaches tend to understand only their "defined" perspective of reality. Yet, simultaneously they blind themselves to the role in the analysis of, and errors caused by, their definitions.

A practical example of the consequence of such partial analysis is the following. A structural or systems approach can define politicians, agencies and farmers each as a different subsystem. Such a classification tends to stimulate of farmers and state as different parties with conflicting interests. Yet, (part of the) farmers and politicians have often an indirect but powerful influence on officials in an irrigation agency--many system managers are more their representatives than of the state--, and can mobilize considerable influence on the water allocation decisions. Chapter 2 gives examples of the partial analysis of most existing irrigation management concepts. Also, most process-based analyses in chapter 2 appeared to be inconsistent in separating the processes and management conditions.

Despite such inconsistencies, the structuralist or systems approaches have their value as well. For quantitative comparative research on organizational structure, performance, and situation they can provide useful insights and knowledge. Yet, for purposes such as a qualitative management analysis, or developing a management perspective, these analytical approaches are biased by their nature of defining subsystems that may not be fully functional or relevant in real-life;

2. The framework's explicit separation of the substantive and managerial aspects of the decision-making processes forced an objective analysis of the *functionality of disciplinary approaches* in the decision-making processes. Most other analytical perspectives do not facilitate this. Consequently, as the involved disciplinary scientists are trained to evaluate the disciplinary approaches toward the quality of their application, rather than toward their functionality per se, the latter tends to be taken for granted. Of course, many professionals have experienced and published on certain disfunctionalities as demonstrated by the related quotations. Yet, these disfunctionalities evolved from an ad hoc and implicit framework of

the involved professional.

Examples of the related framework-specific contributions to this study's findings are those about the actual functionality of the EIRR, the theoretical crop water requirements, the conceptual design, the discharge measurements, the water scheduling, the sensitivity analysis etc.;

3. The definition of all key decisions relevant to the water-delivery performance forced the study to consider the *full scope of irrigation management concerns*. So this study, unlike most other irrigation management studies, included such relevant issues as the investment identification and the flow regulation as well.

   The consideration of all relevant questions made it not only possible to identify, but also *to strengthen the credibility of the findings about the systematic flaws* in the decision-making processes. Examples of such framework-specific contributions to the findings are the absence of accountability for the water-delivery performance, the dominating influence of the EIRR on the feasibility and design, and the influence of the justification approach to feasibility assessment on the design concepts;

4. The quantification of the management performance to a certain extent through the concept of the levels of sophistication facilitated a systematic and consistent analysis of flaws, and of the identification of the requirements for improvement. So this concept strengthened the objectivity of the analysis and thus strengthened the validity of the findings and recommendations;

5. The simultaneous consideration of all key decisions enabled the analysis of the *interaction and consistency between other issues than only the usually researched upon design-utilization interaction*. For example, there were observed to be few, if any, publications on systematic studies of the interaction between the planning and design requirements, between the allocation and the regulation, and between the capacity creation and the decision-making processes of the capacity utilization;

6. The analysis considered not only the management condition "Organizational structure and rules", but also others such as the provision of information and knowledge, the human resource management, and the financial control. It considered the required changes in these management conditions in an integrated manner. Besides, it considered these changes also in view of the requirements of the decision-making processes. This *integrated perspective* gave an unique understanding of the irrigation performance problem. So this study's recommendations of separate activities such as training, human resource management, and institutional reform, were only advocated in consideration of the related required changes in other management conditions.

   The current practices of the observed agencies, government and donors tended to be different as exemplified by this text's related remarks. Examples of related framework-specific contributions to the findings were the observed practices on O&M manuals, investment in human resources, water-management consultants and others;

7. By looking at the influence of the management conditions on the decision-making processes, and subsequently on the performance, the analysis took a *full performance- and resource-based management perspective*. Earlier analyses have not relied on an explicit management perspective, and tended to deal thus with partial problems and solutions.

   An example of a related framework-specific contribution to the findings was the link between the absence of accountability and the lack of performance-related finance for the observed irrigation agencies. Or, the link between the supply-driven mode of investment and the accountability for performance, or between the supply-driven investments and the evolution of the investment concepts; and

8. Based on the recommended changes in management conditions, the analysis goes one step further by focusing on *the required management-control decisions "to get the performance-oriented processes started"*. Only few professionals have published such recommendations, and none of them based on an explicit framework. Examples of such framework-specific contributions to the recommendations were the proposed measures to increase the link between finance and performance, and between the quality of the capacity creation and capacity utilization and the internal performance assessment of the funding agencies.

Discussion: disadvantages of working with the framework. The application of the analytical framework appeared to have the following disadvantages:

1. Thinking and reasoning in structural units (such as a person or a division) tends to occur almost automatically, and *the concentration on the pure processes was difficult*. This can be considered a disadvantage for the application of the framework as it makes a high quality application of the framework less transferable to other irrigation professionals. Besides, as long as most management scientists do not understand the value of a pure process-based analysis, it remains difficult to communicate its value as well. On the other hand, any thinking on the separation of the processes and conditions increases the quality of a management analysis of the irrigation performance problems;

2. Several concepts of the framework are process-based. They are defined in a framework-specific jargon to a certain extent as the concepts of management and control in English and American usage tend to be linked to structures only. The latter has the advantage that they can be imagined more easily than the process-based concepts that cannot be visualized in real-life that easily. This specificity of the framework appeared to be of minor relevance for the analyses, and was

thus not stressed in this text to keep it as accessible as possible. In general, it was tried to keep the framework-specific jargon to an absolute minimum. Only *the concept of the levels of sophistication is a jargon specific to this framework.* This made its transferability to other irrigation professionals less easy, though not impossible;

3. The analytical framework guides and frames the descriptions and analyses in this text completely. It had the disadvantage that certain *repetitions* in the text were inevitably. For example, much of the information, criteria, actors etc. are the same in the seasonal and in-seasonal allocation, or in the different key decisions of the strategic concern. Especially in chapter 5 the many aspects of the investment selection made that the dominating criteria, incentives, actors and information were repeated regularly. The repetitive nature of such analysis was a disadvantage, perhaps especially so for the reader. Similarly, now and then repetitions appeared inevitable in the analyses of the same issues and information from the different perspectives of the processes and the management conditions;

4. Although management performance is quantified to a certain extent by using the levels of sophistication, many conclusions are derived from the systematic analysis of the decision-making processes and are therefore based on qualitative assessments. Especially persons with backgrounds in disciplines that are not used to the validity of qualitative assessments may have difficulties in understanding such validity.

To what degree do the above disadvantages of the application of the framework impede further application? Although a consistent analysis of processes is not that easy, it is well possible. And any efforts to be consistent will pay off in the quality of the analysis. The repetitions are more a problem of presentation than of the analysis itself. Applying the framework in other case studies in terms of relating performance, decision-making processes, management conditions and management control (as represented in Figure 3 of chapter 3) is therefore relatively simple. Simple for a researcher or management specialist to do a management analysis. Though also irrigation managers could use these simple interrelations to take a different perspective of their work.

The concept of the levels of sophistication has been translated in a questionnaire and in a description of the different levels for all water-related key decisions (see Annexes 1 and 2). Its application for management analysis in other systems and organizations also could be copied from each of the publications of the two Sri Lankan case studies. Researchers or management specialists could use it for a management analysis. And even with this concept, an irrigation manager could get some ideas about measures to achieve a higher level of sophistication. Overall, the above disadvantages do not seem major impediments to its application by others, also for the concept of the levels of sophistication.

Significance for the irrigation practice: prospects for future application. The framework was used here for a systematic management analysis. It can be replicated as such. It can be used, and is used in some cases already, also as a tool kit for different purposes as described hereafter:

As a check list of relevant irrigation management concerns.

1. To facilitate an awareness among irrigation professionals of the differences between the substantive and the managerial aspects of their day-to-day irrigation activities. Therefore, the substantive and managerial aspects can be identified for one or several different key decisions. The framework is thus used as a check list of day-to-day irrigation activities.[4] It is used as such in IIMI's Training Division for its Training Needs Exercises and for the development of training modules.[5] Though it can be used for this purpose in any interactive exercise with irrigation professionals, such as a strategic planning exercise;

2. To facilitate a more systematic approach to irrigation management in research by using the framework's management concerns as a check list for the identification of relevant research questions. This can force an irrigation management researcher to be aware about the relevant issues to be included in a full management perspective on irrigation. Or, at least, it may create awareness about those issues that are excluded. The framework is currently used as such in IIMI's research in Sudan, and, possibly, in Tamil Nadu (India);

3. To develop manuals in a systematic way. For example, on procedures and rules for the capacity utilization and the capacity creation, or on information needs for the same;

4. To professionalize the ex-post evaluations and impact studies of irrigation (and other development) investments. These studies were seldom observed to address the managerial aspects at all, and certainly not in a systematic way.[6] Ex-post evaluations and impact studies could be professionalized by using the framework as a check list of relevant issues that influence performance;

As a performance indicator for management.

5. To identify systematically opportunities for improvement of the management performance by means of the concept of the levels of sophistication. The descriptions of the levels of sophistication for the different key decisions in Annex 1 and the questionnaire in Annex 2 give ample guidelines for the identification of the existing level of sophistication. Also the identification of the required measures to achieve a higher level is possible through these annexes. IIMI's ongoing research in Sri Lanka's Kirindi Oya system presently uses the framework as such;

6. To assess management improvements quantitatively before and after management innovations through the levels of sophistication. This can be done as described

for item 5. IIMI's ongoing research in Sri Lanka's Kirindi Oya system uses it in this way as well; and

7. To develop normative indicators for irrigation management performance for different socio-economic and physical environments through comparative research. This was part of IIMI's Organizational Dynamics survey in the Philippines and Sri Lanka.

THE SILENCE ON QUANTITY, QUALITY AND ACCOUNTABILITY

What is the significance of this study's results for the results of previous research? The text makes frequent references to disfunctionalities of disciplinary approaches and previous solutions to irrigation management problems. These will not be repeated here. Yet, some remarks are made of the impact of this study's major findings on the results of previous research.

The major finding from this study is the need to balance the observed influence of the bias for investment quantity on the quality of investment decisions. This bias had its impact on the accountability for the water-delivery performance in the decision making concerning all studied management concerns. Only after a change in priority from investment quantity to the quality of investment decisions, the elevation of the levels of sophistication of the decision making becomes indispensable for performance improvements. Yet, this issue is presently almost absent in the discussion among irrigation professionals dealing with irrigation's underperformance. The findings of much previous research on irrigation's underperformance appeared therefore merely partial solutions. This section briefly evaluates this gap in irrigation management research.

Only few irrigation and development professionals have considered the mutual influences of the different management conditions and of the management control for the capacity utilization and creation. Some have considered the management condition of the human resources as a dead end for development interventions. For example, Wade has explicitly considered this "man management" aspect as a dead end, because, as he stated: " . . .there is not much that can readily be done about problems of this second type in the specific context of irrigation. One could not, for example, use promotion criteria in irrigation which differed from those used elsewhere in the civil service."[7] So his stated bias was for the "big potentials in irrigation reform" by circumventing these crucial, though hopeless issues, and to concentrate on changes in operating procedures and "the information system --especially public monitoring of the 'output' of an irrigation system--"[8] Similarly, Chambers has poohpoohed as a dead end the frequent calls by irrigation professionals for "political will". On the other hand, a few professionals have dealt with irrigation's finance and thereby addressed indirectly factors influencing investment quantity, the quality of investment decisions and performance.[9]

Almost nobody has argued for a moderation of the "investment-quantity-at-the-expense-of-creation-quality".[10] This suggests it to be an even more sensitive issue for irrigation professionals than corruption or political interference. Wade has suggested this in the following quotation:

"International development agencies potentially have a role in reducing the mismanagement of development projects. But at present the official position of both the agencies and the recipient governments is that the [donors] are to concern themselves with increasing the inputs to development, while it is for the host governments to worry about the outputs of development projects. Indeed, there is perhaps no subject in the international development community so sensitive and suppressed as the mismanagement of development programmes".[11]

Several interviewed development professionals argued that any discussion on the "quantity-at-the-expense-of-quality" issue, despite its crucial role for performance, would play in the hands of the opponents of investment in irrigation, and in development in general. Based on similar arguments, others defended increases in investment based on statistical forecasts of population growth and food balances in LDCs.

Yet, such defensive and static approaches toward the quality of the decisions on development investments underestimate the process requirements for performance improvement. Statistical forecasts never compare the potential food production "with" and "without" the right processes and incentives. Admittedly, this would not be easy and probably impossible, or highly speculative. Still, the observed analyses defended large-scale subsidies and by that seem to become self-serving. Such analyses can typically also not explain why, for example, a tiny country like the Netherlands is presently the world's second agricultural exporter.

Therefore, a more logical focus of development investments would be efforts "to get the conditions and processes right", rather than "throwing money"[12] to finance underutilization, and by that stimulate or sustain underdeveloped processes. Similarly, research efforts should be re-oriented "to get the conditions and processes right" by taking a full management perspective in their analysis, and thus avoid partial solutions.

EVALUATION OF THE PROBLEM DEFINITION

The results of this study point at some major changes required in the management and control in the irrigation subsector. These findings seem to confirm the assumption that there is a potential for performance improvement through improved management. On the other hand, the observed systematic overoptimism in the performance assumptions during the investment decision making suggests a need to qualify most estimates of the underperformance to a considerable extent.

EVALUATION OF THE OBJECTIVES OF THE STUDY

The objectives of this study were twofold: 1) the identification of generalized directions of management change for performance improvement in the irrigation subsector in LDCs; and 2) the testing of an analytical framework for irrigation management." Both issues are evaluated here.

The results of the application of the framework work systematically toward an integrated picture of the required changes in the management and control in the irrigation subsector. These recommendations fulfil the first objective of this study. Although the results are to a minor extent based on quantitative analyses, most findings are based on many observations in different environments, and are therefore likely to be true. The applied analytical framework is based on an analytical framework that has been applied several times before, which further substantiates the validity of the findings. The heterogeneous nature of the case studies and the similarity of the observations by the quoted professionals justify the generalization of the findings for the irrigation subsectors in all LDCs. Though in specific countries certain findings may be less true, of course.

This study tested the analytical framework indirectly through its application in the irrigation subsector. The framework's usefulness appears from the apparent contribution of this study's results to the achievement of the first objective of this study.

EVALUATION OF THE LEVELS OF SOPHISTICATION AS A RESEARCH TOOL

This section evaluates the only measurement tool, the level of sophistication, used in the operationalization of the framework. As mentioned in chapter 3, the operationalization of this concept consisted essentially of a translation for irrigation of a similar questionnaire and tables for maintenance management developed by Marcelis.[13] Essentially the same values (see Annex 2) for similar types of activities were maintained to make use of the experience of Marcelis' in-depth work to establish them. Also the lack of any reliable values in irrigation to establish alternative values made it logical to use those developed by Marcelis.

After the initial pilot testing of the questionnaires by some Sri Lankan engineers, the adjusted questionnaires were used for comparative surveys in the Philippines and Sri Lanka. Yet, the disinterest of the respondents to improve their performance made them boost their present performance in their responses of the questionnaires. The responses appeared thus unreliable and incomparable. Adequate cross-checking was required to obtain reliable and comparable outcomes. As such cross-checking was logistically impossible for all respondents, the outcome of the comparative surveys was not used for this study. Instead, in each case study several agency staff were interviewed about the levels of sophistication. Based on these interviews and further observations, a more reliable and comparable picture of the levels of sophistication was obtained for this study.

The used translations as given in Annexes 1 and 2 were not perfect as well. Yet, they were the best possible for the irrigation subsector and for the available expertise and insights in irrigation management. Still, if the questionnaires will be used in further comparative studies refinements of the questions, and, possibly, of the values may be necessary. As long as respondents have no interest themselves in identifying possible ways of performance improvement, the assessments of the levels of sophistication should be done by objective outsiders.

RECOMMENDATIONS FOR FUTURE RESEARCH

The following priorities for future research on the underperformance in the irrigation subsector evolved from this study:

1. First and foremost is the need for research on specific management-control methods and techniques that are *likely* to bring accountability for performance into the financing of irrigation. Especially where subsidies are involved, such research seems required to balance the observed biases toward "quantity-at-the-expense-of-quality";

2. Another research issue would be to establish the probable potential for performance improvement in different countries or regions. These estimates could then be used for realistic investment norms per unit area as Aluwihara and Kikuchi have done for Sri Lanka.[14] Such indicators may not only prevent hidden subsidies in future irrigation investments, but also may attribute a more realistic economic and financial value to performance;

3. Cost effectiveness and efficiency of the collection of service fees in smallholder systems seems a priority research issue that has been comparatively neglected so far;[15] and

4. Similarly, appropriate structures for volumetric measuring of water in smallholder systems seem a priority research issue.

The above research issues relate all to measures to introduce accountability for the water-delivery performance. The following recommendations about research issues evolved from this study as well although they are irrelevant for introducing accountability, and thus of secondary importance from the perspective of performance improvements:

5. Research on the managerial aspects of the coordination of gate settings along the main system. Examples of relevant techniques would be trial-run techniques, or the application of simulation models to experiment with different operational methods and procedures. Thus, more knowledge about relevant contingency (if...then...) instructions could develop;

6. Research by local (research) institutions engaged in irrigation management issues on methodologies for establishing feasible and functional design criteria that incorporate site-specific experiences and historical information, especially with regard to the experiences and requirements of the water users and system managers. Examples of relevant approaches could be a pilot study or a phased development;

7. Research by the same institutions on the possible impact of low-cost sequential improvements of the irrigation capacity at certain locations, also compared to capital-intensive improvements.

Despite the above list, much research seems to have been done on irrigation management already. Performance improvements in the irrigation subsector seem to need therefore much more the application of the available knowledge to change the present management and control, rather than more research.

Notes

1. An actor should be read here as a person with a certain function. A person, without reference to his function, used in the process description or analysis, does not bring such implicit structural meaning along.

2. For example, Bottrall has defined the decision-making process in terms of persons and structures (Bottrall 1981a).

3. Although many systems approaches have recognized explicitly the value of the processes, their very nature necessitates the definition of "parts", and their coordination (e.g., West Churchman 1968:29).

4. Nijman 1989.

5. IIMI/DID 1990; IIMI/BADC 1991; Nijman and Kampfraath 1991a-c.

6. Bottrall 1981a:233-236.

7. Wade 1982b:180.

8. Ibid.

9. E.g., Carruthers and Small 1991; Duane 1986; Repetto 1986; Small 1989b; Svendsen et al. 1990; Aluwihara and Kikuchi 1991.

10. The only exceptions found for this study were Seckler 1982; and Cassen 1986.

11. Wade 1982a:324.

12. Seckler 1982:16.

13. Marcelis 1984.

14. Aluwihara and Kikuchi 1991.

15. Conform Repetto 1986:30. See also note 127 of chapter 4.

References

Abeyratne, Frederick, and John Farrington. 1986. Water availability and the access to farm inputs in major irrigation schemes in Sri Lanka with particular reference to farm power. In S. Abeyratne, P. Ganewatte, and D.J. Merrey (eds.). Proceedings of a Workshop on Water Management in Sri Lanka, January 20 - 22, 1982. pp.47-66 in: ARTI Documentation Series No.10.

Agrar-Und Hydrotechnik Gmbh/Salzgitter Consult Gmbh. 1987. Irrigation and settlement project: Kirindi Oya. Water management consultancy. Final draft O&M Manual, Section IV. Irrigation system operation. October 1988.

Aluwihare, P.B. and M. Kikuchi. 1991. Irrigation investment trends in Sri Lanka: New construction and beyond. Colombo, Sri Lanka: International Irrigation Management Institute.

Asian Development Bank (ADB). 1982. Project performance audit report of the Walawe development project in Republic of Sri Lanka. August 1982.

ADB. 1985. Risk analysis and project selection: A review of practical issues. ADB Staff Paper No. 28. August 1985.

ADB. 1986. An impact evaluation study on water usage and its contribution to agricultural production in irrigation projects in the Philippines. Post-Evaluation Office. December 1986.

ADB. 1987. A study of compliance with special loan covenants. Special study series No.4. Post-Evaluation Office. December 1987.

ADB. 1990a. Project quality. Internal paper presented to ADB Board of Governors. November 1990.

ADB. 1990b. Report of the president to the board of directors on post-evaluation activities during 1989 and the twelfth review of post-evaluation reports. Post-Evaluation Office. February 1990.

Association Nationale des Ameliorations Fonciers, de l'Irrigation et du Drainage (ANAFID). 1990. Gestion des grands perimetres irrigues au Maroc. Volume 1. Distribution de l'eau d'irrigation exploitation et maintenance des reseaux et ouvrages d'irrigation. Technical Committee of ANAFID on "Management of large irrigation schemes". Rabat, 1990.

Azarcon, Y.J. 1990. Public investment in irrigation in the Philippines. A Thesis Presented to the Faculty of the Graduate School of Cornell University in Partial Fulfillment of the Requirements for the Degree of Master of Science.

Barker, R., Coward, E.W. Jr., Levine G. and L.E. Small. 1984. Irrigation development in Asia: Past trends and future directions. Cornell Studies in Irrigation, Number 1.

Barnett, T. 1977. Why are bureaucrats slow adopters? The case of water management in the Gezira Scheme. September 1977.

Bellekens, Y.S. 1986. Evaluating irrigation project development and system performance: Some lessons learned from experience. pp.36-51 in: Bangladesh Agricultural Research Council and Winrock International Institute for Agricultural Development, Methodologies to evaluate the performance of irrigation systems.

Berkoff, D.J.W. 1988. Irrigation management in South-India: The approach of the National Water Management Project. ODI/IIMI Irrigation Management Network Paper 88/2d. December 1988.

Berkoff, D.J.W. 1990. Irrigation management on the Indo-Gangetic plain. World Bank Technical Paper No. 129. World Bank, USA.

Bloemen, I. and J. de Moor. 1983. Waterbeheer in neo-koloniale context: Een vooronderzoek naar de financiering en export van irrigatie-kennis en technologie. Agricultural University:Wageningen.

Bos, M.G. and J. Nugteren. 1974. On irrigation efficiencies. Publication 19. International Institute for Land Reclamation and Improvement:Wageningen.

Bottrall, A. 1981a. Comparative study of the management and organization of irrigation projects. World Bank Staff Working Paper No.458. World Bank:USA.

Bottrall, A. 1981b. Issues in main system management. Paper to Workshop on Investment Decisions to further develop and make use of South-east Asia's Irrigation Resources, Kasetsart University, Bangkok, Thailand. 17 -21 August 1981. Overseas Development Institute:London.

Bottrall, A. 1985. Managing large irrigation schemes: A problem of political economy. Agricultural Administration Unit Occasional Paper 5. Overseas Development Institute:UK.

Burt, C.M. and J.M. Lord, Jr. 1981. Demand theory and application in irrigation district operation. pp.150-158 in: American Society of Agricultural Engineers, Irrigation scheduling for water and energy conservation in the 80's.

Carruthers I. D. 1983a. Irrigation development: Implications of recent experience for aid policy. OECD Seminar. pp36-78 in: Carruthers, I.D. (ed.) 1983. Aid for the development of irrigation. Report on the Development Assistance Committee Workshop on "Irrigation Assistance", held in Paris on 29-30 September, 1982. OECD:France.

Carruthers I. D. 1983b. Neglect of operation and maintenance in irrigation. The need for new sources and forms of support. OECD Seminar. pp91-107 in: Carruthers, I.D. (ed.) 1983. Aid for the development of irrigation. Report on the Development Assistance Committee Workshop on "Irrigation Assistance", held in Paris on 29-30 September, 1982. OECD:France.

Carruthers I. and C. Clark. 1981. The economics of irrigation. Liverpool University Press:UK.

Cassen, R. & Associates. 1986. Does aid work? Report to an intergovernmental task force. Clarendon Press:UK.

Chambers, R. 1974. Managing rural development. Bohurslanmgens AB:Sweden.

Chambers, R. 1975. Water management and paddy production in the dry zone of Sri Lanka. Occasional Publication No.8. Colombo: ARTI.

Chambers, R. 1977a. Men and water: the organization and operation of irrigation. pp340-363 in: Farmer, B.H. (ed.) Green Revolution?

Chambers, R. 1977b. On substituting political and administrative will for foreign exchange: The potential for water management in the dry zone. pp.100-112 in: Samarasinghe, S.W.R. de A. (ed.) Agriculture in the peasant sector of Sri Lanka. Ceylon Studies Seminar:Peradeniya, Sri Lanka.

Chambers, R. 1980. In search of a water revolution: Questions for managing canal irrigation in the 1980s. pp23-37 in: Report of a planning workshop on Irrigation Water Management. IRRI:Philippines.

Chambers, R. 1981. Canal irrigation management in India: Some areas for action, analysis and research. Revised version of paper for the Workshop on problems and research methods in irrigation systems related to chak (outlet) requirements, held at the Gandhian Institute of Studies, Rajghat, Varanasi. 27 - 31 July 1981.
December 1981.

Chambers, R. 1982. Irrigation management: Ends, means and opportunities. Paper for the Workshop on Productivity and Equity in Irrigation Systems in India, Giri Institute of Development Studies, Lucknow, 21-23 September 1982.

Chambers, R. 1988. Managing canal irrigation: Practical analysis from South Asia. Institute of Development Studies, U.K. Oxford & IBH Publishing Co. Pvt. Ltd.:India.

Chambers, R. and J. Moris (eds). 1973. Mwea: An irrigated rice settlement in Kenya. Weltforum Verlag. Munchen.

Clyma, W. 1986. Irrigated agriculture: A comparative analysis of development concepts. pp19-46 in: Irrigation Management in Developing Countries, K.C. Nobe and R.K. Sampath, (eds.) Westview Press:USA.

Consultative Group for International Agricultural Research/Technical Advisory Committee (CGIAR/TAC). 1982. Report of the study team on water management research and training. February/March 1982.

Coward, E.W. Jr. 1980. Irrigation development: Institutional and organizational issues. pp.15-27 in: Coward (ed.) Irrigation and agricultural development in Asia: Perspectives from the social sciences. Cornell University Press: Ithaca and London.

Coward, E.W. Jr. 1986. State and locality in asian irrigation development: The property factor. pp491-508 in: Irrigation Management in developing Countries: Current Issues and approaches. Proceedings of an Invited Seminar Series. Sponsored by the International School for Agricultural and Resource Development. Studies in Water Policy and Management No.8. Westview Press:UK.

De Leeuw, A.C.J. 1990. Een boekje over bedrijfskundige methodologie: management van onderzoek. Van Gorcum: Assen. The Netherlands.

De Leeuw, W. 1985. Het Bura irrigatie - en vestigingsprojekt: Zelfs geen illusie van ontwikkeling. MSc Thesis. Vrije Universiteit:Amsterdam.

Des Bouvrie, C. 1989. Irrigation management in India; then, now, and in the future. Address on the occasion of Sir Arthur Cotton's Birthday celebrations on 15 May 1989, organized by The Institution of Engineers, India. pp28-32 in: Wamana. October 1989.

Development Finance Consultants (DFC) S.A. 1990. Etude SIG - Phase II. Tome I. Resources humaines. Tome II. Gestion des reseaux. Tome III. Developpement agricole. Tome IV. Le systeme d'informations comptables et le systeme de controle. Tome V. Le systeme de traitement des informations.

Dhawan, B.D. 1989. Water resource management in India: Issues and dimensions. pp.233-241 in: Indian Journal of Agricultural Economics, Vol.44, No.3. July-Sept. 1989.

Diemer, G. 1990. Irrigatie in Afrika: Boeren en ingenieurs, techniek en kultuur. PhD Thesis. Rijksuniversiteit Leiden.

Doorenboos, J. and W.O. Pruitt. 1977. Crop water requirements. Irrigation & Drainage Paper 24. Guidelines for predicting crop water requirements.

Duane, P. 1986. Cost recovery in irrigation projects: Perceptions from World Bank operations evaluation. Expert consultation on irrigation water charges, FAO, Rome, 22-26 September 1986. Paper No.5.

Dyson, R.G. 1990. Strategic Planning. pp3-14 in: Dyson, R.G. (Ed.), Strategic planning: Models and analytical techniques. Wiley & Sons: England.

Easter, K.W. and D.E. Welsch. 1986. Implementing irrigation projects: Operational and institutional problems. pp33-56 in: K.W. Easter (Ed.), Irrigation investment, technology, and management strategies for development. Studies in water policy and management no.9. Westview Press:USA.

Evans, Martin. 1984. Policy and change: The Asian Development Bank. pp75-100 in: Room for Manoeuvre.

Farmer, B.H. 1957. Pioneer peasant colonization in Ceylon. A study on Asian agrarian problems. Greenwood Press, Publishers:USA.

Frederiksen, H.D. 1987. Irrigation and drainage systems - Public utilities that are too often improperly oriented and in need of strengthened capability. Paper presented at the XIII th International Congress on Irrigation and Drainage, September 14-26, 1987, Casablanca, Morocco.

Frederiksen, H.D. 1989. Are the non-technical deficiencies overwhelming the technical advances in irrigation? pp1-10 in: Rydzewski, J.R. and C.F. Ward (eds.) Irrigation theory and practice. Proceedings of the International Conference held at the University of Southampton 12 - 15 September 1989. Pentech Press:London.

Galbraith, Jay. 1973. Designing complex organizations. Addison-Wesley Publishing Company, Inc.:USA

Gasper, D.R. 1989. Toward a sociology of project assessment. pp.28-52 in: Int. Studies of Management & Organization, Vol.19, No.1. M.E. Sharpe, Inc.:USA.

Goldsmith, E. and N. Hildyard. 1984. The social and environmental effects of large dams. Volume 1: Overview. A report to The European Ecological Action Group (ECOROPA). Wadebridge Ecological Centre:UK.

Government of Andhra Pradesh (GOAP). 1982. Report of the commission for irrigation utilisation. Volume 1 and 2. November 1982.

Gow, David D. 1991. Collaboration in development consulting: Stooges, hired guns, or musketeers? pp.1-15 in: Human Organization, Vol.50, No.1. The Society for Applied Anthropology.

Gunadasa, A.M.S.S. 1989. The Kimbulwana Oya irrigation scheme: An approach to improved system management. IIMI Case Study No.2. IIMI:Sri Lanka

Harriss, J. 1977. Problems of water management in Hambantota district. pp.364-376 in: Farmer, B.H. (ed.) Green Revolution?

Hart, H. 1978. Anarchy, paternalism or collective responsibility under the canals? pp. A125-134 in: Economic and Political Weekly, Review of Agriculture.

Heaver, R. 1979. Planning and management problems in the implementation of a major scheme: A case study of Mahaweli (Sri Lanka). Agricultural Administration Network Papers No.1. ODI:UK

Heaver, R. 1982. Bureaucratic politics and incentives in the management of rural development. World Bank Staff Working Paper No. 537. World Bank:USA.

Henderson, F.M. 1966. Open channel flow. MacMillan: New York.

Horst, L. 1983a. Irrigation systems. 2e semester N31. Vakgroep Weg-en Waterbouwkunde en Irrigatie:Wageningen.

Horst, L. 1983b. Irrigation systems - alternative design concepts. ODI Irrigation Management Network Paper 7c. April 1983. ODI:UK

Horst, L. 1987. Choice of irrigation structures: The paradox of operational flexibility. pp.45-60 in: Hydraulic Research. Irrigation design for management: Asian regional symposium. Wallingford:ODU.

Hunt, E. and R.C. Hunt. 1974. Irrigation, conflict, and politics: A Mexican case. pp.129-157 in: Irrigation's impact on society. Anthropological Paper 25. (eds. Downing, T.E. and M. Gibson). The University of Arizona Press:Arizona.

Huppert, W. and H.H. Walker. 1989. Management of irrigation systems: Guiding principles. DSE (GTZ) Publication No.240. Rural Development Series. Elektra:Niedernhausen.

Iglesia, Godofredo N. 1979. Design guides and criteria for irrigation canals, O&M roads, drainage channels and appurtenant structures. NIA Philippines. January 1979.

Institute for Food and Development Policy (IFDP). 1979. The aid debate: Assessing the impact of U.S. foreign assistance and the World Bank. Working Paper No.1. January 1979.

International Bank for Reconstruction and Development (IBRD). 1965. Economic aspects of water utilization in irrigation projects. Report No. EC-132. January 1965.

International Commission on Irrigation and Drainage (ICID). 1967. Multilingual technical dictionary on irrigation and drainage, english-french. ICID: New Delhi.

ICID. 1989. Planning the management, operation, and maintenance of irrigation and drainage systems. World Bank Technical Paper No.99. World Bank, USA.

International Irrigation Management Institute (IIMI). 1989. Final report for ADB regional technical assistance 5273. Study on irrigation systems rehabilitation and improved operations and management. Volume 1. Activity A: Rehabilitation and improvement for management. March 1989.

IIMI. 1990. Irrigation management and crop diversification (Sri Lanka). Final Report on the Technical Assistance Study (TA 846 SRI). Volume I. Synthesis of findings and recommendations: Kirindi Oya and Uda Walawe Project. Volume II. Kirindi Oya Project. Volume III. Uda Walawe Project. June 1990.

IIMI/Department of Irrigation and Drainage (DID). 1990. Training Needs Assessment in Malaysia. Exercise held at Kuala Lumpur and Kota Bharu from 13 October to 11 November 1989.

IIMI/Bangladesh Agricultural Development Corporation (BADC). 1991. Draft report on the Training Needs Assessment in Bangladesh. Exercise held at Dhaka, Bangladesh from 26 May to 13 June 1991.

IIMI/World Bank. 1991. Discussion notes and minutes of discussions. IIMI/World Bank Workshop, 4 - 5 February 1991, Colombo.

Johnson, S.H. 1990. Progress and problems of irrigation investment in South and Southeast Asia. pp15-25 in: Water International, Vol.15, No.1

Julian, S.I. 1986. Operation and maintenance plan for irrigation systems management. National Irrigation Administration, Philippines.

Jungeling, Inge. 1986. Local organization of irrigation and the development of technical irrigation in Indonesia: a historical perspective and its implications for the Pompengan implementation project. MSc Thesis Wageningen Agricultural University.

Jurriens, R., Bottrall, A.F. and others. 1984. Evaluation of irrigation design - a debate. pp1-31 in: ODI Irrigation Network Paper 9b. April 1984. ODI:UK.

Kampfraath, A.A. and W.J. Marcelis. 1981. Besturen en organiseren. Bestuurlijke opgaven als instrument voor organisatie-analyse. Kluwer:Netherlands.

Keller, J. 1986. Irrigation system management. Chapter 11. pp.329-352 in: Irrigation Management in Developing Countries, K.C. Nobe and R.K. Sampath, (eds.) Westview Press:USA.

Kelley, T. and S.H. Johnson III. 1989. Use of factor-K allocation system in irrigation management: Theory and application in Indonesia. pp49-71 in: Water Resources Management 3. University of Illinois, U.S.A. Kluwer Academic Publishers:The Netherlands.

Kortenhorst, L.F., Pieter, N.G., Van Steekelenburg and H.S. Leendert. 1989. Prospects and problems of irrigation development in Sahelian and sub-Saharan Africa. pp13-45 in: Irrigation and Drainage Systems 3. Kluwer Academic Publishers:Netherlands.

Lammers, C.J. 1987. Organisaties vergelijkenderwijs. Uitgeverij Het Spectrum BV:Utrecht

Lappe, F.M. and J. Collins. 1986. World Hunger: Twelve Myths. Institute for Food and Development Policy. Grove Press Inc.:USA.

LeMoigne, Guy J.M. 1986. Gerald Lacey memorial lecture: World Bank involvement in irrigation and drainage. pp.1-5 in: ICID Bulletin, Vol.35, No.1. January 1986.

Lenton, R. 1986. On the development and use of improved methodologies for irrigation management. pp47-66 in K.C. Nobe and R.K. Sampath (eds.) "Irrigation management in developing countries." Westview Press: Boulder, Colorado.

Lenton, R. 1989. A brief history of IIMI: Prepared for the external review of IIMI. November 1989.

Levine, G. 1977. Management components in irrigation system design and operation. pp.37-48 in: Agricultural Administration (4). 1977. Applied Science Publishers Ltd:UK

Levine, G. 1980. Hardware and software: An engineering perspective on the mix for irrigation management. pp.5-21 in: Report of a Planning Workshop on Irrigation Water Management. The IRRI. Lugana, Philippines.

Levine, G. 1985. Performance evaluation of large irrigation systems - A view from India. Paper for Regional Workshop on Methods to Evaluate the Performance of Irrigation Systems, June 22-27, 1985. Bangladesh Agricultural Research Council:Dhaka, Bangladesh.

Levine, G. and Ch. Bailey 1987. Water management in the Gezira Scheme. pp115-126 in: Water Resources Development, Vol.3, No.2

Levine, G. and E.W. Coward, Jr. 1989. Equity considerations in the modernization of irrigation systems. ODI/IIMI Irrigation Management Network Paper 89/2b. December 1989. ODI:UK.

Levine, G. and T. Wickham. 1977. Some critical issues in irrigation planning for Southeast Asia. pp.58-72 in: K.W. Easter and L.R. Martin (Eds.), Seminar on water resources problems in developing countries.

Lindblom, C.E. 1971. The science of "Muddling Through". pp.238-255 in: Pugh, D.S. (ed.). Organization theory: Selected readings. Reading: Penguin Books Ltd.

Maass, A. and R.L. Anderson. 1986. . . .And the desert shall rejoice. Conflict, growth, and justice in arid environments. Robert E. Krieger Publishing Company, Inc.:Florida, U.S.A.

Malaterre, Pierre-Olivier. 1989. A study of the Kirindi Oya Right Bank main canal operations through an application of a mathematical flow simulation model: Prospect of improving performance. Final report of a study for Ecole Nationale du Genie Rural, des Eaux et des Forets, Centre Nationale du Machinisme, Agricole du Genie Rural des Eaux et des Forets, IIMI and University of Montpellier (France).

Mansfield, M. 1989. The challenge of performance audit in a policy department. pp10-12 in: Public Sector Vol.12 No. 1. Abridged version of an address to the South Pacific Region Convention of the Australian Institute of Internal Auditors in 1989.

Mantz, E.A. 1984. Beschouwing van bestuurlijke taakgebieden in organisaties: een bestuurstechnisch onderzoek aan de hand van een stadsuitbreidingsproject en daarop aansluitende literatuur.

Marcelis, W.J. 1984. Onderhoudsbesturing in ontwikkeling. Kluwer:Netherlands.

Meijers, Ton. 1990. L'interaction entre les exploitants et l'amenagiste dans le processus de conception technique des perimeters irrigues villageois a l'ile a morphil dans le nord du Senegal. Contribution a l'Atelier International "Conception Viable d'Amenagements Hydro-agricoles Paysans en Afrique Subsaharienne". Universite Agronomique de Wageningen, 5-8 February 1990.

Mendis, D.L.O. 1977. Some thoughts on technology transfer for irrigation and multipurpose projects in Sri Lanka. pp. 48-66. In: Transactions of the Institution of Engineers, Sri Lanka 1977. Colombo.

Mohtadullah, K. 1982. Organizational commitment to management training in public enterprises (utilities). pp175-177 in: Management training and development in public enterprises in developing countries.

Moore, H.P. 1980. Approaches to improving management on large-scale irrigation schemes in Sri Lanka. Study on farm power and water use in the Dry Zone, Sri Lanka. September 1980.

Moore, M. 1987. Rent-seeking and market surrogates: Irrigation and other agricultural services. Draft Paper to be presented at the conference on: The state agricultural development in Asia and Africa, hosted in Dushambe from 19-21 October 1989 by the Institute of Oriental Studies, Academy of Sciences of the USSR and co-sponsored by the Institute of Development Studies, U.K. October 1987. Institute of Development Studies:UK.

Moris, J. 1987. Irrigation as a privileged solution in African development. pp.99-123 in: Development Policy Review, Vol.5. 1987. SAGE:London.

Murray-Rust, H. 1983. Irrigation water management in Sri Lanka: An evaluation of technical and policy factors affecting operation of the main channel system. January 1983. Thesis.

Murray-Rust, H. 1990. COMA: Canal operation & management assessment. March 1990.

Murray-Rust, H., Vander Velde, J. and D, J. Vermillion. 1990. Design-management interactions and their effects on canal performance: Comparative results from IIMI's work in Indonesia and Pakistan.

Murray-Rust, H. and W.B. Snellen. 1991. Performance assessment diagnosis. Final report. Draft. International Irrigation Management Institute (IIMI), International Institute for Land Reclamation and Improvement (ILRI), International Institute for Hydraulic and Environmental Engineering (IHE).

National Irrigation Administration (NIA). 1987. Design manual for canals and canal structures.

NIA. 1990. Annual report 1989.

Nijman, C. 1989. Format for self-analysis of irrigation management jobs with an explanatory try-out for instructors. IIMI. September 1990.

Nijman, C. 1990. System management appraisal and reinforcement technique (SMART). Concept project proposal. March 1990.

Nijman, C. 1991. Irrigation management processes and conditions: A case study of Sri Lanka's Walawe Irrigation Improvement Project. IIMI Country Paper--Sri Lanka No.8. Colombo, Sri Lanka.

Nijman, C. and A.A. Kampfraath. 1991a. Content outline. Managing information systems. Draft. February 1991.

Nijman, C. and A.A. Kampfraath. 1991b. Content outline. Leadership. Draft. February 1991.

Nijman, C. and A.A. Kampfraath. 1991c. Content outline. Interagency coordination. Draft. February 1991.

Nijman, C. 1992a. Irrigation decision-making processes and conditions: A case study of Sri Lanka's Kirindi Oya Irrigation and Settlement Project. IIMI Country Paper--Sri Lanka No.9. Colombo, Sri Lanka.

Nijman, C. 1992b. Performance evaluation of irrigation decision-making processes: Who cares? in: Irrigation and Drainage Systems, August 1992.

Nobe, K.C. and R.K. Sampath. 1986. Irrigation management in developing countries: Current issues and approaches. Studies in Water Policy and Management No.8. Boulder and London: Westview Press.

Oad, R.N and D.A. Fowler. 1983. Rice irrigation water management. Water management synthesis project. Prepared in cooperation with USAID, Contract AID/DSAN-C-0058. December 1983.

Olivares, J. 1986. The assessment of water resources projects involving economic, social and environmental costs and benefits: The World Bank's view. pp.133-143 in: Natural Resources Forum No.2, 1986. United Nations:New York.

Palmer-Jones, R. 1988. Optimal capacity of multi-user irrigation systems'. pp.1-23 in: Multi-user Irrigation: 14/6/88.

Plusquellec, H. 1988. Improving the operation of canal irrigation systems. The Economic Development Institute and The Agriculture and Rural Development Department of The World Bank. March 1988. World Bank, USA.

Plusquellec, H. L., McPhail, K. and C. Polti. 1990. Review of irrigation system performance with respect to initial objectives. pp150.1-150-15 in: Irrigation and Drainage Systems. Kluwer Academic Publishers:Netherlands.

Ponrajah, A.J.P. 1989. Technical guidelines for irrigation works.

Popp, H. 1984. La question hydraulique. Effets socio-geographiques de la politique des barrages au maroc.

PRC Engineering Consultants Int'l. 1982. Irrigation Department. Ministry of Lands and Land Development. Termination report. Water management. Uda Walawe Irrigation Project, Sri Lanka. December 1982.

Radosevich, G. 1986. Legal and institutional aspects of irrigation water management. pp457-489 in: Irrigation management in developing countries: Current issues and approaches. Proceedings of an Invited Seminar Series. Sponsored by the International School for Agricultural and Resource Development. Studies in Water Policy and Management No.8. Westview Press:UK.

Ramamurthy, P. 1989. State power and irrigation inefficiency: Theoretical expectations and bureaucratic practice in South India. pp41-50 in: Rydzewski, J.R. and C.F. Ward (ed.) Irrigation theory and practice. Proceedings of the International Conference held at the University of Southampton 12 - 15 September 1989. Pentech Press:London.

Repetto, R. 1986. Skimming the water: Rent-seeking and the performance of public irrigation systems. Research Report No.4. World Resources Institute. December 1986.

Replogle, J.A. 1986. Some tools and concepts for better irrigation water use. pp117-148 in: Irrigation management in developing countries: Current issues and approaches. Proceedings of an Invited Seminar Series. Sponsored by the International School for Agricultural and Resource Development. Studies in Water Policy and Management No.8. Westview Press:UK.

Replogle, J.A. 1989. Obstacles to flow control and measurement in irrigation practice. pp802-813 in: Rydzewski, J.R. and C.F. Ward (eds.) Irrigation theory and practice. Proceedings of the International Conference held at the University of Southampton 12 - 15 September 1989. Pentech Press:London.

Roe, E.M. 1985. Project appraisal: A venture capitalist approach. pp.208-221 in: Development Policy Review, Vol.3.

Sagasti, F. R. 1988. National development planning in turbulent times: New approaches and criteria for institutional design. pp.431-448 in: World Development, Vol.16, No.4. Pergamon Press plc:UK.

Sah, R.K. and M.L. Weitzman. 1991. A proposal for using incentive precommitments in public enterprise funding. pp.595-605 in: World Development, Vol.19,No.6. Pergamon Press:Great Britain.

Schmehl, W.R. 1986. From diagnostic analysis to designing and constructing on-farm research. pp67-93 in: K.C. Nobe and R.K. Sampath "Irrigation management in developing countries" Westview Press: Boulder, Colorado.

Seckler, D. 1981. The new era of irrigation management in India. Draft. January 1981.

Seckler, D. 1982. The emerging crisis of irrigation management in the LDCs. July 1982. Mimeo.

Seckler, D. 1985. The management of Padi irrigation systems - A debate. ODI Irrigation Management Network Paper 11b. May 1985.

Simon, H.A. 1971. Decision making and organizational design. pp.202-223 in: Pugh, D.S. (ed.). Organization theory: Selected readings. Reading: Penguin Books Ltd.

Sir M. MacDonald & Partners (MMP) Ltd. 1986. Walawe irrigation improvement project. Draft water management and operation manual. July 1986.

Sir M. MacDonald & Partners (MMP) Ltd. 1990. Walawe irrigation improvement project, Sri Lanka. IIMI Report by Charles Nijman.

Siy, R. 1990. Effectiveness of PEO feedback on irrigation projects. Draft Paper. ADB. October 1990.

Slabbers, P.J. 1989. Western and indigenous principles of irrigation water distribution. pp675-681 in: Rydzewski, J.R. and C.F. Ward (ed.) Irrigation theory and practice. Proceedings of the International Conference held at the University of Southampton 12 - 15 September 1989. Pentech Press:London.

Small, L.E. 1981. Investment decisions for the development and utilization of irrigation resources in Southeast Asia. Summary of a workshop held at the Kampangsaen Campus of Kasetsart University, Thailand, August 17-21, 1981.

Small, L.E. 1989a. User charges in irrigation: Potentials and limitations. pp125-142 in Irrigation and Drainage Systems 3. Kluwer Academic Publishers:The Netherlands.

Small, L.E. 1989b. Financing irrigation: A literature review. pp.3-26 in: Financing irrigation services: A literature review and selected case studies from Asia. IIMI Monograph. Colombo, Sri Lanka.

Small, L.E., Adriano, M.S., Martin, E.D., Bhatia, R., Shim, Y.K., and P. Pradhan. 1989. Financing irrigation services: A literature review and selected case studies from Asia. International Irrigation Management Institute:Sri Lanka.

SOGREAH Consulting Engineers. 1984. Walawe irrigation rehabilitation and improvement project. Draft final report. 3. volumes.

Steekelenburg, P.N.G. and G. Zijlstra 1985. Evaluation of irrigation projects sponsored by the European Economic Community. Synthesis Report prepared for the Commission of the European Communities, Dir. Gen. VIII, Brussels. International Institute for Land Reclamation and Improvement (ILRI). ILRI: Wageningen, Netherlands.

Steiner, R. and M. Walter. 1988. Classification of gravity irrigation systems and their operation. WMS Report 78 of the Water Management Synthesis II Project. Utah State University: Logan, Utah.

Svendsen, M. 1988. The changing concept of management in irrigation. pp.15-17 in: IIMI Review Vol.2, No.2 August 1988.

Svendsen, M. and Small, L.E. 1989. A framework for assessing irrigation system performance. pp.I.1-24 in: Papers presented to the IIMI Symposium on performance evaluation of irrigation systems. 23 November 1989.

Svendsen, M., Adriano, M. and E. Martin. 1990. Financing irrigation services. A Philippine case study of policy and response. Second Draft, August 1990.

Ter Hofstede, K. and J. van Santbrink. 1979. Koloniaal Waterbeheer: Een onderzoek naar het ontstaan en de ontwikkeling van het technisch beheer van irrigatiesystemen met als ingang de schakelfunctie tussen projectorganisatie en bevolking. MSc Thesis. Agricultural University:Wageningen.

The Economist. 1991a. Nor any drop to drink. 16th February 1991

The Economist. 1991b. A survey of India. 4th May 1991.

Thornton, D.S. 1966. Contrasting policies in irrigation development. University of Reading Development Study, No.1.

Thornton, D.S. 1984. Introduction: Organising the use of irrigation water. pp169-175 in: Agricultural Administration 17.

Tiffen, M. 1987a. Dethroning the internal rate of return: The evidence from irrigation projects. pp.361-377 in: Development Policy Review, Vol.5.

Tiffen, M. 1987b. The dominance of the internal rate of return as a planning criterion and the treatment of O&M costs in feasibility studies. ODI Paper 87/1b. ODI:UK.

Tiffen, M. 1989. Designing for sustainability or for a high internal rate of return. pp.71-83 in: Rydzewski, J.R. and C.F. Ward (ed.) Irrigation theory and practice. Proceedings of the International Conference held at the University of Southampton 12 - 15 September 1989. Pentech Press:London.

Tullock, G. 1988. Competing for aid. pp299-311 in: Rowley, Ch. K., Tollison, R. D., and G. Tullock (ed.) The Political economy of rent-seeking. Kluwer Academic Publishers: The Netherlands.

Uphoff, N. 1986. Improving international irrigation management with farmer participation. Getting the process right. Studies in Water Policy and Management, No.11. Westview Press:USA.

Valera, A.B. 1985. A comparative assessment of three irrigation systems at Central Luzon, Philippines. Thesis presented to the Faculty of the Graduate School of Cornell University for the Degree of Doctor of Philosophy.

Valera, A. and T. Wickham. 1976. Management of traditional and improved irrigation systems: some findings from the Philippines. Paper presented in Choices in Irrigation Management Workshop, sponsored by the Agricultural Administrative Unit of the Overseas Development Institute, University of Kent, Canterburry, England. September 27 - October 1, 1976.

Verdier, J. 1987. Computerised control of irrigation water distribution. ODI Irrigation Management Network 87/1d.

Vermillion, D.L. 1986. Rules and processes: Dividing water and negotiating order in two new irrigation systems in North Sulawesi, Indonesia. A Thesis presented to the Faculty of the Graduate School of Cornell University in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

Wade, R. 1976a. How not to redistribute with growth: The case of India's command area development programme. pp95-104 in: Pacific Viewpoint, Vol. 14-17, 1976.

Wade, R. 1976b. Performance of irrigation projects. pp.63-66 in: Economic and Political Weekly, January 17, 1976.

Wade, R. 1980. On substituting management for water in canal irrigation: A South Indian case. pp A.147-A.160 in: Economic and Political Weekly, Review of Agriculture. December 1980.

Wade, R. 1982a. The system of administrative and political corruption: Canal irrigation in South India. pp287-328 in: The Journal of Development Studies, Vol. 18, No. 3, April 1982. Frank Cass & Co. Ltd.:UK.

Wade R. 1982b. The World Bank and India's irrigation reform. pp171-184 in: The Journal of Development Studies, Vol. 18, No.2, January 1982.

Wade, R. 1983. Irrigation reform in conditions of populist anarchy: An Indian case. pp285-303 in: Journal of Development Economics 14, 1984. Elsevier Science Publishers B.V.:North Holland.

Wade, R. and R. Chambers. 1980. Managing the main system: Canal irrigation's blind spot. pp A.107-A.112 in: Economic and Political Weekly, Review of Agricultural, September 1980.

Walker, H.H. 1981. Die organisation von bewässerungssystemen. Thesis for P.hd. Universitat Hohenheim.

Weiss, Ch. and N. Jequier (eds.) 1986. Introduction: The World Bank as a technological institution. pp.1-17 in: Technology, Finance and Development. An analysis of the World Bank as a Technological Institution. Lexington Books:Toronto.

Wensley, C.J. 1989. Irrigation rehabilitation: A comparative study of physical facilities and hydraulic conditions in three Philippine irrigation systems. A dissertation presented to the Faculty of the Graduate School of Cornell University in partial fulfillment of the requirements of the Degree of Doctor of Philosophy. May 1989.

West Churchman, C. 1968. The systems approach. Dell Publishing Company, New York, USA.

Wickham, T. 1985. Irrigation management: Research from Southeast Asia. Agricultural Development Council: New York, USA.

Wickham, T. and A. Valera. 1976. Practices and accountability for better water management. Paper presented at the West Africa Rice Development Association Water Management Workshop, Dakar, Senegal, June 8-10, 1976. IRRI, Laguna.

World Bank. 1981. Water management in bank-supported irrigation project systems: An analysis of past experience.

Report No. 3421 Operations Evaluation Department. April 1981.

World Bank. 1984. Tenth annual review of project performance audit results. Volume One: Overview. Report No. 5248. August 1984.

World Bank. 1986. World Bank lending conditionality: a review of cost recovery in irrigation projects. Report No.6283. June 1986.

World Bank. 1989a. World Bank experience with irrigation development. Socio-economic, institutional and technical impact lessons. Volume I: Overview. Report No.7876. Operations Evaluation Department. June 1989.

World Bank. 1989b. World Bank experience with irrigation development. Socio-economic, institutional and technical impact lessons. Volume II: Mexico. Report No.7876. Operations Evaluation Department. June 1989.

World Bank. 1989c. World Bank experience with irrigation development. Socio-economic, institutional and technical impact lessons. Volume III: Morocco. Report No.7876. Operations Evaluation Department. June 1989.

World Bank. 1990a. A second look at irrigation development. Mimeo. May 1990.

World Bank. 1990b. Evaluation results for 1988. Issues in World Bank lending over two decades. A World Bank operations evaluation study. World Bank:USA.

World Bank. 1990c. Indonesia. Irrigation sub-sector project (Ln. 2880-IND). Discussion paper on operational issues at the scheme level. Agricultural Division (ASTAG), Asia Technical Department, The World Bank. January 1990.

World Bank. 1990d. World Bank experience with irrigation development. Socio-economic, institutional and technical impact and lessons. Volume IV: Overview. Report No.8494. Operations Evaluation Department. March 1990.

World Bank. 1990e. World Bank experience with irrigation development. Socio-economic, institutional and technical impact and lessons. Volume V: Philippines. Report No.8494. Operations Evaluation Department. March 1990.

World Bank. 1990f. World Bank experience with irrigation development. Socio-economic, institutional and technical impact and lessons. Volume VI: Thailand. Report No.8494. Operations Evaluation Department. March 1990.

Yin, R.K. 1984. Case study research: Design and methods. Applied Social Science Methods Series. Vol. 5. Sage Productions, Beverly Hills.

Yudelman, M. 1985. The World Bank and agricultural development - An insiders view. WRI Paper No. 1. World Resources Institute, U.S.A. December 1985.

Zuurbier, P.J.P., Bots, J.M., Edwards, A.R., Van Heck, E., Hendricks, J.A., Van der Meer, C.J., Stemne, S.I. and A.C.M. Zwanenberg. 1991. Besturen van organisaties. Een inleiding tot de bedrijfskunde. Educaboek:Netherlands.

ANNEX 1

Levels of Sophistication of the Irrigation Management Concerns

AN ANALYSIS OF an irrigation organization focussed on its key decision-making processes, is likely to lead to the conclusion that conditioning is required for performance improvement. Kampfraath and Marcelis (1981) have identified four criteria to guide the choice among different conditioning alternatives that together form the basis for the concept of the "level of sophistication."

These four criteria are derived from the decision-making processes: systematics, feedback, foreseeing and integration. Decision-making processes are essentially processes of transformation of the "resource" information into decisions. Two dimensions influence the quality of the decision, namely 1) what information is taken into account; and 2) how that information is processed. The first dimension can be split up into three criteria:

* In fact, a decision is a position toward future action, so that for taking that decision "*foreseeing*" (i.e., to what degree does decision taking foresee the scope of the decision?) is likely to influence the quality of the decision;

* Another element is the influencing through and of other processes. A position in the area of seasonal planning has consequences for the area of maintenance, for example. "*Integration*" (i.e., to what degree are problems seen in a wider context before the decision is taken?) is used as a criterion for this aspect.

* The position will only have actual consequences if the de facto action has commenced. Up to that moment the position can be revised based on information of the past; the quality of the position depends on the level of "*feedback*" (i.e., to what degree the decisions taken are tested continuously for appropriateness?).

The second dimension refers to the following criterion:

* "*Systematics*" (i.e., to what degree decisions are taken following a more or less fixed pattern?).

The level of sophistication is derived from those four criteria through the attachment of an estimated quantitative label to different qualitative levels of those four criteria, as shown in Table 1 of chapter 3. The levels of sophistication of the different irrigation management concerns and key decisions used here were derived from Table 1 and are listed in this Annex.

STRATEGIC CONCERN: DESIRED INVESTMENT OBJECTIVES

0-20/VERY LOW: *The establishment of the desired investment objectives is ad hoc without considering the likely sustainability of these objectives during the lifetime of the envisaged investments. No feedback with on the desirability and acceptability of the identified desirable objectives occurs from such stakeholders as the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors. No rules support this decision making, though a certain routine may exist.*

20-40/LOW: *Necessities for the short-term sustainability of the desired objectives during the life- time of the envisaged investments are incorporated. Irregular feedback on the desirability and acceptability of the most important desirable investment objectives takes place from such stakeholders as the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors. Broad rules support this decision making.*

40-60/AVERAGE: *Priorities for the short- and long-term sustainability of the desired investment objectives during the lifetime of the envisaged investments are considered. Regular feedback occurs on the desirability and acceptability of relevant system objectives from such stakeholders as the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors. The preferences and requirements of these groups with respect to these objectives are considered. Rules support important aspects of this decision making (e.g., the determination of the district and national social and economic opportunities for the investments).*

60-80/HIGH: *Foreseen developments that will affect the short- and long-term sustainability of the desired objectives during the lifetime of the envisaged investments are considered. Frequent feedback occurs on the desirability and acceptability of the most important desirable investment objectives takes place from such stakeholders as the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors. Important preferences and requirements of these groups with respect to these objectives are incorporated. Procedures in terms of combinations of mutually attuned rules support this decision making.*

80-100/VERY HIGH: *Expected developments that will affect the short- and long-term sustainability of the desired objectives during the lifetime of the envisaged investments are reviewed and considered. Continuous feedback occurs on the desirability and acceptability of the most important desirable investment objectives takes place from such stakeholders as the existing local community, the future beneficiaries, the separate agencies and individuals in those agencies, the local and national politicians, the consultants and donors. All relevant preferences and requirements of these groups with respect to these objectives are incorporated. Balanced systems of mutually attuned procedures support this decision making.*

STRATEGIC CONCERN : FEASIBLE INVESTMENT OBJECTIVES

0-20/VERY LOW: *The assessment of the feasible objectives is ad hoc without considering their likely sustainability during the lifetime of the investments. No feedback on the appropriateness of the feasible objectives is obtained from relevant sources such as agencies, publications, local communities or beneficiaries. No consideration of the mutual influences between such feasible objectives such as the watershed management, dam sites, command area, suitability of soils, water-delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, and environment; mono-disciplinary feasibilities dominate the decision making. No rules exist regarding the determination of the feasible objectives though a certain routine may exist.*

20-40/LOW: *Necessities for the short-term sustainability of the feasible objectives during the life- time of the envisaged investments are incorporated. Obvious experiences regarding the appropriateness of the feasible objectives of relevant agencies, publications, local communities or beneficiaries regarding the appropriateness and the feasible objectives are processed. Incorporation of convincing mutual influences between the different feasible objectives such as the watershed management, dam sites, command area, suitability of soils, water-delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment etc. Broad rules (e.g., steps to be taken, criteria to be used, consultations required, level of agreement of different groups) support the decision making.*

40-60/AVERAGE: *Priorities for the short- and long-term sustainability of the feasible objectives during the lifetime of the envisaged investments are considered. Consideration of the regular feedback of important information regarding the appropriateness the feasible objectives. Consideration of directly related mutual influences between the different feasible objectives such as the watershed management, dam sites, command area, suitability of soils, water- delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment etc. Rules (e.g., steps to be taken, criteria to be used, consultations required, level of agreement of different groups) support important decision-making processes regarding the feasible objectives.*

60-80/HIGH: Consideration of *foreseen developments that will affect the short- and long-term sustainability of the feasible objectives during the lifetime of the envisaged investments. Consideration of the frequent feedback of most relevant information regarding the appropriateness of the feasible objectives. Incorporation of important mutual influences between the different feasible objectives such as the watershed management, dam sites, command area, suitability of soils, water-delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment etc. Procedures in terms of combination of mutually attuned rules support important decision-making processes regarding the feasible objectives.*

80-100/VERY HIGH: *Expected developments that will affect the short- and long-term sustainability of the feasible objectives during the lifetime of the envisaged investments are reviewed and considered. Consideration of the continuous feedback of all relevant information regarding the appropriateness of the feasible objectives. Incorporation of all mutual influences between the different feasible objectives such as the watershed management, dam sites, command area, suitability of soils, water-delivery concept, water duties, cropping patterns and intensities, maintenance, settlement, environment etc. are incorporated. Balanced systems of mutually attuned procedures support important decision-making processes regarding the feasible objectives.*

STRATEGIC CONCERN : FUNCTIONAL INVESTMENT REQUIREMENTS

0-20/VERY LOW: *The decision making about the functional requirements is ad hoc and does not foresee the sustainability of these requirements (e.g., in case of crop diversification, or after degradation of parts of the system due to deficient maintenance) during the lifetime of the envisaged irrigation system or the involved components. No feedback occurs of experiences of the local community and the system managers regarding the appropriateness of the functional requirements for the investment. The decision making about the functional requirements does not try to integrate the engineering interests with other irrigation and nonirrigation interests and requirements of such stakeholders as the local community, the water-management staff, the politicians, the future settlers, and the (national or regional) agricultural interests. No rules exist regarding the determination of the functional requirements, though a certain routine may exist.*

20-40/LOW: *The decision making about the functional requirements considers necessities regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. Feedback occurs of obvious experiences of the local community and system managers regarding the appropriateness of the functional requirements for the investment. The decision making about the functional requirements considers convincing subsidiary influences between engineering interests and other irrigation and nonirrigation interests and requirements of such stakeholders as the local community, the water-management staff, the politicians, the future settlers, and the (national or regional) agricultural interests. Broad rules exist regarding the determination of the functional requirements.*

40-60/AVERAGE: *The decision making about the functional requirements considers priorities regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. Most important experiences of the local community and the managing agency regarding the functional requirements for the investments are considered. The decision making about the functional requirements integrates engineering interests with directly related influences of irrigation and nonirrigation interests and requirements of such stakeholders as the local community, the water-management staff, the politicians, the future settlers, and the (national or regional) agricultural interests. Important decision-making processes regarding the functional requirements such as the number and sites of intermediate reservoirs, the determination of peak irrigation requirements to certain subsystems, the required controllability over water flow etc. are supported with rules.*

60-80/HIGH: *The decision making about the functional requirements considers foreseen developments regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. Most experiences of the local community and the managing agency regarding the functional system requirements are considered. The decision making about the functional requirements integrates engineering interests with important other influencing factors of irrigation and nonirrigation interests and requirements of such stakeholders as the local community, the water-management staff, the politicians, the future settlers, and the (national or regional) agricultural interests. Most decision-making processes regarding the functional requirements such as the number and sites of intermediate reservoirs, the determination of design and peak irrigation requirements to certain subsystems, the required controllability over water flow etc. are supported with combinations of mutually attuned rules.*

80-100/VERY HIGH: *The decision making about the functional requirements considers and reviews expected developments regarding the sustainability of these requirements (e.g., in case of crop diversification, after degradation of parts of the system because of lack of maintenance) during the lifetime of the envisaged irrigation system or the involved components. All relevant experiences of the local community and managing agency regarding the functional requirements are considered. The decision making about the functional requirements integrates engineering interests with all influencing factors of irrigation and nonirrigation interests and requirements of such stakeholders as the local community, the water-management staff, the politicians, the future settlers, and the (national or regional) agricultural interests. Decision-making processes regarding the functional requirements are supported by balanced systems of mutually attuned procedures.*

ALLOCATION CONCERN : SEASONAL ALLOCATION PLAN

0-20/VERY LOW: *The seasonal allocation planning of water duties, cropping calendar, pattern, irrigable area and cultivation risks for different subsystems occurs ad hoc, though a certain routine may exist. Few rules guide this planning. No consideration for the related decision making by other stakeholders such as the agricultural department, the water users and the maintenance planners. Performance evaluation through complaints.*

20-40/LOW: *The seasonal allocation planning considers to some degree the available supply during the season for the different subsystems. No quantification of cultivation risks. Rules of thumb are used for the seasonal assessment of supply and demand, and the allocation planning. Incorporation of convincing influences of decision making by other stakeholders such as the agricultural department, the water users, the politicians and the maintenance planners. Performance evaluation through complaints and registration of final seasonal plans.*

40-60/AVERAGE: *The available supply during the season for the different subsystems is assessed and priorities are made between the allocation parameters (i.e., irrigable areas, cropping pattern, calendar, water duties and cultivation risks). Quantification of cultivation risks. Consideration to some degree of the consequences of the current season's allocation decisions on future expectations; i.e., a more active allocation strategy. Rules support this decision making. Consideration in the allocation planning of the directly related decision making by other stakeholders such as the agricultural department, the water users, the politicians and the maintenance planners. Performance evaluation through registration of final plans and comparison with important earlier experiences, and through regular monitoring of the actual implementation.*

60-80/HIGH: *Assessment of the available supply during the season for the different subsystems, and priorities are set between the allocation parameters, also considering the consequences for future expectations for important subsystems (given the allocation strategy for these subsystems and the overall system). Quantification of the cultivation risks and water duties for subsystems. Procedures of mutually attuned rules support this decision making. Incorporation of important influences of decision making regarding the different subsystems by other stakeholders such as the agricultural department, the water users, the politicians and the maintenance planners. Performance evaluation through comparison of final plan with earlier experiences for the different subsystems, and through frequent monitoring and evaluation of the actual implementation.*

80-100/VERY HIGH: *Assessment of the available supply during the season for the different subsystems, and priorities are set between the allocation parameters, also considering and reviewing the expected developments during the season and their consequences for future expectations of subsystems (given the allocation strategy for these subsystems and the overall system). Balanced systems of mutually attuned procedures support this decision making. Incorporation of all relevant decision making regarding the different subsystems by other stakeholders such as the agricultural department, the water users, the politicians and the maintenance planners. Performance evaluation through comparison of the final plan with earlier experiences for all subsystems, and through continuous monitoring and evaluation of the actual implementation.*

ALLOCATION CONCERN : IN-SEASONAL ALLOCATION

0-20/VERY LOW: *Little effective planning of the in-seasonal allocation occurs; operational targets for conveyance and distribution, cropping calendar, pattern, irrigable area and cultivation risks for different subsystems are set ad hoc, while incorporating urgencies. A certain routine may exist. Few rules guide this planning. No consideration in the official allocation decisions, if any, by other stakeholders such as the water users and the agricultural department. Gate tenders determine to a large degree the actual allocations, whereby often the conveyance along the main system is neglected. Performance evaluation through complaints. No reliable or effective feedback to higher hierarchical levels on the realization of the operational targets for distribution and conveyance for the different subsystems.*

20-40/LOW: *Short-term planning of in-seasonal allocation whereby necessities and urgencies are considered. Rules of thumb are used for the in-seasonal assessment of supply and demand, and allocation planning. Incorporation of convincing influences for different subsystems of decision making by other stakeholders such as the water users, the agricultural department and the politicians. Gate tenders take allocation decisions partly on their own, and partly based on instructions. Only for urgencies, operational targets for distribution and conveyance are considered separately. Performance evaluation through complaints and registration of final allocation plans (i.e., water schedules). Feedback on realization of the operational targets for distribution and conveyance for the different subsystems occurs for obvious points in the (sub)system.*

40-60/AVERAGE: *Regular (e.g., weekly or biweekly) planning of the in-seasonal allocation. The consequences of allocation decisions on future expectations are considered to some degree. The allocations consider the foreseen supply and demand changes during realization of the operational targets for distribution and conveyance for the different subsystems. Rules support this decision making. Important targets for conveyance to the tail end of the main canal and other important subsystems are incorporated in the matching of supply and demand. Consideration of the directly related decision making by other stakeholders such as the water users, the agricultural department and the politicians. Gate tenders take allocation decisions in line with water schedules and related instructions. Performance evaluation through the registration of water schedules and through comparison with important earlier experiences, and through regular monitoring of the actual implementation of most important operational targets. Allocation schedules consider regular feedback on the effective rainfall for most important subsystems. Experience with allocations is laid down in records (e.g., database, seasonal reports).*

60-80/HIGH: *Planning through frequent scheduling of allocations to different subsystems. Consideration of the consequences of allocation decisions on future expectations. The allocations consider the foreseen supply and demand (e.g., probable effective rainfall) changes during realization of the operational targets for distribution and conveyance for the different subsystems. Combinations of mutually attuned rules support this decision making. Incorporation in the matching of supply and demand of the most relevant decision making by other stakeholders such as the water users, the agricultural department and the politicians. Gate tenders take allocation decisions in line with water schedules and related instructions. Part of the instructions include standard practices for operational methods and procedures. Operational targets for distribution and conveyance are considered separately. Performance evaluation through frequent comparison of the actual implementation with the scheduled operational targets for conveyance and distribution for different subsystems. Frequent feedback on the demand includes the effective rainfall for all important subsystems.*

80-100/VERY HIGH: *The actual allocation is laid down in the water schedules. The gate tenders allocate accordingly, also in line with standard practices. Expected developments regarding supply and demand for different subsystems during the realization of the operational targets for distribution and conveyance for the different subsystems are reviewed and considered. Most sudden demand changes are thus covered in a consistent and reliable manner. Balanced systems of mutually attuned procedures support this decision making. Incorporation in the matching of supply and demand of all relevant decision making by other stakeholders such as the water users, the agricultural department and the politicians. Performance evaluation through continuous comparison of the actual implementation with the water schedules for conveyance and distribution. Deviations and delays are reported and registered.*

REGULATION CONCERN

0-20/VERY LOW: *Hardly any preparation and calculation of the operational methods and plans occurs; they are established ad hoc and hardly foresee the consequences for upstream and downstream water levels in the main system. No rules support this decision making, though a certain routine (developed through on-the-job experience) may exist. No feedback occurs of used operational methods. Hardly any coordination of the operation of different structures along the main system. No advance determination of the time required for the operations. Gate tenders do the division of work by themselves. Performance evaluation by complaints and by some monitoring of the time spent.*

20-40/LOW: *Supervisors do some preparation and calculation of operational methods and plans (e.g., determination of approximate time and size of flow variations along the main system). The operational methods and plans consider the necessities for the conveyance of the resulting upstream and downstream water levels. Irregular feedback of the most obvious experiences with operational methods and stabilization occurs. The different operational methods incorporate convincing influences of the operations of the different structures along the main system on the stability of the water levels. Broad rules support this decision making. Advance estimation of the time required for the operations. Division of work is done partly by gate tenders themselves, partly by their supervisor. Performance evaluation by complaints and by monitoring of time spent by supervisor.*

40-60/AVERAGE: *Special staff of higher hierarchical levels do part of the preparation and calculation of operational methods and plans. The operational methods and plans consider priorities with respect to the conveyance of resulting upstream and downstream water levels. Regular feedback occurs regarding the important experiences with operational methods. Relevant influences of the operations of the different structures along the main system on the water levels are incorporated in an operational plan. Rules support this decision making. Time required for the operations is calculated by means of historical data. Division of work is done through tasks and instructions. Performance evaluation by regular monitoring of actually implemented operational methods and time spent by supervisor.*

60-80/HIGH: *Special staff for a systematic preparation and calculation of operational methods and plans. Frequent feedback occurs regarding practiced operational methods and resulting water-flow regulation. The operational plan incorporates all control structures that influence the regulation along the main system. Combinations of mutually balanced rules support this decision making in all subsystems. Time required for the operations is calculated, partly by means of calibrated norms. Division of work is done through tasks and instructions. Part of the instructions constitute standard operational methods. Performance evaluation by monitoring and evaluation of the actually implemented operational methods and by comparison of the time spent with the norms.*

80-100/VERY HIGH: *Special staff for a complete systematic preparation and calculation of operational methods and plans. Most operational methods have been standardized. Expected developments regarding upstream and downstream water levels are reviewed, evaluated and incorporated in the operational methods. Continuous feedback takes place regarding practiced operational methods and the resulting water flows and levels. Balanced systems of mutually attuned procedures support this decision making in all subsystems. Calculation of the time required for the operations is based on unit time calculations (e.g., UMS). Performance evaluation by monitoring and evaluation of the actually implemented operational methods and time spent.*

ANNEX 2

Questionnaire for Levels of Sophistication

— PRE SEASONAL PLANNING —

NOTE: **The questions on this page and the following 4 pages deal only with the pre-seasonal planning. The questions should not be answered for water allocation during the season.**

1. HOW DOES THE MATCHING OF SUPPLY AND DEMAND OCCUR BEFORE THE START OF THE CULTIVATION SEASON ?

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
Only one of the following 1.1(a) to 1.1(d) can be responded with 'yes'					
1.1 (a) The gate operators determine the starting date of the cultivation season and the areas to be cultivated	0				
(b) Field supervisors determine the starting date and the different areas to be cultivated	5				
(c) Senior officers in the hierarchy determine the starting date and the different areas to be cultivated, but only for a limited part of the irrigation system	10	100			
(d) The starting date, different areas, and possibly crops to be grown, are determined at a central point for the whole irrigation system	15		80	100	100
Only one of the following 1.5(a) to 1.5(c) can be responded with 'yes'! Only for the question responded with 'yes' the related sub-questions have to be responded					
1.5 (a) Requests of individual water users are considered in season planning if water is abundantly available	15	100			
- True, and in addition, water users and gate operators are informed before the start of the season	5	100			
- True, and in addition, water users and gate operators are consulted	5	50			
- True, and in addition, the majority of farmers or their representatives accept the allocations	5	75			
1.5 (b) Actual requests of the smallest sub-systems (for example tertiary or field canals) are considered in the seasonal planning, if water is available abundantly	10				
- True, and in addition water users and gate operators are informed before the start of the season	5				

— PRE SEASONAL PLANNING —

		VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
	- True, and in addition water users and gate operators are consulted	5				
	- True, and in addition the majority of farmers or their representatives accept the allocations	5				
1.5 (c)	Actual request of important sub-systems (for example distributary canals, tracts or blocks) are considered in the seasonal planning if water is available abundantly	5			100	
	- True, while in addition water users and gate operators are informed before the start of the season	5				
	- True, and in addition water users and gate operators are consulted	5				
	- True, and in addition the majority of farmers or their representatives accept the allocation	5				
1.17	A fixed seasonal allocation policy exists and is implemented. (This policy gives procedures and guidelines regarding possible starting and completion dates for the cultivation season, crops, water duties for different areas. Or, it determines which sub-systems get priority or are denied cultivation for different water availability situations)	15	75	100	50	
1.18	This seasonal allocation policy is determined in consultation with headquarters, water users, local administration/government officials, relevant agencies and possibly politicians	10	75		50	
1.19	This seasonal allocation policy is evaluated after each season	10	25	25		
1.20	Seasonal cultivation plans are in accordance with agricultural plans	5	25	100		
1.21	Seasonal allocation decisions are in line with annual and seasonal maintenance plans, rehabilitation and improvement plans	5	25	80	50	

— PRE SEASONAL PLANNING —

		VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
1.22	The seasonal decisions are in line with the long term allocation strategy. (For example, if no rice cultivation is allowed in areas where only water is available for less water consuming subsidiary field crops, the seasonal water duty allocations are in line with these envisaged long term water allocations)	10	25		25	
	TOTAL	100	63	42	38	15

— PRE SEASONAL PLANNING —

2. HOW IS THE IMPLEMENTATION OF THE SEASONAL ALLOCATION DECISIONS PLANNED ?

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
2.1 The urgency of requirements of water users or sub-systems (for example agricultural inputs, credits, labor availability) determines actual starting dates or staggers between water users or sub-systems	5		100		
2.2 A system of fixed priorities/rules for implementation of seasonal plan is laid down in schedules and is implemented	5	75		50	
2.3 Seasonal agricultural plans and maintenance plans form the basis for the implementation of the staggers	10	50			
- True, but in addition these staggers are determined as well by an annual agricultural plan and maintenance plans	10	50			
2.5 A weekly schedule for the implementation of the cultivation season exists on paper in which all related tasks are scheduled in time.	20	75		50	
- True, and in addition to this weekly implementation schedule, a time utilization schedule is made that reflects the degree of utilization of the different involved divisions in time	10				
- True, and in addition, a time utilization schedule for every individual staff member exists	10				
- True, and in addition, this time utilization schedule is detailed by means of a bar schedule	10				
2.9 The implementation planning is executed by a central planning officer	20			50	50
TOTAL	100	29	5	23	10

— PRE SEASONAL PLANNING —

3. HOW IS THE PROGRESS MONITORING AND EVALUATION (QUANTITATIVELY AND QUALITATIVEL OF THE IMPLEMENTATION OF THE SEASONAL ALLOCATION PLAN ?

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
3.1 Monitoring and evaluation of starting up of cultivation season through supervision of gate operators by field level supervisors	5	100		50	
3.2 Monitoring and evaluation of starting up of cultivation season through supervision of gate operators by supervisors who are hierachically higher than field level staff	5	50	50	25	
3.3 Regular (= at least weekly) progress meetings with involved staff	10	75			
- True, but also with participation of farmers or their representatives	10				
3.5 Regular documentation of progress and delays in starting dates of the cultivation season for different cultivated extents	10	20			
3.6 Formal, documented completion of starting up of seasonal plan and verification of realized water duties during starting up and of cultivated crops and cultivated extents	10	50	100		
- True, and in addition written reporting and anlysis of causes of deviations from plan	10				100
3.8 Regular comparison of implementation progress with plan	10	50	25		
- True, with written reporting and analysis of causes of deviations	10	50			
3.10 Monitoring and evaluation of costs involved (for example salaries, transport) in implementation of seasonal plan for important sub-systems by calculation at conclusion of starting up of season	10				
- True, but in addition written reporting and analysis of deviation	10				
TOTAL	100	32	15	4	10

— IN-SEASONAL PLANNING —

NB: The questions on this page and the following 4 pages have to be responded for water allocation during the season only !

4. HOW IS THE DEMAND FOR WATER DURING THE CULTIVATION SEASON MATCHED WITH THE AVAILABLE WATER RESOURCES ?

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
Only one of the following 4.1(a) to 4.1(d) can be responded with 'yes'					
4.1 (a) Gate operators can allocate water volumes (=timing, quantity and duration) according to own judgement and preferences	0	50	100	75	100
4.1 (b) Field supervisors determine these in-seasonal allocations	5	50		25	25
4.1 (c) The allocation of water volumes for a limited part of the irrigation system is determined by senior officers in the hierarchy	5	25			
- 4.1.c is true, and this determination of the allocation happens					
c.1 daily	5	50			
c.2 weekly	4	50			
c.3 bi-weekly	3				
c.4 monthly	2				
c.5 irregularly	1				
4.1 (d) The allocation of water volumes is determined at a central point for the whole irrigation system	10	25			
- 4.1.d is true, and this determination of the allocation happens					
d.1 daily	5				
d.2 weekly	4	50			
d.3 bi-weekly	3	50			
d.4 monthly	2				
d.5 irregularly	1				
Only one of the following 4.15(a) to 4.15(c) can be responded with 'yes'					
4.15 (a) Individual water user requests (actual) are considered in water allocation if water is available abundantly, also in view of requirements and allocations of other users	15	100			
- True, while in addition informing water users (or their representatives) and gate operators before the implementation of the scheduled allocation	5	100			
- True, and in addition water users or their representatives and gate operators are consulted	5	75			

— IN-SEASONAL PLANNING —

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
- True, and in addition the majority of farmers or their representatives are in agreement with the allocation	5	75			
4.15 (b) Actual requests of the smallest sub-systems (for example, tertiary or field canals) are considered if the water is available abundantly, also in view of requirements and allocations of other sub-systems	10				
- True, while in addition informing water users (or their representatives) and gate operators before the implementation of the scheduled allocation	5				
- True, and in addition water users or their representatives and gate operators are consulted	5				
- True, and in addition the majority of farmers or their representatives are in agreement with the allocation	5				
4.15 (c) Actual requests of important sub-systems (for example distributary canals, tracts or blocks) are considered if water is available abundantly, also in view of requirements of other sub-systems	5		25	100	100
- True, while in addition informing water users (or their representatives) and gate operators before the implementation of the scheduled allocation	5				
- True, and in addition water users or their representatives and gate operators are consulted	5				
- True, and in addition the majority of farmers or their representatives are in agreement with the allocation	5				
4.27 A fixed in-seasonal allocation policy exists and is implemented. (This policy gives procedures and guidelines regarding water volumes for different areas in timing, quantity and duration. Or, it determines which sub-systems get priority or are denied water for different water availability situations)	15	75		50	

— IN-SEASONAL PLANNING —

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
4.28 This in-seasonal allocation policy is determined in consultation with headquarters, users, local government officials, relevant agencies and possibly politicians	10	50		10	
4.29 This in-seasonal allocation policy is regularly evaluated	10				
4.30 In-seasonal allocation decisions are in accordance with the seasonal allocation plan	5	100		50	
4.31 In-seasonal allocation decisions are in accordance with the seasonal agricultural implementation plan	5	25	50		
4.32 The decisions are in line with a long term allocation strategy. For example, if no rice cultivation is allowed in areas where only water is available for less water consuming subsidiary field crops, the water allocations are in line with these envisaged long term water allocations	5	25		25	
TOTAL	100	66	4	19	6

— IN-SEASONAL PLANNING —

5. HOW IS THE IMPLEMENTATION OF THE IN-SEASONAL ALLOCATIONS PLANNED ?

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
5.1 The urgency or requirements of water users or sub-systems (for example labor availability, input supply, pest or disease incidence, other agricultural reasons) determines the actual allocations (timing, quantity and duration) to different sub-systems	5	25	100	100	100
5.2 A system of fixed priorities/rules has been laid down on paper and is implemented	5	75		25	
5.3 A schedule of actual water requirements from different sub-systems forms the basis for the allocation implementation scheduling	10	100		25	
- True, but the allocation scheduling is determined also by a written schedule of seasonal or annual water delivery performance and agricultural production targets	10				
5.5 A weekly allocation implementation schedule exists in which related tasks in time have been scheduled and indicated as well	20	100		25	
5.6 This weekly allocation implementation schedule exists in which related tasks in time have been scheduled and indicated as well	10				
5.7 In addition, a time utilization schedule for every individual staff member is provided	10				
5.8 In addition, this time utilization schedule is detailed by means of a bar schedule	10				
5.9 This implementation planning is executed by a central planning officer	20			50	
TOTAL	100	35	5	24	5%

— IN-SEASONAL PLANNING —

6. HOW IS PROGRESS MONITORING AND EVALUATION (QUANTITATIVELY AND QUALITATIVELY) OF THE IMPLEMENTATION OF THE IN-SEASONAL ALLOCATIONS ?

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
6.1 Progress monitoring and evaluation of actual water delivery through supervision of gate operators by field level supervisors	5	50		50	50
6.2 Progress monitoring and evaluation of actual water delivery through supervision by officers who are higher in the hierarchy than field level staff	5	25	25	25	25
6.3 Regular progress meetings (= at least bi-weekly) with invovled agency staff	10	100			
- True, but also with participation of farmers or their representatives	10				
6.5 Regular documentation of monitoring and evaluation of deviations in timing of start and completion of actual water delivery	10	75			
6.6 Formal, documented completion and verifications of water delivery performance (for example, timeliness, predictability, adequacy, efficiency)	10	75			
- True, and in addition documented reporting and analysis of cause of deviations from scheduled allocations	10	25			
6.8 Regular comparison of implementation progress and scheduled implementation	10	50			
- True, with documented reporting and analysis of causes of deviations	10	50			
6.10 Monitoring and evaluation of costs involved (for eample salaries, transport) in implementation of in-seasonal allocations for important sub-systems by ex-post calculation	10				
- True, but in addition documented reporting and analysis of deviations	10				
TOTAL	100	41	1	4	4

—GATE OPERATIONS AND WATER FLOW REGULATION—

NB: The questions of this page and the following 2 pages have to be responded only for the actual gate settings (procedure, size, frequency) and actual flow regulation. (This is different from the earlier questions regarding allocation of water volumes)

7. HOW DOES THE PREPARATION OF GATE SETTINGS (= PROCEDURE, SIZE AND FREQUENCY) BY OWN STAFF TAKE PLACE ?

NB: This question does not refer to the planning in time of these operational methods and plans, which had been covered in questions 1 to 6 already. Questions 7 and 8 refer to the management concern that the actual flow regulation through the execution of gate settings at a specific moment itself happens as effectively and efficiently as possible

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
7.1 The gate operators do the preparation of procedure, size and frequency of different gate settings by themselves	0	100	80	100	100
In principle, only one of the following 7.2(a)1 - 7.2(a3), 7.2(b) and 7.2(c) can be responded with 'yes.' Yet, it is possible to respond to both 7.2(b) and 7.2(c) with 'yes'					
7.2 (a1) Field supervisors give specific instructions to the gate operators about procedure, size and frequency of different gate settings	5				
7.2 (a2) Officers who are hierarchically higher than field level staff give specific instructions to the gate operators about the procedure, size and frequency of different gate settings	5		20	50	
7.2 (a3) Supervising officers do the administrative and technical preparation of procedures, size and frequency of gate settings (for example, rating curves for gates)	15				
7.2 (b) There are fixed rules/standing orders for procedures, size and frequency of gate settings (for example, for important water level fluctuations after rainfall, or for safety)	25		10	25	
7.2 (c) Special technical staff do the preparation of procedures, size and frequency of gate settings	25				
7.7 Such special technical staff has up to date information of hydraulic conditions of canals, control and measurement facilities	15		20		
7.8 Regular analysis of gate setting procedures by means of historical data	10				
7.9 Systematic analysis for different water flow scenarios by means of time-and-motion techniques (= non stop monitoring for some days)	10				

—GATE OPERATIONS AND WATER FLOW REGULATION—

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
7.10 The outcomes of such analyses are discussed with the supervisors	5				
7.11 The analyses are discussed with the gate operators, for which inputs from their side are expected	10				
TOTAL	100	0	4	9	0

—GATE OPERATIONS AND WATER FLOW REGULATION—

8. HOW IS THE CONTROL OVER TIME UTILIZATION BY GATE OPERATORS ?

	VALUE	MOROCCO	SUDAN	SRI LANKA	PHIL
8.1 Supervisors check their actual working hours	5	75		25	25
8.2 Gate operators record their own daily working hours	5	75		25	25
8.3 Methods like multi-moment recordings (= continuous monitoring for a couple of days), are used for fixing once in every two or three years the working hours in a representative period	10				
8.4 Gate operators record their time taken per operation	5				
8.5 Time taken per operation is regularly analyzed by means of comparing different operations	10				
<u>Only one of the following 8.5 and 8.6 can be responded with 'yes'</u>					
8.6 Working time norms are developed by means of historical data	15	25			
8.7 That time norm is determined by means of work studies or multi-moment recordings	25				
8.8 Analyses are done on actual time spent in comparison to norms	10				
8.9 Such analyses are done by a special officer (for example, who is involved in the preparation of operational methods as well)	15				
8.10 The outcomes of the analyses are discussed with supervisors	5				
8.11 The outcomes of these analyses are discussed with gate operators, whereby their input is expected	10				
TOTAL	100	11	0	3	3

ANNEX 3

Hydraulic Control : Flow, Levels and Storage Control

THIS ANNEX ELABORATES on the factors that influence flow, level and storage control. The section intends to give some insight in the hydraulic aspects of irrigation for non-engineering readers. Also, it proposes a more management-relevant terminology for the purely hydraulic concepts of upstream and downstream control.

THE NEED FOR FLOW, LEVEL AND STORAGE CONTROL

All structures in irrigation systems are intended to increase control over water flows and levels. "Control" refers thereby to the process of giving direction to the water flow and levels, and the process of getting some degree of feedback on realized flows and levels. The latter may subsequently be used to change the future direction so that targets will be achieved. Thus, this definition of control includes both management and hydraulic control.

Control over water flow is seen here as a continuum between no control and full control. The required degree of control over water flow and level depends on the required quality of the water delivery; if more timeliness, reliability, and efficiency are pursued, then more control over the physical process is required.

Control over water flow and level in an open canal is necessary for the following reasons: 1) to prevent the overtopping of canals without wasting water through spillways; 2) to facilitate and control the distribution by maintaining enough head to command the service area through gravity; and 3) to facilitate and control the conveyance of water along the canal.

In many traditional irrigation systems, there is little opportunity for control over the water flow. Only by maintaining the full discharge it is possible to issue enough water through the offtakes, because lower discharges result usually in too little head.[1]

Modern designs tend to increase the opportunity for flow and level control. For example, by introducing cross-regulators in a canal. Cross regulators serve to achieve level control along a canal while conveying variable flows through it. A problem of canals with cross-regulators is the time lag in the transmission of flow variations over long distances; only in canals with flow variations such responsiveness becomes relevant. In canals with fixed cross-regulators like duckbill weirs this responsiveness becomes even more constraining. Another problem in canals with cross-regulators is the need to manage these flow variations and thus the operations of the cross-regulators. By introducing level control structures (i.e., the cross-regulators) the canal becomes a cascade of small reservoirs. The filling and emptying of these reservoirs have to be managed to ensure the conveyance of water along the canal. Yet, the latter problem is less valid for fixed cross-regulators where such filling and emptying occurs more automatically as long as the overall discharge in the canal is sufficient.

The management of filling and emptying of these reservoirs to ensure conveyance and distribution requires more than just localized control over flow and level at a certain moment; it requires the integration of the flow and level control along the canal for a period of time. Such integrated flow and level control to reach the pursued degree of storage control is defined here as flow regulation. Flow regulation encompasses both the formulation and execution of an operational plan for the conveyance of water along a canal and the distribution through its offtakes. The operational plan includes the operation of storage and diversion works to adjust water levels in the canal and possible intermediate reservoirs, and to adjust changes in stream flow.[2]

SENSITIVITY OF STRUCTURES FOR FLOW AND LEVEL CONTROL

Different types of irrigation structures release different discharges after the same flow fluctuations upstream. For example, this so-called sensitivity is different for overflow type (i.e., weirs and flumes) and undershot type (i.e., orifices) structures. The change of the downstream discharge as a result of an equal increase of the upstream water level is much higher for a weir than for an orifice.

This sensitivity of structures has of course much influence on their functionality for the flow regulation. If the function of a structure is to reduce fluctuating water levels upstream, then a weir seems more fit. From a decision making perspective, a weir used as a level regulating structure in the parent canal requires fewer operations to control the diverted flow (with a similar accuracy) after a flow fluctuation in the parent canal.

On the other hand, the orifice seems more fit if the structure's function is to reduce fluctuations in the downstream water flow after upstream water level fluctuations. From a decision making perspective, an orifice as offtake requires fewer operations to control the water diverted flow with the same accuracy, after water level fluctuations in the parent canal.

COMPLETE AND PARTIAL HYDRAULIC CONTROLS

The hydraulic properties of water make the control over the physical process in irrigation very complex. They cause the decision making on the flow through a structure to be influenced by the downstream water levels, and thus by the so-called backwater effect of structures downstream. With backwater effects it becomes very difficult to control accurately the discharge through a structure. In a management environment where management control is weak, the introduction of more hydraulic controls during the design phase (if enough head is available) may help to reach sufficient control over the physical process to achieve the pursued water-delivery performance.

ICID has defined a hydraulic "control" as follows: "A section or a reach of a conduit where conditions exist that make the water level above it a fairly stable index of discharge. A control may be partial or complete. A complete control is independent of downstream conditions and effective at all stages.".[3] A complete hydraulic control gives the opportunity to control the water flow fully as "the water doesn't know what's happening downstream".[4]

If the "water does know what's happening downstream" the so-called backwater effect makes it more difficult to control flow as the canal reaches become hydraulically interdependent. Subsequently flow control needs more information: an assessment of the gate opening and the level both upstream and downstream of a structure. Even then it remains difficult to assess the flow without calibrating the structure for different hydraulic situations.

System design may harness hydraulic controls in the following ways:

* *flow assessment* requires a *narrow weir* so that the level fluctuates more with variable discharges;

* *level control* in a limited upstream reach of a hydraulic control will be improved with a *wide weir* as it limits level fluctuations for variations of flow. (Such level control facilitates the opportunities for flow control through the offtakes in the upstream canal reach.);

* *decoupling of different canal reaches*, in particular preventing the downstream reaches from influencing the upper reaches, requires weir type of structures. These create the hydraulic conditions that facilitate the so-called upstream control type of regulation that designers often pursue.

BASIC MODES OF REGULATION AND RELATED DESIGN CONCEPTS

The basic design concepts for flow regulation rely on different sources of information for the target setting for the operations. These are either from the head or from the tail of the canal.

An *upstream mode of regulation* means that a change in water flow is (envisaged to be) initiated from the head end of the canal (i.e., filling), and must be "pushed" downstream. This upstream mode of regulation can be achieved manually through allocation and regulation decisions and control, as well as automatically through decision making during the planning and design phase. Design concepts that favor an automatic upstream mode of regulation are such hydraulic controls as overflow type of structures (e.g., duckbill weirs) and different types of more advanced technological concepts (e.g., counterbalancing gates).

In a system designed for a manual upstream mode of regulation without any hydraulic controls its existence in the day-to-day operation depends on the quality of the management and its communications due to the hydraulic interdependency of the canal reaches. Apart from the high communication requirements, a problem in long canals with this type of regulation is the high hydraulic lag time to react on requests from the tail end. If this lag is a major impediment, the design can alleviate it by using intermediate storages. These can act, depending on how good they are managed, as a buffer for the variability of upstream flows and levels.

Alternatively, a *downstream mode of regulation* means that a change in water flow is (envisaged to be) initiated from the tail end of the canal (i.e., draining). This downstream mode of regulation can be achieved manually through allocation and regulation decisions and control, as well as automatically through decision making during the planning and design phase. Design concepts that favor an automatic downstream mode of regulation do not envisage hydraulic controls. A special automatic, counterbalancing gate exists for downstream control as well as some other high-tech gates that react automatically on downstream level fluctuations. A particular feature of these automatic downstream modes of regulation is that the propagation of information about targets occurs hydraulically. Also, a degree of downstream mode of regulation exists in canals with undershot gates where limited coordination between the different canal reaches occurs, and where thus part of the information is propagated hydraulically.[5]

For both upstream and downstream modes of regulation manual *storage control* along canals with cross-regulators is difficult to achieve as follows from the following quotation: "the storage capacities corresponding to different water surface profiles for different steady state flows conditions are generally not readily available to the irrigation agency in charge of operations. Per default, the current operational rules do not take into account the variations of canal built-in storage capacities corresponding to the different flow regimes in the management of the transfer of water. Instead, the operations rules are generally expressed in more simple terms for the gate tenders, for example the standing orders to maintain water level at full supply depth at the cross-regulator. These rules mean that the volume comprised within a reach would increase or decrease with the variation of inflow and that would oppose to some extent and delay the transfer of water.".[6] Storage control in canal reaches under unsteady flow conditions is thus very difficult to achieve with manual operation only.

Yet, another automatic system aims at a constant storage. In this design concept the target control level lies in the middle of the canal reach between two counterbalancing or other type of automatic gates.

BALANCING BETWEEN MANAGEMENT AND HYDRAULIC CONTROL

The above mentioned design concepts do not replace the need for management control as the decision makers at system and sub-system levels have considerable potential to use a design concept for an upstream mode of regulation in a downstream mode. Therefore, more consistency seems required between the mode of regulation envisaged during the planning and design and the actual mode of utilization. This means not necessarily a choice between a downstream and upstream mode of regulation but a choice for an adequate combination of the two in the various sub-systems of the main system, also in view of the likely objectives and practices during capacity utilization.

Notes

1. For example, in Sri Lanka's ancient irrigation concepts this lack of controlled flow was compensated partly by the construction of cascades of small tanks as buffers for the upstream variability, and for some degree of control over the water levels.

2. Definition free after ICID 1967:615.

3. Ibid:384.

4. Henderson 1966.

5. See also IIMI 1989 and Nijman 1992a.

6. IIMI 1989.

ANNEX 4

Fake Management-Control Systems

IN PRINCIPLE, THE sections on financial control systems in chapters 4 and 5 should cover all material and immaterial control systems, other than incentive systems and information systems that were covered under other management conditions. In practice, the chapters discuss just the most important management-control system, the financial control. Yet, several systems were observed to be often considered erroneously as management-control systems. This Annex discusses them.

Two different categories of control systems and methods can be recognized. They correspond to the different categories of decision-making processes described in chapter 3 (see also Figure 4). These different categories of processes form the different objects of control, as listed hereafter:

1) *B-process control systems* for controlling the physical processes (i.e., A-process) relate only to substantive choices in the B-process. Examples are the methods for assessing the crop water requirements or the inflow, methods of zoning and rotational water deliveries, methods for assessing the feasible or designed water requirements or inflow, or the methods of assessing the feasible or functional zoning and rotational water deliveries. Such B-process systems do not control or relate to the decision making of the B-process itself; and,

2) *C-process control systems* for controlling the decision-making processes about the physical processes and conditions (i.e., B-process), such as systems of physical and financial accounting and control.

These systems are often closely related to management information and incentive systems, and sometimes the boundary is rather arbitrarily.

Though per definition, the systems and methods of the first category, the B-process systems, have no function as management-control systems. Yet, several of them are often erroneously considered as such, and some generalizations of such misunderstandings seem sufficiently relevant to summarize here.

CAPACITY UTILIZATION

Control systems are usually based on some performance indicators. The *theoretical crop water* *requirements* are often considered an instrument to control the water allocation, both during the utilization and the creation of irrigation capacity. Yet, this method cannot control much at field level. It is based on theoretical assumptions and does not provide managers with the information and arguments to restrict allocations. Its major weakness remains the seepage and percolation rates that can vary considerably, even within a small allotment. A reliable assessment of these rates is thus too difficult to make the assessment functional in a management-control system. IIMI research has demonstrated this in the Kirindi Oya and Uda Walawe systems.[1]

The concept of the "cumulative relative water supply" considers only these losses to the degree they are really lost to a sub-system over a period of time. This reduces the influence of this major weakness somewhat thus, though its practicality still has to be tested.[2] In the absence of other management-control systems, these calculations are sometimes enforced on the field staff and farmers, at least that is what the higher hierarchical irrigation managers (like to) think . . .the practice tends to be different.

These theoretical crop water requirements are thus not a management-control system, and they can function only marginally in another control system, neither can it replace the absence of others. Although this misconception may seem trivial, it has contributed to many delusions in irrigation projects, and the consequent underperformance.

Gross *comparative water-delivery performance indicators* for larger sub-systems or systems based on comparative data may play a somewhat more functional role. Though they do not provide the manager with any location- and time-specific arguments as well. More useful in any management-control system are location-specific gross performance indicators based on historical data. They provide managers with such location-specific arguments, though they are still not time-specific. A combination of a management information system and historical, normative indicators can provide for such a time-specific management-control system.

Alternatively, water pricing can replace this type of B-process systems. Or, this can be achieved through the creation of decentralized profit centers, thus delegating this decision making to lower hierarchical units or to the farmers themselves. The section on Financial Control Systems in chapter 4 elaborates upon these two options.

Other B-process systems are the *rotation* of water deliveries, *zoning* of cultivation, *yield optimization*, *planning of staff time utilization*.[3] These systems may help to enforce some reduction of water wastage in certain parts of a system, though they do not necessarily lead to it; they are not management-control systems. Their effectiveness depends instead on the related management-control systems that influence staff to use such a system in a more or less functional way.

In general, donors require the development of *O&M manuals* for the utilization of their irrigation investments. Such manuals provide all sorts of fore mentioned and other B-process systems and methods such as instructions for the assessment of the water requirements, the scheduling, the monitoring and evaluation, and flow regulation. They seldom touch upon the more sensitive C-process management-control issues. This contrasts with the dependence of the functionality of such manuals on the management control. Without touching these management-control issues, such manuals seem therefore a waste of money.[4]

CAPACITY CREATION

Design concepts. Conceptual design is also a method that many professionals assume to be a management-control concept in that it influences design decision-making processes. In practice, it only relates to substantive design choices, and not to the preparatory processes of these decisions. Therefore, it does not relate to the C-process, the management control.

In contrast, the here proposed condition to develop an explicit statement on a "Program of requirements" for the new irrigation investments would represent such a management-control system as it influences the process of the B-process.

Cost-benefit analysis. Similarly, cost-benefit analysis guides substantive choices of the feasibility assessment. It does not control its output, neither the process of decision making. The prescribed cut-off rate of most donors provide a certain management control. It is meant as an output performance indicator for this process, and was observed to function as such.

Notes

1. IIMI 1990a.

2. Sakthivadivel in IIMI Technical Staff Seminar, 10 December 1990.

3. E.g., Murray-Rust 1990.

4. See, for example, page 103 and Le Moigne 1986.

To conclude, a short discussion on Diemer's interesting process-based anthropological perception of the origins of the way engineers have come to look at several of these systems the way they do at present. Diemer has called this perspective of irrigation engineers the ***engineering paradigm*** (Diemer 1990).

For many reasons, the engineering paradigm of irrigation traditionally regarded an irrigation system as an agricultural production system. Design of such a system was optimized toward the physical water efficiency at the expense of the economic opportunities for water and farmers. In the past, under fully controlled governance (e.g., under colonial rule), such assumptions could, to a certain degree, be realized. Yet, even physically, perfect planning by the agency is impossible given the huge and unrealistic amount of detailed information about location-specific soil, topography and other considerations that is required for optimal physical planning. The only observed study that recognized this physical impossibility is on the Moroccan system of "assolement" (i.e., the state controlled cropping pattern and calendar for different sub-systems) and is based on several detailed case studies by a German social geographer (Popp 1984:243-244).

Over time, these opportunities and governance situations have changed, while the engineering paradigm did not; in fact, engineers are educated without any awareness of such historically developed assumptions and their present validity.

The consequences of this engineering paradigm on irrigation are manifold. Engineers tend to plan, design and operate irrigation systems for the delivery of water to crops, rather than to their actual clients, the farmers. Similarly, engineers and agronomists have always thought that the best cultivation plans could only be developed by the agencies; if optimization of the use of physical resources only is considered, this is indeed the case. In practice, however, market, economic and management constraints cause quite different opportunities that cannot be planned or controlled by the agencies. Along such paradigmatic lines, agencies traditionally planned and controlled cultivation in Sudan and Morocco. Also in Asia engineers preferred this type of cultivation in irrigation systems through the subsidized provision and control of many additional inputs by the irrigation agency, often with support and pressure of the donors. More recently, more awareness of the high social and economic costs and missed opportunities of such approaches have led to more liberalized approaches in these countries, again with support and pressure of the donors.

Diemer's interesting thesis elaborates on several of the mentioned points (Diemer 1990). By explicitly adopting a process-based perspective of irrigation, Diemer derived many findings similar to this study. The difference with this study is that Diemer focussed on FMIS and did not systematically consider the management conditions and management control processes. He thus also omitted, for example, the important role of finance. Diemer also meant his study more to provide a process-based sociological perspective, rather than a management perspective (Diemer pers. comm.).

Samenvatting

DE INVESTERINGEN IN irrigatie voorzieningen gedurende de laatste decennia zijn immens geweest. De geschatte jaarlijkse investeringen van 15 miljard dollar maken irrigatie de grootste subsector van de agrarische sector, zelf verreweg de grootste sector van investeringen in ontwikkelingslanden. Sinds het midden van de zestiger jaren is het bewustzijn gegroeid dat de uitkomsten van die investeringen ver beneden hun potentieel liggen. Ze zouden uiteindelijk gemiddeld ten opzichte van de schattingen ten tijde van de investeringsbeslissingen twee keer zoveel kosten en maar de helft opbrengen.

DE PROBLEEM DEFINITIE EN DOELSTELLING

Tegelijkertijd met het toegenomen bewustzijn over de onderbenutting van de irrigatie voorzieningen, realiseerde men zich dat het management niveau van de systemen laag was in vergelijking met de expertise en inspanningen in de constructie van nieuwbouw en rehabilitatie. Experimenten in de Filipijnen, Sri Lanka en India in het eind van de zeventiger jaren suggereerden een potentieel voor verbeterde capaciteitsbenutting puur door management verbeteringen. Echter, dit potentieel is sindsdien niet benut. Bovendien ontkennen veel ingenieurs het management probleem. Er blijken dus afwijkende benaderingen en visies op het irrigatie management probleem te bestaan, en daarom hebben vele irrigatie deskundigen gepleit voor een meer objectieve benadering van de onderbenutting in de irrigatie. Deze studie poogt zo'n benadering te ontwikkelen middels een bestaande besturingsbenadering. Ook wordt getracht door toepassing van de benadering op de irrigatie problematiek een verbeterd inzicht in de onderbenutting te verkrijgen, alsmede de mogelijkheden tot verbetering te identificeren.

BESTAANDE IRRIGATIE BESTURINGSBENADERINGEN

Er zijn weinig expliciete pogingen gedaan om een concept voor de besturing van irrigatie systemen te ontwikkelen. Van de bestaande concepten zijn de meeste meer gericht op de formele verschijning van de organisatie, de structuur. De meeste concepten blijven ook vaag over de relatie tussen de structuur en de besluitvormingsprocessen. Geen enkel concept probeert een integrale benadering te zijn, dat wil zeggen alle voor irrigatie managers relevante zaken mee te nemen in de analyse. De potentiële bijdrage van deze studie is een expliciete integrale benadering van de irrigatie besturing, alsmede een systematische analyse van de relatie tussen besluitvormingsprocessen en structuur. Bovendien worden andere soorten besturingscapaciteit, ofwel management condities, dan alleen structuur bekeken, zoals het financieel beheer, de mensen, en de voorziening van informatie en kennis.

EEN INTEGRALE BESTURINGSBENADERING

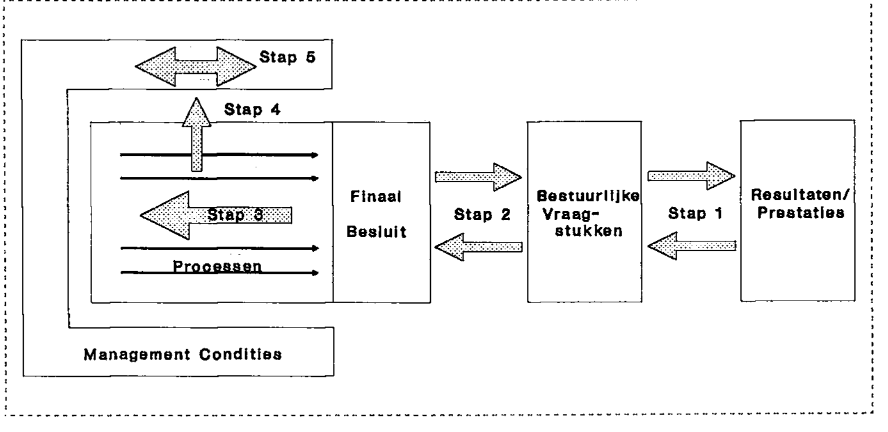
De management benadering in deze studie is gebaseerd op de integrale besturingsbenadering zoals die ontwikkeld is door Kampfraath en zijn collega's van de Vakgroep Bedrijfskunde van de Landbouwuniversiteit te Wageningen.

De onderstaande figuur geeft deze proces-benadering stapsgewijs weer. De eerste stap is de identificatie van de belangrijkste bestuurlijke vraagstukken die beantwoord moeten worden voor de levering van water (stap 1). Deze vraagstukken zijn verdeeld in twee hoofdgroepen, namelijk 1) vraagstukken georiënteerd op het scheppen en instandhouden van capaciteit ten bate van de uitvoering; en, 2) vraagstukken georiënteerd op het benutten van deze capaciteit. Voor het *scheppen van capaciteit* betreft dit de besluiten ten aanzien van respectievelijk de gewenste investeringsdoelstelling, de haalbare investeringsdoelstelling en de functionele eisen ten aanzien van de investering. Voor het *benutten van capaciteit* betreft dit de water allocatie en regulering.

Voor de finale besluiten van elk van deze belangrijke vraagstukken wordt vervolgens de bijdrage aan de prestaties van de organisatie vastgesteld (stap 2). Indien deze bijdrage als onvoldoende wordt beschouwd, worden de besluitvormingsprocessen geanalyseerd die leiden tot dat finale besluit. De vaststelling van de niveaus van perfectie van de besturing van de belangrijkste besluiten is onderdeel van die analyse (stap 3). Gebaseerd op de analyse van de interactie tussen de besluitvormingsprocessen en de soorten van besturingscapaciteit, de management condities, worden veranderingen in de laatste geïdentificeerd die waarschijnlijk tot verbeteringen in de besluitvormingsprocessen zullen leiden (stap 4). En dus tot verbeterde besluiten en verbeterde resultaten. Zoals gezegd, andere management condities dan structuur zijn de mensen, hun motivatie en drijfveren, het financieel beheer en de voorziening van informatie en kennis. De laatste stap is de identificatie van de besturing van de besluitvormingsprocessen, ofwel de regie, die nodig zijn om de geïdentificeerde verbeteringen in management condities en besluitvormingsprocessen te bewerkstelligen (stap 5).

De besturingsbenadering verbindt dus de prestaties en resultaten van de organisaties met het fysieke proces, de besluitvormingsprocessen daarover, management condities, alsook de regiserende besluitvormingsprocessen. Hierdoor wordt een integrale kijk op de onderbenutting in een organisatie mogelijk.

Prestatie-georiënteerde management analyse



DATA VERZAMELING

De data verzameling voor deze studie vond plaats door middel van twee diepgaande case studies van twee Sri Lankaanse irrigatie organisaties, alsook door vergelijkende case studies in Marokko, Sudan en de Filipijnen. Minder intensieve waarnemingen vonden plaats in India, Maleisië en Pakistan. De data verzameling ten aanzien van de besluitvormingsprocessen bestond uit interviews met managers en uitvoerende staf in irrigatie en andere diensten, ministeries, financieringsorganisaties, en consultants. Ook rapporten, archieven, databestanden en andere documentatie zijn bestudeerd. Een literatuurstudie diende ter vorming van en vergelijking met de bevindingen. Hieronder volgen de voornaamste bevindingen en aanbevelingen voor de benutting en schepping van capaciteit in ontwikkelingslanden.

RESULTATEN: HET BENUTTEN VAN CAPACITEIT

De bepaling van het beschikbare water aanbod in de geobserveerde irrigatie systemen gebeurde meestal meer op een benaderende dan op een precieze wijze. De bepalingen waren meestal aan de "veilige" kant--bij voorkeur MET een 100 procent waarschijnlijkheid, d.w.z. nul risico--om de risico's van droogte en dus de gerelateerde conflicten tussen boeren en politici te minimaliseren. Hierdoor werd een afweging tussen lagere risico's voor een kleinere groep en hogere risico's voor een grotere groep boeren uitgesloten. Andere belanghebbende partijen dan de irrigatiedienst waren gewoonlijk niet op de hoogte van het beschikbare water aanbod. Dus deelden ze ook niet in de verantwoordelijkheid van de gerelateerde risico's.

In tegenstelling tot de algemene opvatting bleek de bepaling van zowel de vraag naar water, als de water allocatie en de regulatie, in alle case studies vraag-gestuurd te zijn. Deze besluitvormingsprocessen werden vrijwel geheel aan de uitvoerende staf overgelaten. Staf op hogere hiërarchische niveaus maakten water schema's op basis van theoretische berekeningen die geen rekening hielden met relevante invloeden, zoals de vereiste inspanningen door staf en boeren om hoge water efficiëntst te bereiken. De schema's hadden daarom zelden enige praktische waarde voor de implementatie van de water allocatie en regulatie.

Staf op hogere hiërarchische niveaus probeerden daarbij hun eigen inspanningen in deze besluitvormingsprocessen te minimaliseren. Alleen bij klachten van boeren en politici raakten ze betrokken bij de besluitvorming. Om klachten te voorkomen stonden ze toe dat staf van lagere hiërarchische niveaus in de vraag naar water voorzagen door een overvloedig debiet in alle kanalen (voorzover voorradig). De hoofdkanalen bleken dus vaak het maximale debiet te vervoeren. Er was geen systematische controle op deze besluitvorming in de case studies, aangezien de vraag-gestuurde besluitvormingsprocessen dit niet behoefden.

De minimale betrokkenheid van de staf van de irrigatiediensten bevoordeelde de boeren aan de bovenstroomse gedeelten van de kanalen. De boeren aan de benedenstroomse gedeelten hadden vaak problemen om voldoende water te bemachtigen, aangezien de ontwerp debieten van de kanalen meestal te klein waren voor de geobserveerde ruime water allocatie.

De regulatie van de water stromen door de hoofdkanalen bleek een "adhocratie". De uitvoerende staf bleek geen "als...dan..." instructies te krijgen voor bedieningsmethoden en werkwijzen in termen van een bepaalde tijd, duur en grootte van stroomfluctuaties. Dus werkten ze volgens de methode van vallen en opstaan. Het irrigatie areaal onder hun directe verantwoordelijkheid werd daarbij meestal bevoordeeld t.o.v. benedenstroomse arealen teneinde de klachten te minimaliseren. Ook de uitvoerende staf verantwoordelijk voor de benedenstroomse arealen konden deze bevoordeling niet systematisch corrigeren. Voor hen was het aanvragen van een vergroting van het totale debiet in het hoofdkanaal de makkelijkste uitweg.

Een verhoging van het debiet naar het eind van het kanaal bleek alleen mogelijk door ofwel een verhoging van het algehele debiet, ofwel, indien mogelijk, door een rotatie van water of een spreiding van de begindatum van de cultivatie (wanneer de vraag naar water het grootst is). Invoering van de laatste twee maatregelen vereisten echter een verhoogde inspanning door hogere hiërarchische niveaus en gebeurde alleen indien er klachten kwamen van een invloedrijke partij zoals (een deel van) de boeren, superieuren en politici.

De bovenstaande processen werden voornamelijk veroorzaakt door een lage motivatie van de bij de benutting van capaciteit betrokken staf. De lage motivatie werd veroorzaakt door de volgende "negatieve" factoren: boeren waren nooit tevreden; geen financiële, carrière of andersoortige prikkelingen om te presteren in de levering van water; het voortdurende risico van politieke inmenging; en professionele en financiële prikkelingen in het belang van de constructie en het onderhoud in plaats van de benutting van de capaciteit. Ook de irrigatiediensten in hun geheel hadden geen prestatie-georienteerde prikkelingen, anders dan de genoemde negatieve.

Sommige van bovenstaande praktijken, motivatie en prikkelingen golden meer voor het ene land dan voor het andere. In Marokko waren de management praktijken van een hoger niveau in vergelijking met de andere case studies en sommige van de voornoemde generalisaties gingen niet op voor Marokko. De aan prestatie gerelateerde motivatie en prikkelingen bleken hoger door een meer hoogstaand management, dat verbruikt water per individuele boer in rekening brengt, en dat water volumetrisch levert aan boeren. Echter, ook in Marokko bleken de irrigatiediensten geen stimulansen te hebben om de water allocatie en regulatie in het hoofdkanaal te besturen teneinde overduidelijke en voor hen bekende water verspilling te voorkomen.

Voornaamste aanbevelingen. De verbetering van de capaciteitsbenutting zou in alle case studies een verhoging vereisen van de inspanningen van de staf op hogere hiërarchische niveaus. Dit vereist dat zij, evenals de uitvoerende staf, meer gemotiveerd worden voor dit soort werk. Dit lijkt onwaarschijnlijk zolang de irrigatiediensten als geheel niet meer geïnteresseerd in en aanspreekbaar voor hun prestaties in de levering van water zouden worden.

De over het geheel genomen aanbevolen richtingen van organisatie verandering waren, vanuit het oogpunt van een betere capaciteitsbenutting, de volgende:

1. Een decentralisatie van de irrigatiediensten. Dit zou grotere informatie uitwisselingen op lagere hiërarchische niveaus tussen boeren en dienst, en tussen verschillende hiërarchische niveaus mogelijk maken;

2. Een financiële afhankelijkheid van de irrigatiedienst van de prestaties in de levering van water. Dit zou een aanspreekbaarheid voor deze prestaties introduceren. Bijvoorbeeld door een duidelijke relatie met de betalingen voor

geleverde diensten door boeren. Meer financiële onafhankelijkheid van de irrigatiediensten betekent ook een verminderde afhankelijkheid van de willekeurige budgettaire toewijzingen door de overheid;

3. Een meer prestatie-georiënteerd personeelsbeheer, zoals prestatie-gebaseerde beloningssystemen en carrière ontwikkeling, speciaal voor hogere hiërarchische niveaus. Dit zou een decentralisatie van de gerelateerde bevoegdheid van de centrale overheid naar de irrigatiediensten vereisen;

4. Een meer expliciete en specifieke definiëring van de missie van de irrigatiedienst;

5. Externe openbare controle voor een betere verantwoording (als geen financiële of andere verantwoording naar de klant bestaat);

6. Meer doorzichtigheid en dus aanspreekbaarheid voor de prestaties in de water regulatie door een afzonderlijke, centrale "regulatie eenheid";

7. Als gekozen is voor een rol van water gebruikers' groepen in de besluitvorming dan zal waarschijnlijk een machtigere positie voor hen in de watergerelateerde besluitvormingsprocessen nodig zijn dan werd waargenomen in alle case studies. Dit zou bereikt kunnen worden door meer bestuurlijke macht, ofwel door financiële verantwoording aan de water gebruikers en/of hun groepen. Een verdergaande stap als de eigendomsoverdracht van (een gedeelte van) het systeem (en mogelijk de dienst) zou de collectiviteit van boeren nog sterker maken om de dienst aan te spreken op zijn prestaties in de capaciteitsbenutting;

8. Betere overheidsregelingen en gerelateerde uitvoering zijn nodig om de geobserveerde afwijkende motieven in sommige meer zelfstandige irrigatiediensten in te perken;

Gezien de betrokken belangen van de diensten, hun staf en de boeren, lijken de bovenstaande veranderingen alleen haalbaar indien ze serieus gesteund worden door de nationale politici en de belangrijkste financieringsorganisaties.

RESULTATEN: HET SCHEPPEN VAN CAPACITEIT

De gewenste investeringsdoelstellingen. De besluitname over gewenste investeringsdoelstellingen bleek vaak alleen door politici te gebeuren. De voorbereiding van zulke besluiten gebeurde gewoonlijk door de staf van de financieringsorganisaties met steun van consultants en staf van de irrigatiedienst. Deze voorbereiding liet gewoonlijk weinig tijd en beslissingsruimte over voor interactie met andere belangengroepen.

Politici bepaalden dus vaak politiek relevante doelstellingen als de project situering en de selectie van begunstigden. In sommige gevallen bleek de politieke druk de professionele begeleiding van zulke besluiten ineffectief te maken.

Het verkrijgen van externe financiering bleek de belangrijkste wenselijkheid in deze besluitvorming voor zowel politici als de irrigatie dienst. Het overheerst de andere gewenste investeringsdoelstellingen, anders dan de politiek relevante. Ten gevolge van deze politieke prioriteit voor externe financiering bleek de financieringsorganisatie, in principe, en in de praktijk, een grote invloed te hebben op de bepaling van de wenselijkheid van de investeringsdoelstellingen. Dus, de wenselijkheid van zulke investeringsdoelstellingen als de project grootte en de prestaties van de levering van water en agrarische produktie was in alle case studies voornamelijk een discretie van de staf van de financieringsorganisatie of consultant.

Hierdoor werd het waarschijnlijk, en werd ook waargenomen, dat de belangen van de boeren en andere lokale instanties onvoldoende vertegenwoordigd waren in de besluitvorming over de gewenste investeringsdoelstellingen. Vaak werd de wenselijkheid vanuit het oogpunt van de boer gelijk verondersteld met de maximale financiering, aangezien de investeringen vaak werden gezien als politieke giften aan lokale kiezers.

Gecombineerd met de waargenomen aanbod-gestuurde beschikbaarheid van financiële middelen voor irrigatie investeringen, belemmerden deze door de politiek gedomineerde besluitvormingsprocessen en de gerelateerde attitudes, een mogelijke keuze voor minder kapitaalintensieve, meer effectieve investeringen in bijvoorbeeld water beheer en conservering. Dit gold voor alle case studies.

Echter, het belangrijkste hiaat dat werd waargenomen in deze besluitvorming leek de afwezigheid van een expliciete definitie van de gewenste prestatie niveaus voor de nieuwe investeringen. De wijdverspreide en langdurige ervaringen met onderbenutting van irrigatiecapaciteit maakte deze afwezigheid des te opmerkelijker. Zelfs als de financieringsorganisaties, overheden of consultants zich bewust waren van de onwaarschijnlijkheid van het behalen van de aannames ten aanzien van de prestatie niveaus voor specifieke systemen of projecten, dan nog werden zulke overwegingen niet meegenomen in de investeringsselectie en ontwerp. Aannames ten aanzien van de beoogde prestaties werden in alle case studies impliciet gehouden.

De waarschijnlijke betrokkenheid van de betreffende partijen als de nationale politici, overheden en irrigatiediensten tot de impliciet gedefinieerde prestatie doelen was vrijwel nihil (behalve voor de weinigen die daartoe intern gemotiveerd waren). Zeker gezien de afwezigheid van enige prikkeling om die doelen te halen, en de aanwezigheid van prikkeling om zoveel mogelijk externe financiering te verwerven en te besteden (in een omgeving gedomineerd door een schijnbaar overvloedige beschikbaarheid van financiële middelen voor irrigatie investeringen). In alle case studies bleek de motivatie en betrokkenheid voor prestatie verbeteringen vrijwel afwezig bij de genoemde partijen. De wijdverbreide onderbenutting van irrigatiecapaciteit in het verleden scheen niet tot betere voorwaarden jegens de kwaliteit van daaropvolgende investeringsbesluiten geleid te hebben. De onderliggende reden lijkt het conflict tussen de kwaliteit van de investeringsbesluiten en de geld-overhevelende functie van de financieringsorganisaties, dat wil zeggen met hun bestedingsdrang.

De haalbare investeringsdoelstellingen. De overvloedige beschikbaarheid van financiële middelen voor irrigatie investeringen leek vooral veroorzaakt door het karakter van de haalbaarheids- en beoordelingsstudies. In alle case studies bleken deze studies te gebeuren nadat het politieke besluit al genomen was om het project te ondernemen. De verschillende stappen en methodologiën bleken slechts te dienen ter rechtvaardiging van het besluit. De haalbaarheid van alternatieve typen projecten, project situeringen, of een meer gefaseerde ontwikkeling om dezelfde resultaten te behalen, was in alle case studies niet bestudeerd.

De besluitvoorbereiding van de haalbaarheid bleek voornamelijk de taak van de staf van de financieringsorganisaties en consultants. Soms omdat zij werden verondersteld meer onafhankelijk te zijn dan staf van het betreffende land of irrigatiedienst, in andere gevallen omdat ze vertragingen in de uitbetalingen van de leningen zouden kunnen voorkomen. Echter, het bleek erg moeilijk tot onmogelijk voor die externe partijen om de waarschijnlijke haalbaarheid te bepalen, vooral met betrekking tot de veronderstelde prestatie verbeteringen. De staf van de betreffende irrigatiedienst en overheid vertegenwoordigden over het algemeen het gevestigde belang om de financiering te realiseren. Het was daarom onwaarschijnlijk dat ze informatie zouden verschaffen dat die belangen zou kunnen schaden. In de weinige waargenomen gevallen waar ze daartoe bereid waren, bleek het ze meestal ook niet gevraagd te worden. Ook de staf van de financieringsorganisaties en de consultants, gestimuleerd door de doelen van hun eigen organisaties, bleken niet geïnteresseerd in een volledig objectieve besluitvorming.

De aannames met betrekking tot de prestatie verbeteringen en andere optimistische aannames werden dus niet verdedigd en werden impliciet gehouden. De kosten-baten en gevoeligheids analyses werden in geen van de case studies toegepast om onhaalbaarheid te bepalen. Ze leken daarom hun oorspronkelijke functie van een objectieve bepaling van de haalbaarheid van een investering verloren te hebben. In plaats daarvan werden ze gebruikt om irrigatie investeringen te subsidiëren.

De geobserveerde financieringsorganisaties bleken opmerkelijk weinig ondernomen te hebben om de neiging tot een te groot optimisme over de haalbaarheid in te perken. In plaats van expliciete bewijzen te eisen voor de veronderstelde prestatie verbeteringen werd in de geobserveerde ontwikkelingsbanken alleen een tegenwicht geboden in de vorm van de milde "peer reviews". Deze vergaderingen werden gewoonlijk voorgezeten door personen die primair verantwoordelijk waren voor de hoeveelheid leningen, in plaats van voor de kwaliteit van de investeringsbesluiten.

In alle case studies werden de prestatie doelen van de investeringen impliciet vastgelegd tijdens de haalbaarheidsstudies en beoordelingen, en daarmee vooral gestuurd door de staf en prioriteiten van de financieringsorganisaties. Betrokkenheid tot en bewustzijn over, die doelen van de kant van de nationale overheid en irrigatiediensten was laag tot afwezig.

Rechtvaardigingen waarom een bepaalde investering niet weer zou mislukken waren meestal conceptueel en niet gerelateerd aan de realiteit. De verschillende conceptuele benaderingen zijn de afgelopen jaren ontwikkeld om het management hiaat op te vullen (zoals de parallelle veldkanalen, het on-farm water beheer, de operationele en onderhoudshandboeken, water beheer consultants, boeren participatie, en controle en evaluatie). Echter deze verplichtten de irrigatiedienst en overheid niets ten aanzien van kwesties als hun prestaties en aanspreekbaarheid daarover. In feite vergroten de genoemde oplossingen de invloed van de financieringsorganisaties in de feitelijke investeringsplanning en ontwerp. Ook hierdoor voelden de irrigatiediensten zich in toenemende mate niet meer verantwoordelijk voor de kwaliteit daarvan, noch voor hun succes in de capaciteitsbenutting. Opeenvolgende conceptuele oplossingen, vastgesteld in een door de financieringsorganisaties gedomineerde besluitvorming, leken te hebben geleid tot een steeds verder afbrokkelende betrokkenheid van de staf van de irrigatiediensten met de werkelijke haalbaarheid van die conceptuele oplossingen.

Een logisch en gerelateerd effect van de waargenomen manipulatie van de aannames met betrekking tot de economische interne rentevoet was de vanuit het nationaal oogpunt afnemende controle over de kapitaaluitgaven. In geen van de case studies bestonden maxima voor de investering per water gebruiker, per eenheid toename in agrarische produktie, per volume eenheid opgeslagen of gereguleerd water, per gecreëerde arbeidsplaats, of per geïrrigeerd oppervlak. Dus werden die maxima alleen gebaseerd op politieke overwegingen. Dit leidde tot een maximaliserende houding van irrigatiediensten en politici bij het verwerven van financiering--en tot aanzienlijke economische verliezen voor het land als geheel voor zowel de huidige als in toekomstige generaties.

De functionele eisen t.a.v. investering. Net zoals voor de haalbaarheids- en beoordelingsstudies werd ook voor de besluitvorming over de functionele eisen van het ontwerp in alle case studies waargenomen dat dit alleen op een conceptueel niveau plaatsvond. Ingenieurs van financieringsorganisaties, consultants en irrigatie diensten tezamen bepaalden deze ontwerp concepten en herzagen ze regelmatig. Echter, in geen van de case studies werd interactie met de aanwezige systeem managers of boeren waargenomen teneinde een expliciet "programma van eisen" voor de investering te bepalen.

De resulterende rigide toepassing van verschillende blauwdrukken voor het ontwerp, zonder voldoende informatie over de lokale situatie, bleek wijdverspreid. Het leidde tot ontwerpfouten zoals vrijwel willekeurige groottes van de tertiaire vakken, vaak willekeurige plaatsing van kunstwerken, ontwerp voor ongeschikte bodems en gewaspatronen, en het suboptimaal gebruik van reeds bestaande reservoirs en drainage patronen. Ook tijdens het ontwerp bleek misbruik van de theoretische formules voor de waterbehoefte van het gewas meer gebruik dan uitzondering. Opeenvolgende bepalingen konden inconsistent zijn zonder enige rechtvaardiging. De ontwerpen werden aldus aangepast aan de voorgaande optimistische aannames voor de haalbaarheids- en beoordelingsstudies. Ook politieke inmenging kwam nogal eens voor in de besluitvormingsprocessen over het ontwerp.

Alhoewel er in de literatuur een behoorlijke oppositie kon worden gevonden tegen het gebruik van blauwdrukken voor het ontwerp, pasten alle bestudeerde financieringsorganisaties ze toe. Van hun kant leek het voordeel van conceptuele ontwerpen dat ze kwesties als de prestaties in de dienstverlening en in de besturing van besluitvormingsprocessen konden omzeilen, terwijl ze toch een "oplossing" hadden.

Tot op zekere hoogte was men zich in alle case studies bewust van het niet functioneren van de ontwerpen. Echter, in het algemeen ging de voorkeur uit naar het verkrijgen en besteden van investeringsfondsen op de korte termijn, ook al ging dat ten koste van de prestaties op de midden en lange termijn. De constructie en politieke prioriteiten in de irrigatiediensten overheersten over het algemeen de prestatie-gerelateerde argumenten, en belemmerden mogelijke veranderingen naar een meer realistisch professionalisme. Een behoorlijke politieke verantwoordelijkheid leek nodig om zulke processen te keren. Door de tijd genomen leek het irrigatie ontwerp te zijn geëvolueerd tot een nogal routineus, weinig creatief proces.

Het bewustzijn hoe de huidige ontwerp concepten zich over de tijd hebben ontwikkeld bleek daarbij te vervagen bij de jongere generaties irrigatie ingenieurs. Wetenschappelijke ontwerp concepten bleken meestal geinternaliseerd en de functionaliteitsvraag werd meestal niet eens gesteld.

De invloed van de staf van financieringsorganisaties en consultants op de formulering van deze concepten bleek aanzienlijk. Alhoewel de supervisie door staf van de financieringsorganisaties beperkt was--zij bezochten een project meestal slechts een maal per jaar--bleken zij toch meer verantwoordelijk voor de rechtvaardiging en succes van de investering, en dus voor het ontwerp concept, dan de staf van de lokale irrigatiedienst of overheid. Om ofwel nieuwe leningen te rechtvaardigen, ofwel om bestaande te continueren, moesten de staf van donors en consultants met oplossingen komen voor het mislukken van eerdere investeringen. Het conceptuele karakter van deze oplossingen bleek vaak het gevolg van hun onbekendheid met de werkelijke lokale situatie betreffende de instituties, boeren en fysieke condities. Van hun kant waren de waargenomen lokale partijen geneigd om in te stemmen met vrijwel elke voorgestelde oplossing, zolang als zij zelf niet verantwoordelijk of aanspreekbaar voor de prestaties werden. De werkelijke functionaliteit van het ontwerp bleek vaak een ondergeschikte kwestie voor overheid, diensten, consultants en financieringsorganisaties.

De zichtbaarheid van kapitaalintensieve irrigatie investeringen blijft waarschijnlijk politiek aantrekkelijk. Deze politieke druk was waarschijnlijk een belangrijke reden voor de pogingen van de geobserveerde financieringsorganisaties om de blauwdrukken voor het ontwerp voortdurend te veranderen en minder dogmatisch te maken. Hierdoor werden steeds nieuwe oplossingen verzonnen als rechtvaardiging voor nieuwe investeringen. De tragedie van zulke donor-gestuurde conceptuele oplossingen was echter dat, hoe gepast die ontwerp concepten ook konden zijn, ze bleken te leiden tot een steeds verdergaande medeverantwoordelijk van de financieringsorganisaties voor de prestaties van de ontwerp concepten, aangezien ze steeds meer hun intellectuele eigendom werden. Vooral ook gezien de al genoemde afwezigheid van aanspreekbaarheid van de irrigatiediensten voor de functionaliteit van hun ontwerpen, en hun prestaties in de levering van water.

Vanouds werden irrigatie arealen proefondervindelijk ontwikkeld dat wil zeggen met vallen en opstaan. Ondanks het meer recente conceptuele karakter van irrigatie ontwerpen lijkt de werkelijke areaal ontwikkeling nog steeds op die manier te gebeuren. De vroege pioniers experimenteerden op kleine schaal alvorens hun ontwerpen op grotere schaal toe te passen. Tegenwoordig echter lijkt de overvloedige beschikbaarheid van financiële middelen voor irrigatie investeringen toe te staan dat op grote schaal geëxperimenteerd wordt, en dus dat op grote schaal fouten gemaakt worden.

Van die grootschalige fouten lijkt niet echt te (kunnen) worden geleerd, aangezien de aannames over de functionaliteit van een ontwerp altijd impliciet bleven. Idealiter zou het ontwerp moeten starten met een bepaling van een betaalbaar en haalbaar "programma van eisen" en niveau van dienstverlening dat met de investering gehaald kan worden. Zulke besluitvorming was afwezig in alle case studies.

Voornaamste aanbevelingen. Een verbetering van het scheppen van capaciteit zou in alle case studies een verhoogd niveau van management inbreng door hogere hiërarchische niveaus vereisen. Dit zou ook vereisen dat zij, evenals de veld staf, beter gemotiveerd worden voor de kwaliteit van die besluiten. Dit leek onwaarschijnlijk zolang de irrigatiediensten zelf niet meer geïnteresseerd in en aanspreekbaar werden voor de kwaliteit van hun investeringsbesluiten en de uiteindelijke prestaties gedurende de benutting van de capaciteit. De over het geheel genomen aanbevelingen met betrekking tot veranderingen in de irrigatie organisaties waren, vanuit het oogpunt van een betere schepping van capaciteit, de volgende:

1. Een directe relatie tussen de financiële inkomsten van de irrigatiedienst en de kwaliteit van de capaciteitsscheppende besluiten, en de uiteindelijke prestaties gedurende de benutting van de capaciteit. Bijvoorbeeld doordat de irrigatie-

dienst en de boeren deelnemen in de investeringskosten. Ofwel door een krappere financiering door een vermindering van de (in de kosten-baten analyse) verborgen en andere onvoorwaardelijke subsidies. Het laatste kan bereikt worden door, bijvoorbeeld, een vermindering van de misbruik van de kosten-baten analyse door betere controles op alle prestatie-gerelateerde aannames waarop de haalbaarheids- en beoordelingsstudies zich baseren. Ook een expliciete verplichting jegens de veronderstellingen ten aanzien van de prestatie verbetering kan worden geïntroduceerd door, bijvoorbeeld, het consistent gebruik van een "prestatie verantwoordingsbalans" door alle belangrijke financieringsorganisaties;

2. Een decentralisatie van de besluitvorming naar het niveau van de irrigatie dienst of het project. Dit zou het mogelijk maken de capaciteit te vergroten om de besluitvorming te voorzien van informatie over relevante ervaringen, voorkeuren en eisen, zowel in kwalitatieve als kwantitatieve zin. Momenteel bleek veel van die besluitvorming op het zeer centrale niveau van de staf en consultants van de financieringsorganisaties plaats te vinden. (Door een dergelijke decentralisatie kan ook het belang van vooraf, op hoog niveau bepaalde, conceptuele benaderingen afnemen.);

3. Een meer prestatie-georiënteerd personeelsbeheer, bijvoorbeeld door beloningssystemen en carrière ontwikkeling gebaseerd op verrichte prestaties, speciaal voor hogere hiërarchische niveaus. Dit zou een decentralisatie van de gerelateerde bevoegdheden van de centrale overheid naar de irrigatiedienst vereisen;

4. Een meer onafhankelijke status voor de irrigatie diensten, ook financieel, lijkt de beste manier om een verbeterde kosten-effectiviteit en -efficiëntie van irrigatie investeringen te garanderen.

RESULTATEN: PRIORITEITEN VOOR PRESTATIE VERBETERINGEN

Maak prestaties een intern probleem voor de irrigatiediensten. Verbeterde prestaties ten aanzien van de dienstverlening van een irrigatiedienst kunnen alleen worden bereikt door degenen die besluiten nemen, dat wil zeggen door de staf van de irrigatie dienst. Kortdurende inbrengen van externe actoren kunnen zulke prestaties niet garanderen. Prestatie verbeteringen in alle geobserveerde irrigatiediensten vereisten dat de dienst het een zorg van zijn staf maakt om die prestaties te verbeteren. De boven genoemde aanbevelingen zijn voorbeelden van dergelijke maatregelen.

Maak prestaties een lokaal i.p.v. een extern probleem. Het leek onwaarschijnlijk dat deze maatregelen geïnitieerd zouden worden door de geobserveerde irrigatiediensten zolang prestatie verbeteringen niet een probleem voor de dienst zelf waren. Daarom zouden ofwel de nationale overheid, politici of financieringsorganisaties het een probleem voor de irrigatiediensten moeten maken.

Mogelijke maatregelen hiertoe zijn, bijvoorbeeld, het relateren van de financiële inkomsten van de dienst aan de geleverde prestaties; het gebruik van subsidies die niet de neiging van diensten versterken om alleen voor de kwantiteit van de investeringen te gaan (bijvoorbeeld door deelneming in de kosten, vaste uitkeringen, of door proportionele subsidies); de vermindering van verborgen en andere onvoorwaardelijke subsidies; een hogere kwaliteit van besluiten ten aanzien van de investeringsbeoordeling; meer objectiviteit jegens de hoeveelheid investeringen van de staf van de financieringsorganisaties; de zelfstandige ontwikkeling van investeringsvoorstellen door de irrigatiedienst; en een externe "audit van de levering van water" als geen financiële of andere aanspreekbaarheid bestaat. Kwesties van aanspreekbaarheid en prestaties zouden een serieus agenda punt moeten worden in de zogenaamde "beleidsdialogen".

Laat de financieringsorganisaties voorzichtige bankiers worden, die financiële risico's lopen voor de prestaties van hun investeringsbeslissingen. Zoals gezegd vereisten prestatie verbeteringen van een irrigatiedienst dat de nationale overheid, politici of financieringsorganisaties deze verbeteringen een verantwoordelijkheid van de dienst zouden maken. Echter, de bestudeerde financieringsorganisaties bleken voornamelijk aanspreekbaar voor de kwantiteit van de investeringen, en niet voor de kwaliteit van hun investeringsbeoordelingen.

Mogelijke maatregelen om de kwaliteit van de investeringsbeoordelingen een verantwoordelijkheid van de financieringsorganisaties en hun staf te maken zijn, bijvoorbeeld, meer financiële doorzichtigheid en risico deling door donoren. Dit kan bereikt worden door bijvoorbeeld directe kredietlijnen naar de irrigatiediensten in plaats van naar centrale overheden. Irrigatiediensten bleken zelf nooit aangesproken te worden voor (gedeeltelijke) terugbetaling van de leningen voor irrigatie investeringen. Ook kunnen de financieringsorganisaties ten opzichte van hun Board of Governors aanspreekbaar gemaakt worden voor de kwaliteit van hun investeringsbeoordelingen door het vergelijken van de oorspronkelijk beoordeelde en uiteindelijke behaalde prestaties van de investeringen (in plaats van voor de zogenaamde professionaliteit van de staf en de kwantiteit van de investeringen). Ook zouden de financieringsorganisaties als geheel aanspreekbaar gemaakt kunnen worden voor hun succes in het faciliteren van prestatie verbeteringen. Concluderend, om irrigatiediensten en overheden meer prestatie-georiënteerd te maken zouden de financieringsorganisaties zich moeten beperken tot bankieren, en de kwaliteit van investeringsbeoordelingen moeten laten prevaleren boven de bestedingsdrang.

Bestuur en organiseer teneinde bevredigende prestaties in de levering van water te behalen. Indien de voornoemde aansprakelijkheid geintroduceerd zou kunnen worden, dan nog kan het moeilijk zijn om hogere niveau's van perfectie te behalen in de besluitvormingsprocessen. De aanbevelingen van deze studie bevatten om die reden verscheidene specifieke regiserende besluiten die beogen om op prestatie gerichte eisen te ontwikkelen, introduceren en beheersen in de besluitvorming over het scheppen en benutten van capaciteit.

EVALUATIE

De toepassing van de besturingsbenadering had de volgende voordelen. Elke expliciete benadering vergemakkelijkt een gerichte data verzameling en analyse. Verdere bijdragen van de gebruikte besturingsbenadering waren: het bevorderen van een consistente analyse van de processen; de dwang om zo objectief mogelijk de functionaliteit van de verschillende disciplinaire benaderingen in de besluitvormingsprocessen te analyseren; de dwang om het complete scala van belangrijke besluiten ten aanzien van het primaire proces, de levering van water, in beschouwing te nemen; het daardoor inzien van het belang van andere processen dan de in de irrigatie gebruikelijke relatie tussen ontwerp en capaciteitsbenutting; en de integrale kijk op prestaties, besluitvormingsprocessen, management condities en de regie.

Nadelen van het werken met de besturingsbenadering waren dat het in het begin moeilijk was om consistent processen en condities te scheiden, en dat door de systematische toepassing op alle belangrijke besluitvormingsprocessen en management condities herhaling in analyse en presentatie onvermijdelijk was. Die nadelen lijken geen grote belemmering te zijn voor toepassing van de benadering door anderen. Die anderen kunnen onderzoekers of management specialisten zijn. Maar ook een irrigatie manager zou de onderlinge verbanden van de besturingsbenadering (zoals eerder weergegeven in de figuur) kunnen gebruiken voor een andere kijk op het eigen werk.

Vooruitzichten voor praktische toepassingen van de bestuursbenadering in de irrigatie zijn allereerst als checklist van relevante aandachtsgebieden van irrigatie op de hiernavolgende manieren: een systematische bewustmaking van de management aspecten van irrigatie; een systematische ontwikkeling van onderzoeksvragen of van handboeken ten aanzien van de capaciteitsbenutting; en een professionalisering van ex-post evaluaties en effectiviteitsstudies van irrigatie investeringen. Ook het concept van de bestuurstechnische niveaus van perfectie zou gebruikt kunnen worden als een prestatie indicator voor de besturing van irrigatie systemen en biedt daartoe de volgende mogelijkheden: om systematisch mogelijkheden voor verbetering te identificeren, om kwantitatief verbeteringen in de besturing voor en na innovaties te bepalen, en om door vergelijkend onderzoek normen te ontwikkelen voor de prestaties in het irrigatie beheer voor verschillende socio-economische en fysieke situaties.

Aanbevelingen ten aanzien van prioriteiten voor toekomstig onderzoek naar de onderbenutting in de irrigatie subsector die voortkomen uit deze studie relateren vrijwel allemaal aan de volgende maatregelen om de aanspreekbaarheid over de prestaties in de levering van water te vergroten:

1. onderzoek naar specifieke methoden en technieken van besturing van de besluitvormingsprocessen die naar alle *waarschijnlijkheid* de aanspreekbaarheid voor prestaties inbrengen in de financiering van irrigatie;

2. onderzoeken van het waarschijnlijke potentieel voor prestatie verbeteringen in verschillende landen en regio's (Zulke schattingen zouden dan gebruikt kunnen worden als realistische investeringsnormen per eenheid oppervlak. Dergelijke normen zouden verborgen subsidies in toekomstige investeringen kunnen voorkomen, maar zouden ook kunnen bijdragen aan een meer realistische economische en financiële waarde van de besturings prestaties);

3. onderzoek naar de kosten-effectiviteit en -efficiëntie van het (gedeeltelijk) in kosten brengen geleverd water in systemen met veel kleine boeren; en

4. onderzoek naar aangepaste kunstwerken voor volumetrische metingen van de levering van water in systemen met veel kleine boeren.

Echter, er is al veel onderzoek naar irrigatie beheer gedaan. Prestatie verbeteringen in de irrigatie subsector lijken daarom meer af te hangen van de toepassing van de beschikbare kennis voor veranderingen van het huidige irrigatie beheer dan van meer onderzoek.

Curriculum Vitae

Charles Nijman, born in 1960 in Rijswijk (The Netherlands), studied from 1978 to 1985 at the Wageningen Agricultural University in The Netherlands. He graduated as an agricultural engineer in tropical land and water use with majors in management science and irrigation.

Since 1985 he worked as a staff member for the Dutch Ministry of Foreign Affairs (1985-1986), and as a researcher for the Food and Agricultural Organization (FAO) of the United Nations in Burkina Faso, West Africa (1986-1987).

In 1987 he joined the International Irrigation Management Institute (IIMI) on secondment from the Dutch Ministry of Foreign Affairs to work on management issues in the irrigated subsector. Initially, he conducted in-depth organizational analyses of two Sri Lankan irrigation agencies from 1988 till 1990. These were published as IIMI Country Papers. From 1990 to 1992 he conducted and reported on comparative case studies in Sudan, Morocco and the Philippines, and less intensive studies in Malaysia and India. These studies form the basis for this thesis. During his assignment at IIMI he assisted also in training needs, management training and strategic planning exercises in Malaysia.

In September 1992 he joined GITP International/Management Consultants B.V. in Nijmegen, The Netherlands.