

Improving Research Management:

**Institutionalization of Management Information
Systems in National Agricultural Research
Organizations in Sub Saharan Africa.**

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Improving Research Management:

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Abstract

Agricultural research management in the public sector in Sub Saharan Africa suffers from a lack of relevant, timely and accurate information on which to base decision-making. Developments in Management information systems over the past several years have been dramatic and can offer research managers in developing countries a great deal of help in the orderly capture, processing and presentation of information for decision-making. This thesis describes case study research on institutionalization of a MIS in National Agricultural Research Organizations in Sub Saharan Africa. Full MIS institutionalization is defined as the continuous and integrated use of MIS by NAROs' staff for data collection, and data processing into information and decision-making in NAROs' research management processes. The MIS software package INFORM (Information for Agricultural Research Management) was designed and developed by ISNAR (The International Service for National Agricultural Research) in the early 1990s in collaboration with developing countries' NAROs and implemented in several countries in Africa, Asia and Latin America.

The institutionalization of the latest version INFORM-R and INFORM- Light in the annual research management cycle of priority setting, planning, budgeting, monitoring, evaluation and reporting of Sub Saharan African NAROs was found to be inadequate. Issues such as data collection and use, adequacy of the MIS software packages, leadership, information management capacity, organizational structure etc. were initially considered as problem factors. The goal of the study is to get insight into factors affecting positively and negatively institutionalization and the continuous and integrated use and maintenance of the MIS in NAROs in Sub Saharan Africa. The objectives are fourfold: to evaluate the extent of institutionalization, to identify factors that promoted (critical success factors) and frustrated (critical failure factors) institutionalization, to evaluate the contribution of MIS to agricultural research management, and to recommend a method of working for institutionalizing MIS.

Based on the goal and objectives, we attempted to answer three questions: (1) to what extent is MIS institutionalized in Sub Saharan African NAROs? (2) What key factors promoted (critical success factors) and frustrated (critical failure factors) institutionalization of the MIS in Sub Saharan African NAROs? (3) How does institutionalization of MIS improve research management and performance of Sub Saharan African NAROs? Based on our literature review, a causal model for MIS institutionalization was developed and used to design a questionnaire and face-to-face interviews in four countries (NAROs) in Sub Saharan Africa: CSIR Ghana, DRD Tanzania, NARO Uganda and ZARI Zambia. Quantitative and qualitative data were collected from managers and researchers in these NAROs. The quantitative data were analysed by statistical means, frequency, correlation and regression in SPSS, and the qualitative data were analysed using (a self designed) MIS institutionalization database.

Regarding the question on critical factors of success and failure, we conclude that leadership involvement is the most important critical success factor that strongly and significantly correlates with institutionalization of MIS in Sub Saharan African NAROs. This implies that the more NAROs' leaders (especially the Director General, Permanent Secretary or Minister of Agriculture) get involved in the institutionalization of MIS, the greater the chance of success. Other critical factors such as adoption, adaptation, government support, ICT Infrastructure, organizational structure and culture, and transparency in information sharing also contribute to the success of institutionalization. The major critical failure factors that frustrate institutionalization are lack of funds, user resistance to change and lack of MIS policy/strategy guidelines. Based on these results an impact model for institutionalization has been designed.

Considering the results of the question on how MIS improved research management, we conclude that MIS enables NAROs to organize their data and generate information for timely decision-making on their annual research management cycle. Annual reports generated from MIS improve NAROs internal performance, in terms of NAROs being able to show accountability, relevance and sense of continuity to their stakeholders and beneficiaries. Website publications generated from MIS improve NAROs external performance, in terms of NAROs being able to show their achievements to the world. With respect to the results of the question on the extents of institutionalization, we conclude that MIS is still not fully institutionalized in Sub Saharan African NAROs. Zambia and Uganda NAROs scored high while Tanzania and Ghana NAROs scored low. We therefore strongly recommend that the Zambian and Ugandan NAROs can serve as benchmarks of good practices to other NAROs in Sub Saharan Africa wishing to introduce MIS in their organizations.

Based on these conclusions, we recommend that the Director General, or Permanent Secretary or Minister of Agriculture (depending on the organization structure of a NARO) be the continuous champion of MIS in order to ensure full and continuous institutionalization of MIS in Sub Saharan African NAROs.

The champion should: include MIS in their organizational vision and support MIS policy and strategy development in NARO, allocate special funds for MIS institutionalization, support and spearhead efforts to acquire funds from partners, donors, governments, or clients, participate in the stages of introduction, adoption, implementation, adaptation and institutionalization of MIS and encourage teamwork, support and finance the procurement of ICT infrastructure (especially Local Area Network) and connectivity of NARO headquarters with remote research stations, support MIS training (especially training of institute/station managers and program leaders, reward MIS coordinators and practitioners by promotion or higher degree training, ensure clear link between NAROs and ministries of agriculture and finance so as to enable funds to reach NAROs in a timely fashion.

Finally, the above-mentioned recommendations for a MIS champion and other useful recommendations for research managers at stations/institutes, governments (ministries of agriculture and finance), donors, MIS coordinators, and researchers, were used to design a flow chart model for planning and managing MIS projects in NAROs.

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List of Acronyms

AgSSIP	Agriculture Services Sub-Sector Investment Programme (Ghana)
ARTP	Agricultural Research and Training Program (Uganda)
ASIP	Agricultural Sector Improvement Program (Zambia)
BOT	Board of Trustees
CERES	Research School for Resource Studies for Human Development, Utrecht University, The Netherlands
CFF	Critical Failure Factors
CGIAR	Consultative Group on International Agriculture Research
CSF	Critical Success Factors
CSIR	Council for Industrial and Scientific Research (Ghana)
CTA	Technical Centre for Agricultural and Rural Cooperation (Wageningen, Netherlands).
DANIDA	Danish International Development Agency
DFID	Department for International Development (United Kingdom)
DGIS	Directorate-General International Cooperation (Netherlands)
DRD	Division for Research and Development (Ministry of Agriculture and Food Security Tanzania)
INFORM	Information for Agricultural Research Management
INFORM-R	INFORM Relational Database
INFORM-L	INFORM-R Light
ISNAR	International Service for National Agricultural Research
ISS	Institute of Social Studies at The Hague, The Netherlands
LEI	Agricultural Economics Institute in The Hague.

MGSS	Mansholt Graduate School of Social Sciences
MIS	Management Information Systems
NARO	National Agricultural Research Organization
NARS	National Agricultural Research System
NWO	Dutch Research Council
PME	Planning, Monitoring, and Evaluation
SCRB	Soils and Crops Research Branch (now called ZARI)
SIDA	Swedish International Development Cooperation Agency
SSA	Sub Saharan Africa
TARP	Tanzania Agricultural Research Program
USAID	United State Agency for International Development
WANA	West Asia and North Africa
WOTRO	Netherlands Foundation for the Advancement of Tropical Research (Department of the Dutch Research Council)
WB	World Bank
ZARI	Zambia Agricultural Research Institute

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PART 1 INTRODUCTION AND LITERATURE REVIEW

Chapter 1. Introduction and Background

Agricultural research management in the public sector in Sub Saharan Africa suffers from a lack of relevant, timely and accurate information on which to base decision-making (IFPRI 2002, Ballantyne et. al. 1993, Vernon 1995, Farashahi 1999). Developments in Management information systems over the past several years have been dramatic and can offer research managers in developing countries a great deal of help in the orderly capture, processing and presentation of information for decision-making. A MIS can greatly assist managers in the deployment of resources (researchers, funds, and physical assets) across research projects and programs. To be able to do this successfully, managers and researchers need accurate and timely information on the current resource allocation across research projects, commodities, research stations and Agro-ecological zones etc. This distribution has to be compared with agreed priorities.

Some of the required information is available but in many different and unorganized places. Other information remains uncollected. The effective, efficient and institutionalized use of MIS by agricultural research organizations in Sub Saharan Africa focused on research on commodities consumed by the poor may prove to be a cost-effective route to poverty alleviation and hunger (Vernon, R., 2001). A MIS can be used to monitor research directed to environmental goals in developing countries, such as soil erosion, soil salinity, water and air pollution, zero tillage, pesticide contamination, pesticide-resistant pests, high precision farming techniques like integrated pest management and fertilizer application. A MIS can provide answers to questions like what is the proportion of women in a research project. It can also demonstrate the budget and status of women in research organizations in developing countries.

This thesis presents results of case study research on institutionalization of a Management Information System in National Agricultural Research Organizations in Sub Saharan Africa. The study focuses on the MIS software packages INFORM-R and INFORM-R Light developed by ISNAR in the late 1990s in collaboration with developing countries NAROs and implemented in several countries in Asia, Latin America, WANA region and Sub Saharan Africa.

1.1. NAROs in Sub Saharan Africa

Public service institutions that perform research in agriculture, fisheries, and forestry, agricultural policy and rural development form the NAROs (National Agricultural Research Organizations). NAROs in Sub Saharan Africa originated from botanical gardens created by the colonial powers in the 1950s. In the 1960s NAROs made much progress in increasing yields and production of various crops especially cereals. This was largely because of agricultural research and the use of improved technologies (Beye, 2002). Beye (2002) wrote that increase in food production was because of sustained investment in the agricultural sector especially agricultural research. During this period, first generation resources for managing agricultural research for instance human and physical resources were in place. New buildings were erected and well-trained research personnel were in place to perform research activities. NAROs enjoyed rapid growth in agricultural research and development during 1970 – 1985.

After the independence of most Sub Saharan African countries from colonial powers, research management and maintenance of NAROs was left in the hands of the indigenous research managers. In the late 1980s and early 1990s due to structural adjustment programs and austerity measures Sub Saharan African NAROs experienced decline of public investment in agricultural research (Byerlee 1998). International donors largely supported investment in agricultural research and development in the form of bilateral

and multilateral loans and grants (Roseboom 2002). Donors especially the World Bank, USAID, DGIS, DFID, SIDA, and DANIDA etc, funded a large chunk of agricultural research projects, while governments of Sub Saharan African countries (excluding South Africa) were responsible for paying staff salaries and providing infrastructure (Byerlee 1998).

Apart from the decline in research budgets, NAROs also faced other challenges during this period. Emphasis shifted to accomplishing second-generation targets such as organization and management (Mook 2003). Research management, in other words process management (priority setting, planning, budgeting, monitoring, evaluation and reporting), resource management (staff, funds, facilities and equipment) and information management (data collection, data storage, data processing, information generation and dissemination) were poor in Sub Saharan African NAROs. In a typical Sub Saharan African NARO research activities were often duplicated in the same agro ecological zone (Beye 2002). Information on past and current research activities was lacking. Annual reports were rarely produced. Information on human resources, projects and finance was stored and managed on paper and sometimes these papers get lost as a result of being shifted from one department to the other. ICT infrastructure (computer hardware and software) and information management skills of NAROs staff were inadequate. NAROs managers and researchers were asked to do more with less. Their governments and stakeholders requested them:

- to make their research and development more relevant to farmers and consumers,
- to take on new research priorities that will help in poverty and hunger alleviation,
- to speed-up the generation and diffusion of technology,
- to improve performance of NAROs' staff in terms of quality and quantity of research outputs,
- to involve new partners,

- and to be more accountable for their use of resources for instance human, financial, and physical resources.

To be able to accomplish these tasks, these managers must have good information about research management at their fingertips that they can use when making decisions and managing their organizations. This called for the introduction of an efficient, user-friendly Agricultural Research Management Information System.

1.2. What is a Management Information System?

There is no one generally accepted definition of an MIS. Different authors define MIS according to the direction they wish to focus their books. Lucey (2005) distinguished two focuses of an MIS. There is the production-oriented focus and the decision oriented focus. The production-oriented focus views MIS as a means of producing information either manually or by computer. For example, Alter (2002) defines a computerized MIS as an information system that generates information for monitoring performance, maintaining coordination and providing background information about the organizations' operations. The decision-oriented focus of an MIS views MIS as a means of processing data for decision-making. For example, Lucey (2005) defined an MIS as "a system to observe, capture and convert data from internal and external sources into information and to communicate that information, in an appropriate form, to managers at all levels in all functions to enable them to make timely and effective decisions for planning, directing and controlling the activities for which they are responsible". In this thesis we adopt the definition based on the decision-oriented focus of an MIS, which lays more emphasis on the use of information and not mainly on how it is produced. In this report we sometimes refer to INFORM-R and INFORM-R Light as MIS software or a MIS software package.

1.3. NAROs and MIS

In the 1990s, the International Service for National Agricultural Research (¹ISNAR) collaborated with NAROs staff in several ²countries in Africa, Asia and Latin America to develop and introduce a MIS software package for agricultural research management (INFORM 1990, INFORM-R 1997, INFORM-R Light 1999). The aim of introducing the MIS was to support research-related management decision-making in NAROs. The first version of the MIS software was called INFORM (Information for agricultural research management) (Nestel, & Govert, 1991).

INFORM is a computerized flat file database management information system. It contained data on human resources, research activities and financial resources. INFORM-R and INFORM-R Light (Vernon, R & Webber, H, 2000) were the second and third versions of the MIS software. They are relational database systems that provide easily accessible information at the various stages of the agricultural research management cycle, and on its major processes: priority setting, planning, budgeting, monitoring, evaluation and reporting.

INFORM-R and INFORM-R Light have menu systems that enable research managers and researchers, after training, to interrogate the system to obtain a wide range of information about the research program and its scientists. The information is aggregated at national and station levels. The architecture of INFORM-R Light menu system is as follows:

¹ ISNAR is currently a program of the International Food Policy Research Institute (IFPRI), one of the 15 future harvest institutes of the consultative group on international agricultural research (CGIAR). ISNAR's mandate at the time of this research was to strengthen management, organization and policy in national agricultural research organizations in developing countries. The MIS project at ISNAR was a tool to strengthen research management in NAROs.

² The countries concerned are: Bhutan, Bolivia (PROINPA), Gambia, Ghana, India, Kenya, Mozambique, Philippines, Sudan, Senegal, Sri Lanka, Tanzania, Uganda, Zambia, Mali, Bangladesh, Pakistan and Papua New Guinea.

- Reports: on research activities and researchers (meant for Research Managers and Researchers). The reports are meant for planning, budgeting, monitoring and evaluation of research.
- Data Collection and Capture: (data collection entry forms meant for MIS practitioners and data entry staff),
- Data Management: (meant for MIS national coordinators) (see figure 1.1).

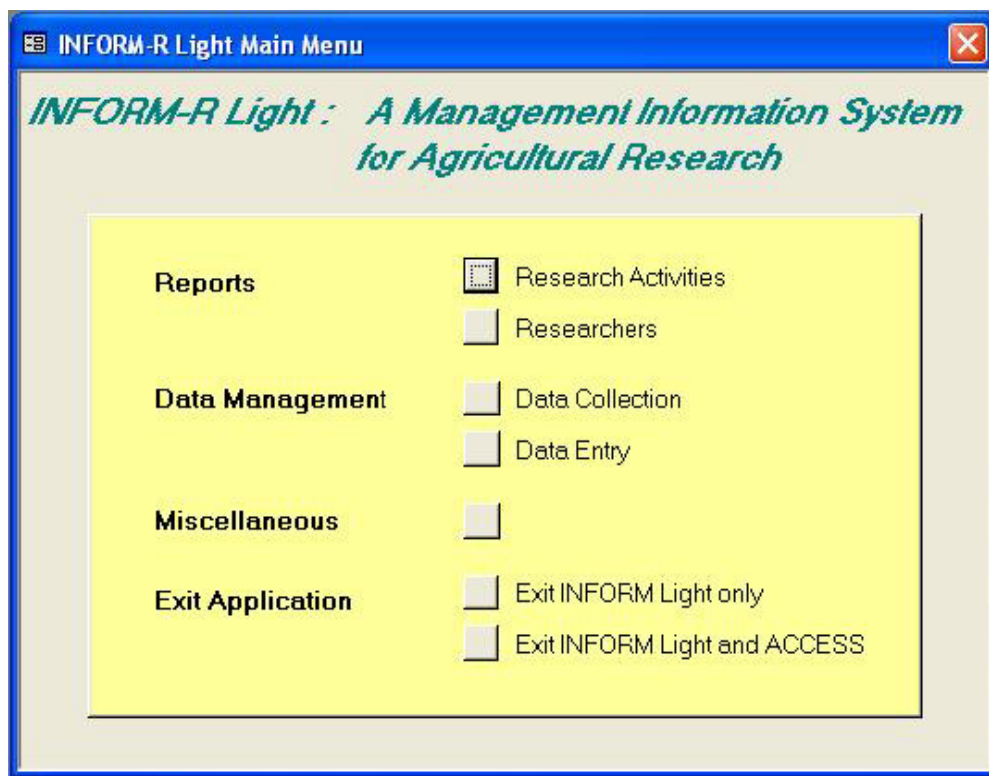


Figure 1.1: INFORM-R Light main menu.

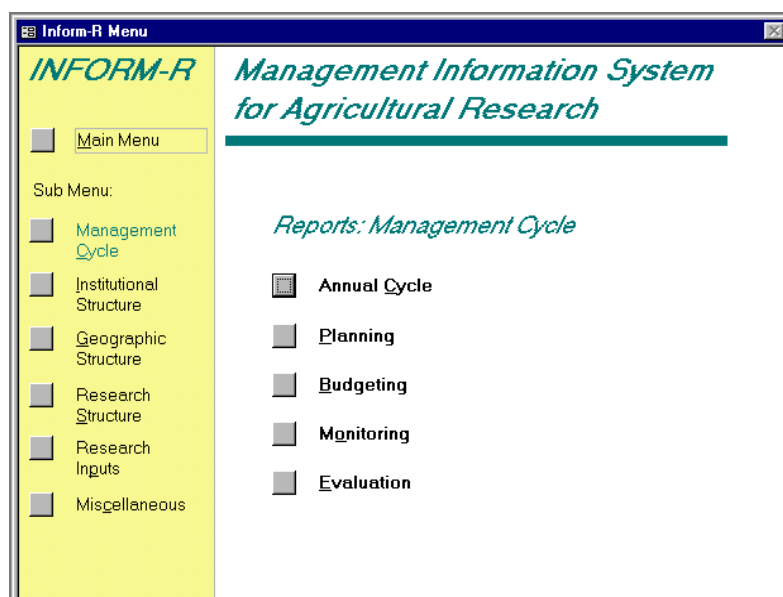


Figure 1. 2: INFORM-R main menu.

INFORM-R main menu provides detailed reports on research management cycle (see figure 1.2).

INFORM-R and INFORM-R Light provide research managers with the information they need about the research systems they manage: information about inputs to research, the research program (experiments) and, finally research outputs (improved technologies, experiment reports, publications). The data is available in aggregate form so that managers are not overburdened by detail, and can interpret this information quickly and decide what action is needed, if any. They can store data related to stages before, during and after the implementation of research activities. They can store research proposals, produce reports for research planning meetings and record the appraisal of proposals. INFORM-R can roll approved proposals into research activities; e.g. Experiments. The systems support planning process by listing proposals in orders such as commodity, commodity groups (see figure 1.3), main discipline, research station and agro-ecological zone.

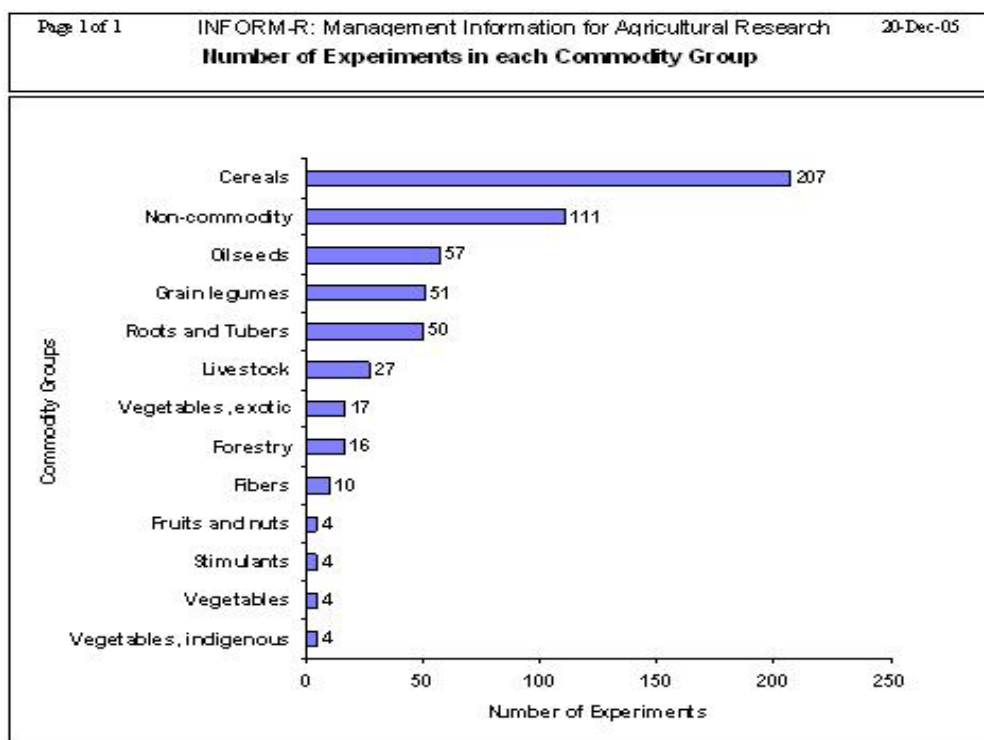


Figure 1.3. Number of Experiments in each Commodity Group.

While research activities are active, the systems can use a range of indicators to produce monitoring reports (see example in figure 1.4). Actual research data can also be stored. This information is linked to a largely automatic facility for the production of annual reports.

When research activities come to an end, main results aggregated over the years can be entered into the systems. The systems can generate printed reports of the actual results of each experiment, as well as summaries for managers to see what has been completed and reported on, and which reports are still outstanding. Key words selected from experiment titles, objectives and other sources can be used to identify, for example, all experiments relating to a particular topic or theme.

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INFORM Light: Management Information for Agricultural Research

Annual Monitoring of Experiments (sorted by Commodity)

Printed: 20/12/2005

Research Year:

Scores:

Quality of Experiments Annual Report

3: Full report

2: Adequate report

1: Partial report

0: No report yet

Attainment of Experiment Objectives

3: As planned

2: Behind schedule

0: Nil

Continued Relevance

3: High

2: Medium

1: Low

Future Status

C: Continue unchanged

M: Modify & Continue

T: Terminate

Exp ID

Experiment Title

Annual Report Quality

Attainment of Objectives

Continued Relevance

Total Score

Future Status

Commodity:

Amaranthus

3087

Amaranthus Cultivar Trial

0

0

0

0

T

3087

Amaranthus Cultivar Trial

0

0

0

0

7971

Positioning of plant health Inspectors at Borders

2

3

3

8

C

Commodity:

Bambara groundbeans

6402

Bambara Observation Nursery.

0

0

0

0

6402

Bambara Observation Nursery.

2

2

0

4

M

Commodity:

Bananas and Plantains

5734

Banana Germplasm Evaluation

0

0

0

0

5734

Banana Germplasm Evaluation

2

0

3

5

5734

Banana Germplasm Evaluation

2

3

3

8

C

Commodity:

Beans

Figure 1.4. Annual Monitoring of Experiments Report.

Benefits of INFORM-R and INFORM-R Light

Agreed research priorities could be entered in INFORM-R and then used to reveal any mismatches between these priorities and the actual research agenda (see figure 1.7). INFORM-R can also show patterns of resource allocation in comparison with agreed priorities. Managers need this information to help them plan staff assignment, training and recruitment, to decide on the distribution of the available resources, and to adjust to any shortfalls. This allows for realistic decision making while ensuring continuity of research.

INFORM-R and INFORM-R Light provide a number of views of the research program useful in project planning. It can show resource allocation across commodities, research stations and agro-ecological zones. It can provide lists of research activities, and of scientists, sorted in several ways. Other outputs can help to prevent the duplication of

research activities and facilitate cross-program linkages. INFORM-R and INFORM-R Light assist monitoring through the use of interim reports, which track progress of research experiments, projects and programs. This enables managers to draw appropriate and timely conclusions and, if necessary, take corrective action.

Evaluation in INFORM-R and INFORM-R Light can be facilitated with a modest input from researchers, program leaders; and top management. The evaluation results can show up gaps between intentions and the realization of objectives; focus researchers' attention on outputs, and provide a record of all experiments, 'failed' or successful.

Experiments Evaluation Reports

Title: Characterisation and Evaluation of Bean Germplasm

M No: 5764 Scientist: Nyerere, Michael Evaluation Date: 27-Jun-1996

Start Date: 1-Jan-1994 Planned End: 1-Jan-1998 Actual End: 1-Mar-1995

Indicator	Score	Score Options
Objectives Achievement:	Fully realised 3	3: Fully realised 2: Largely realised 1: Significant problems 0: Experiment abandoned
Local Knowledge:	Significant 2	2: Significant 1: Some 0: Insignificant
World Knowledge:	Some 1	
Full Report Prepared:	No 0	
Reported in Station or Institute:	Yes 1	Reported in Station Annual Report Yes = 1 Reported in Station Annual Report No = 0 Reported in Local journal Yes = 1 Reported in Local journal No = 0 Reported in International journal Yes = 1 Reported in International journal No = 0
Reported in Local Journal:	No 0	
Reported in International Journal:	No 0	
On Farm Results:	No 0	
Extension Ready:	No 0	
Passed to Extension Service:	No 0	
Other Outputs:	No 0	
Impact Review Indicated:	No 0	
Impact Review Years:	0	Total Score 7
Problems Explanation:		

Record: 21 of 163

Main Menu Mgmt Notes Print Preview Close

Figure 1.5. Experiments Evaluation Reports.

INFORM-R and INFORM-R Light can reduce administrative burden of reporting. Data items can be collected and stored in one operation and then used flexibly for a range of different purposes as required. This information can also feed directly into annual reports,

or into reports for management at various levels, for donors, governments and for the general public.

1.4. **Agricultural Research MIS and the Management Cycle**

ISNAR's agricultural research MIS development and implementation framework were built on the premise that most NAROs pass through an annual research management cycle of: priority setting, planning, budgeting, monitoring, evaluation and reporting; next to of course executing research activities.

Three dimensions along which one can look at research management are (A) **resources (inputs)**, (B) **research management processes** and (C) **decision making levels** i.e. research structure and administration.

(A) Resources (inputs)

The key resources (inputs) of an agricultural research MIS are staff (Managers, researchers and support staff), research activities (³programs, ⁴projects and ⁵experiments), finances and physical resources (land, laboratories, machinery etc) (see figure 1.6). In order to link staff and projects an MIS should provide time sheets for recording staff time spent on research proposal and projects, and on time spent on non-research activities (administration, training, extension services etc.). In order to link staff to finance an MIS should enable data to be captured about the cost of each researcher or each category of researcher e.g. gross salary, benefits and allowances. In order to link projects to finance an MIS should enable

³ Programs: A program is a group of related projects, often within a single commodity group or discipline and usually of sufficient national importance to be expected to continue indefinitely i.e. without a specific end date (e.g. the rice program).

⁴ Projects: A project is a group of related experiments or studies sharing a common objective, usually with a finite overall budget and time allocation

⁵ Experiments are the lowest level of research activity for which a research protocol is prepared. It has titles, objectives, treatments or hypothesis. In agricultural research MIS, this term is also used to include surveys and studies.

data to be captured about three types of costs: (a) Staff cost = time spent x salary and benefits (of all participating researchers), (b) direct project costs (e.g. inputs such as fertilizer), (c) indirect costs: a share of general costs.

(B) Research management processes:

The research management processes of an agricultural research MIS are priority setting, planning, budgeting, monitoring, evaluation and reporting on projects, programs, final and annual reports.

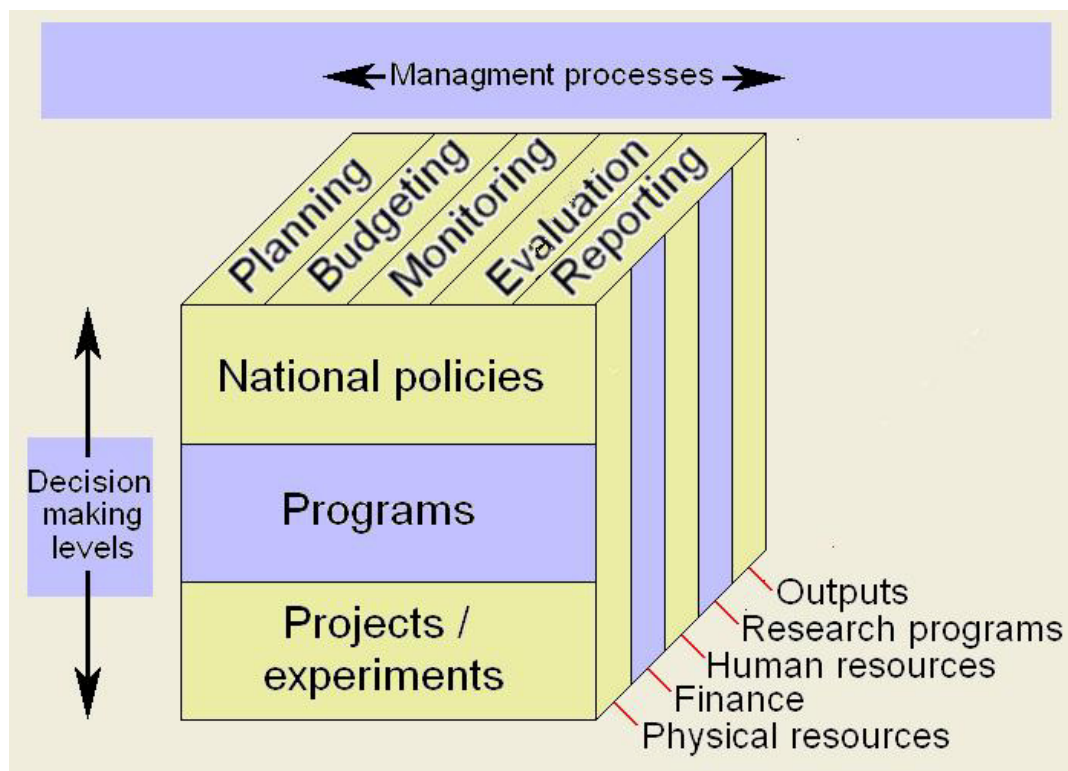


Figure 1.6: Research Management Processes and MIS.

Adapted from Vernon (2001).

Priority setting in agricultural research is a process of selecting the most important line of research activities to implement e.g. programs and projects. NAROs are often faced with fewer resources to perform all intended research. It is therefore necessary to analyze research activities and select the most important based on their objectives and value for

society. Priority setting starts at the level of policy setting. In developing countries NAROs, the national policies might include food security, poverty alleviation, improved natural resource base, import substitution and export earnings etc. When policies factors are set, their effects on priorities are analyzed across commodities (Crops and Livestock) and non-commodity factors e.g. post harvest technology, socio-economics, soils etc.

Scientists and stakeholders e.g. farmers representatives, extension workers, and food processors identify within each commodity or factor the key problems, relative cost and chances of success. This exercise results in a ranking of research alternatives taking into account the weights attached to the problems and objectives. This ranked order of priorities supports decision-making on which scientific disciplines are needed to undertake research, and resources to be allocated. Lists of resource allocations to commodities (staff, funds and physical resources) could be captured in an agricultural research MIS. Resource allocations in NAROs differ from priorities partly due to the absence of MIS. A good MIS could help NAROs compare resource allocation across commodities with agreed priorities. It could also help NAROs monitor resource allocations across commodities and non-commodity factors in several remote research institutes and stations supported by government and donor funding.

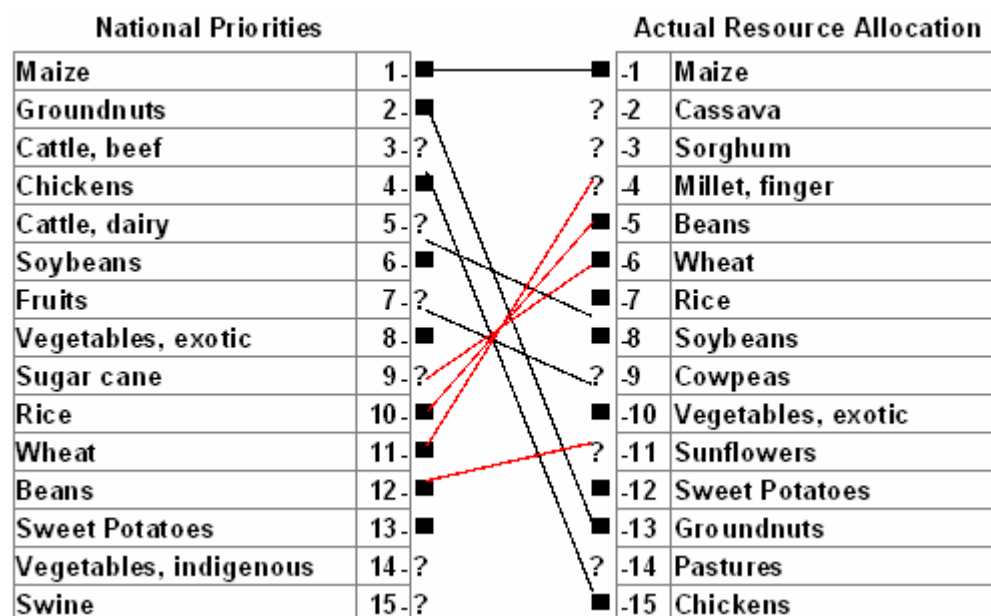


Figure 1.7: Priorities and Resource allocation by Commodity (Example from a NARO in Sub Saharan Africa).

Management Notes:

1. Does the priority list need revision?
2. How should resource allocation be adjusted to be closer to priorities? Usually this is a gradual process, done through annual research planning meetings, at which this output can be studied.
3. How have any mismatches come about? And what can be done to minimize this in future.

Planning is about deciding what should be done, when and how. It is about needs assessment, setting goals and developing future plans. Agricultural research priorities are turned into practice through research planning. This of course depends on available resources. There are four types of research planning: strategic planning, program planning, project planning and experiment planning.

Strategic planning

Strategic planning is a means of adjusting organizations' objectives, activities and management resources in response to changes in its external environment and client needs. Valverde (2001) stated that in the agricultural research sector, strategic planning positions NAROs within the context of national development plans. It enables effective

and efficient use of scarce resources and identifies structural changes needed for good performance. Strategic or long term planning defines the broad directions of the organization including the main research and non-research programs (e.g. training, and extension (nowadays referred to as communicative intervention). An agricultural research MIS should reflect these categories.

Program planning

Program planning defines the size, scope and content of the different research programs for the medium or long term. It also identifies the resources needed to implement programs for instance human resources (number of researchers and disciplines), special equipment and funding. Program plans lead to research projects. A research program is a set of research activities organized into research projects. Examples of research programs are plant breeding, animal health, rice, post harvest technology, and policy analysis. Information at program level is of key importance to decision makers. Research managers could use program-planning documents as a tool to negotiate funding with governments, donors and external partners (Collion, 2001).

Project planning

Project planning in agricultural research is the systematic and integrated management approach to identify and prepare a plan to resolve a problem identified within the broad field of agriculture (Capo et. al. 2001). A research project problem may be related to management, production, harvesting, storage, processing, and marketing of commodity, crop, animals or natural resources etc. There are four phases of project planning namely: (1) identification of project area and objectives, (2) preparation of project proposal, (3) revision of project proposal, (4) approval of project objectives and budget. Research projects have specific start and end dates that are supposed to produce specific results or outputs.

Experiment planning

In comparison with other higher levels of research planning (program, projects) actual research work is usually done at the levels of experiments, field trials, studies, surveys and other types of investigations. Experiment planning is the lowest level of agricultural research planning. Results of project planning are used to develop experiment proposals. Experiment proposal consist of these attributes: summary description, objectives, rationale and justification, research method, budget, specific activities, resources and detailed planed work. Experiment planning has its roots in the field of experiment design, part of the discipline of biometrics (Edsen, 2001). Researchers and Managers are usually the key actors in experiment planning process.

Experiment planning cycle consist of four steps:

1. identification of experiment areas and objectives (by researchers)
2. preparation of experiment proposals (by researchers)
3. review of experiment proposals (by research managers)
4. approval of experiments and resource commitments (by research managers).

Three main factors largely affect research-planning cycle: (1) natural cycles for instance cropping or seasonal cycles, (2) financial regulations of the funding agencies e.g. begin and end of financial year, deadline for budget submissions, schedules for disbursement of funds, (3) implementation and conduct of research planning at program and project levels (Edsen, 2001).

Budgeting

Budgeting is a tool for translating operational short term agricultural plans into financial terms and research action (Bruneau, 2001). Budgeting is part of planning and priority setting and must be supported by sound financial management policies, systems and practices. In Agricultural research MIS budgeting involves allocating funds to these

categories: allowances, transport, labour, materials and other recurrent costs for executing programs, projects and experiments.

Budgeting can assist researchers and managers to anticipate and avoid financial problems, bring resource allocation in line with priorities, motivate research staff to meet objectives, coordinate efforts and activities, communicate goals and objectives to staff. In many NAROs, however budgeting is used as a control mechanism by top management, donors and ministries of agriculture and finance (Bruneau, 2001).

Monitoring means to ensure that inputs, work schedules and outputs are proceeding according to plan, and to provide early warning if there is deviation from what was expected. It involves recording data on key indicators derived from existing sources such as projects interim report forms, time sheets, and budget reports. It includes analyzing data generated and reporting through quarterly, and annual progress reports to management for decision-making. There are three types of monitoring: research monitoring, monitoring staff and monitoring budgets. **Research monitoring** involves checking whether or not milestones have been achieved. Milestones are interim targets to be achieved at a certain time during project implementation. **Monitoring staff activities** involves checking actual activities of individual researchers against proposed/agreed research activities, checking staff participation in research projects (number, type, too many? too few?), checking cost of staff involvement in projects (cost recovery, or billing). **Monitoring budgets** involves checking actual expenditure against budgeted expenditure at project and program levels, identifying constraints and bottlenecks in implementation (under expenditure), identifying over-expenditure (costs getting out of hand), and mid-course correction: take action before it is too late.

Evaluation involves appraising or establishing the merit, worthiness of what has been done. It deals with four aspects: Quality, performance, relevance, possible and eventual

impact. Quality deals with adhering to the set standards. Performance compares achievements with expected outputs. Relevance deals with relevance of the programmes, projects, experiments, and resources to the higher-level objectives of NAROs. The two areas that are being evaluated are research and resources (staff and finance). **Evaluation of research** is to appraise project completion (on time and within budget), project objectives (fully or partially achieved), project outputs (establish a record for future reference), project implementation (as expected? feedback to planning). **Evaluation of resources** is to appraise the use of resources against priorities, for instance actual costs of rice research versus planned or budgeted costs, including not only direct project costs (fertilizer and equipment) but all costs (including staff). **Impact Assessment** is another type of evaluation that deals with establishing change in behaviour, in social-economic situation or environment as a result of what has been done. It deals with the ultimate effect of the output on the end users.

Reporting: An MIS provides useful information for the generation of different types of reports: Organizational reports (annual reports), administrative reports e.g. progress or interim reports, research results and evaluation reports (for internal use, or for government and donors), and research reports (publications for the general public).

(C) Decision making levels:

National Policies

National research leaders are responsible for making decisions at the national policy level. Their three important areas of responsibility are research priorities, research program, and research personnel. Research priorities guide the formulation of research programs, which in turn generate the need for appropriate research personnel to execute the programs. National research leaders will need to have access to aggregated information from the country's current research program to make decisions and to ensure that institutional

research priorities are in line with national research strategies. Managers will also need information on current research personnel broken down by commodity and non-commodity factor for comparison with agreed priorities and the current research program.

Managers are interested in the performance of research programs, so they will like to know if the program inputs and outputs are progressing as planned. Regarding inputs they will need information about the qualification of the researchers to be able to recruit researchers with appropriate skills and to plan necessary training. Managers need information about the amount of time researchers commit to better schedule research activities, to monitor implementation and to better justify requirements for additional staff time if necessary. With respect to program outputs, managers need information on the status of the outputs that researchers are expected to produce for example publications, and routine reports such as interim, annual, or experiment completion reports. This helps managers to better direct staff to achieve those outputs and better evaluate researchers achievements and to reward performance where appropriate (Brush and Kramer 1997).

A well-designed MIS can provide Managers with aggregate information about the allocation of resources across programs, commodities and compare them against agreed priorities.

Station or institute Managers:

Station or institute Managers are responsible for research management and administration within NAROs institutes or research stations. These managers need much information on budgets and expenditure, personnel issues such as staff performance assessment, recruitment, training and promotions, infrastructure procurement and maintenance. Station and institute Managers require both detailed and aggregate information for making administrative and management decisions. Experiment reports provide the detailed information while lists of projects and researchers, and graphs of resource allocation across commodities provide summarized information.

Program Level:

Program managers specifically need information on the program they are leading but may be interested in external scientific information as well. They will need details of every experiment as it is stated in the research protocol, feedback on the progress of its implementation and the final reports on its completion. They will also need information on budgets/expenditure, and program staff. They need such information to evaluate progress within the program, to ensure that the results are passed on to the stakeholders and for planning the next research years' program.

Project/Experiment Level

Researchers are responsible for making decisions at the project and experiment levels. Information in research organizations is intended for two purposes: firstly to improve management of research and organizations that perform research, and secondly to add value to actual research and experimentation that research organizations are expected to deliver (Allmand et al.). Researchers need detailed scientific information from their country and other sources such as libraries and the Internet to make decisions in the preparation of projects or experiments proposals and for searching for potential collaborators and competitors. An agricultural research MIS is designed to provide access to such information in order to avoid duplication of research and encourage collaboration. Researchers are the primary source of data for MIS. They provide personal data and data on their research activities which is being processed into information for decision making by their managers.

1.5. Implementation of MIS in NAROs.

Hobbs (1996) a former ISNAR staff wrote that to successfully introduce a Management Information Systems (MIS) to National Agricultural Research Organizations (NAROs) in developing countries, the qualities of three factors must be at a high level: the quality of the MIS, the implementation process and the institutionalization.

The quality of the MIS Software Package

The MIS software package must be well designed; user friendly, and it must meet information needs of the organizations. The software design aspect was largely met through the collaborative development and introduction of INFORM, INFORM-R and INFORM-R Light by ISNAR and NAROs.

The implementation process

The implementation process has to be organized and scheduled in a fashion that would motivate NAROs staff at all levels to willingly and actively participate in using the MIS software package for their research management business model. The design of ISNAR's MIS implementation processes in NAROs consisted of a sequence of activities, which included initial meetings and seminars with top management, institute directors, and researchers to explore needs for management information and to demonstrate INFORM. After this introduction, data capture and skills training activities were undertaken to build the capacity for producing management reports using INFORM. The sequence also entailed follow-up activities including advice to help resolve implementation problems and in evaluating the performance of the system. Final activities in the sequence involved the institutionalization of INFORM systems.

The institutionalization

The MIS has to be institutionalized in the organization; in other words, the system has to be integrated into the routine annual research management cycle (see figure 1.8). This calls for widespread acceptance and use of the system and the information generated from the system to improve research management. This aspect was largely neglected in NAROs. Detailed description of the research management vs. MIS cycle is in *Annex 1* of this thesis.

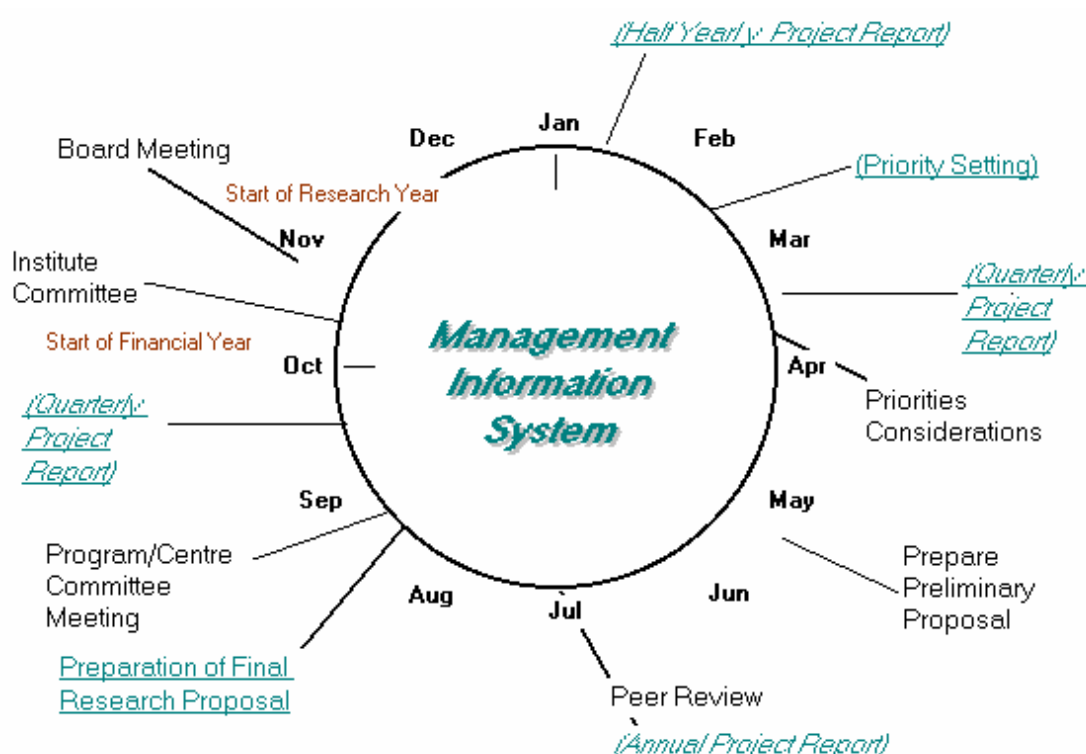


Figure 1.8: Research Management vs. MIS Cycle

1.6. The Problem Area: Institutionalization.

ISNAR conducted INFORM training and follow-up service activities in NAROs but results were mixed between success and failure of institutionalization (Balaguru et al. 1994, and Vernon, 2001). This led to the development of INFORM-R and INFORM-R Light systems. INFORM-R and INFORM-R Light were implemented by ISNAR in several NAROs in Sub Saharan Africa but the institutionalization of the systems in the annual research

management cycle was found to be inadequate (Webber, 2000 and 2002). By inadequate institutionalization we mean inadequate use of the MIS for data collection and decision-making in NAROs research management processes. In other words, the systems were not really integrated into the daily practices of management and research.

Observations made by ISNAR staffs during follow-up visits in Sub Saharan African NAROs indicated that the reasons behind inadequate institutionalization may be because of organizational issues (local NARO factors) such as leadership involvement, resistance to change by NAROs staff, poor information management culture, inadequate information and communication technology infrastructure, government and donor support issues. In general, no NARO has been able to fully integrate the MIS into their research management cycle.

Data collection and use problem:

Reports from ISNAR staff that assisted NAROs in the implementation and institutionalization of the systems towards the end of the 1990s and the beginning of the 21-century revealed that most NAROs made use of the system to collect data, to process and provide information on personnel and research activities. But they did not use it continuously to collect data and make decisions when conducting research management activities such as priority setting, annual project planning and budgeting, progress reports and evaluation reports and annual reports. A clear evidence of this issue could be seen in the INFORM-R and INFORM-R Light databases provided by the NAROs from 1997 – 2004. A good examination of the content of the databases showed in some cases deficiencies in the data set and hence deficiencies in the information generated. These deficiencies included lack of completeness of data.

Leadership problem:

Country reports from NAROs MIS practitioners and ISNAR staff pointed out that resistance to use INFORM emanated in some cases from managers (e.g. CSIR Ghana) and in some cases from researchers (e.g. NARO Uganda). The majority of senior managers were aware of the existence of the MIS but they were not aware of its importance. Top managers lacked a sense of ownership of the MIS and were not committed to motivating their staffs to integrate MIS in their research annual management cycle. Lack of leadership involvement frustrates NAROs staffs and reduces their interest in participating in institutionalizing MIS. This research will investigate the level of involvement of NAROs leaders in institutionalization.

Information management capacity issues:

Reports from MIS National Coordinators suggested that some senior managers lack capacity to use computers and prefer to make decisions based on personal experience rather than using facts and figures provided by INFORM. Middle managers were reported to have embraced the system. In the case of researchers, it was reported that some show resistance by not providing sensitive data into the system. Data on salaries, age, rank, budgets, monitoring and evaluation are regarded as sensitive and are not easily shared by this group of resistors. Other researchers do not like to fill in forms and lack the skills to use computers. This problem was said to be wide spread among many NAROs and have negative consequences on NAROs performance. For instance NAROs were not able to generate annual, monitoring and evaluation reports due to lack of data. These reports are useful because they enable NAROs to compare their achievements with their outputs and show their governments and stakeholders that they are relevant and can perform.

Adequacy of the MIS Software

It may be possible that some managers and researchers did not perceive INFORM-R and INFORM-R Light to be adequate for research management in their NARO. This research

will attempt to investigate the extent to which NAROs adapted the systems to suit their organization and research structures.

Organizational Structure problems:

There are also structural, power and political issues as shown by the problem of not knowing which department to house INFORM, whether the Biometrics office, or the Planning, Monitoring and Evaluation Unit or the office of the Director General. Markus (1983) wrote that information itself is power; and an MIS can both create power and shift the location of power (Hobbs, 1999).

Different kinds of organizational problems (local NARO factors) in relation to institutionalizing INFORM-R and INFORM-R Light were identified in many NAROs. A NARO, for instance Sri Lanka Council for Agricultural Research Policy (CARP) was observed by ISNAR staff to be performing better than others in terms of institutionalization of MIS. Past ISNAR reports were based on observations while conducting MIS training and follow-up activities and reports from MIS National Coordinators. A full-scale research on institutionalization of agricultural research MIS in developing countries especially Sub Saharan Africa has not been conducted before. This research would seek to gain detailed understanding on the critical factors and other unforeseen factors and any combination of factors thereof that promote and frustrate institutionalization of MIS in Sub Saharan African NAROs.

1.7. What is Institutionalization?

To institutionalize something means to cause it to become part and parcel of an institution. This may be for instance establishing a standard practice, habit or custom within a human system (Kramer, 2000). A method, an idea or an approach that becomes institutionalized is regarded as routinized and integrated in the organizational business processes. This can happen if the method, idea, approach or innovation is communicated widely within the

organization and members of the organization are committed to using and actually do it to improve their activities. An institutionalized innovation is expected to continue for a long period. To institutionalize an innovation is time consuming. This is similar to organizational development, which is also time consuming. People in organizations very often resist new ideas for the first time. This is because new ideas are raw and have not been tested. People may accept new ideas if they have nothing to lose but if they have something to lose (for instance power, honour, status, identity and money) then they resist change. Organizations also use strategies to resist change because change brings uncertainties.

To test new ideas within an organization, planning is required to introduce the idea in a proper fashion. Institutionalization in itself is a process (Kishore and Mclean 1998). The process of institutionalization may start with sensitizing and making everyone in the organization aware of the innovation and how it can benefit the organization and its members. Some researchers in the social sciences and information systems community have provided us with some ideas on the chronological process of institutionalization and the different terms used in literature. Kishore and Mclean (1998) pointed out that researchers used terms such as institutionalization, routinization and incorporation, to describe the final stage in the “innovation adoption process”. Kishore and Mclean developed the “success of adoption” construct and according to them, two conditions must be met for an innovation to be recognised as institutionalized, routinized or incorporated in an organization.

The first condition is that the innovation must be adopted widely by most or the entire adopting unit within the community of potential adopters. This is the breadth of adoption in other words referred to as diffusion of innovation within the adopting organization (Rogers, 1993). The second condition is that “the adopted innovation should be put to full and complete use by the adopters in a fashion as prescribed by the designers of the

innovation (Kishore and Mclean 1998). If the innovation, however, is adapted to suit local organizational business processes, then success will only occur when the innovation is used in a fashion that enables complete and full use of the features and functionality of the adapted innovation. This is the depth dimension of adoption and it is referred to as infusion of the innovation in the organization. In a nutshell, when an organization achieve a high level of diffusion and infusion of an innovation, then the innovation is said to be incorporated, routinized and institutionalized within the organization.

Horton et. al. (2000) stated that an organizational system such as a PM&E (Planning, monitoring and evaluation) system is said to be organized when the rules and norms of the system have been established for instance the training manuals have been prepared and the professionals have been trained to manipulate the system. But the system can only be regarded as institutionalized when users accept and value the system and use it routinely. This means that the system becomes part of the operating procedures and organizational culture.

1.8. What is Institutionalization of a MIS?

Following previous discussions on institutionalization, full MIS Institutionalization in this research would mean continuous and integrated use of MIS by NAROs' staff for data collection, data processing into information and decision-making in NAROs' research management processes.

1.9. Research Goal

The goal of this case study is to get insight into factors affecting positively and negatively institutionalization of MIS in National Agricultural Research Organizations in Sub Saharan Africa.

Through this goal we hope to gain knowledge of the interaction between NAROs in Sub Saharan Africa and an introduced information system. The research would also increase our understanding of the relative importance of various critical success and failure factors in institutionalization of MIS in Sub Saharan African NAROs and hopefully NAROs in other continents of the world.

1.10. Research Objectives

The objectives of this research are:

- To evaluate the extent of institutionalization of MIS in Sub Saharan African NAROs.
- To identify factors that promoted (critical success factors) and frustrated (critical failure factors) institutionalization of MIS in Sub Saharan African NAROs.
- To evaluate the contribution of MIS to agricultural research management in Sub Saharan African NAROs.
- To recommend a method of working for institutionalizing MIS in Sub Saharan African NAROs.

The most important critical success factors observed from the literature and the case study NAROs would enable us to recommend a method for institutionalizing MIS in Sub Saharan African NAROs. The recommendations should provide knowledge on the conditions and processes under which managers and researchers are able and willing to institutionalize MIS in NAROs. Issues about managing change in relation to MIS institutionalization in NAROs will be researched, discussed and recommended for improving research management.

1.11. Research Questions

The research will attempt to answer these questions:

1. To what extent is MIS institutionalized in Sub Saharan African NAROs?
2. What key factors promoted (critical success factors) and frustrated (critical failure factors) institutionalization of MIS in Sub Saharan African NAROs?
3. How does institutionalization of MIS improve agricultural research management and performance of Sub Saharan African NAROs?

Research question one reflect objective one, question two reflect objective two and question three reflect objective three. Recommendations (objective four) will be based on the results and analysis of question 1 to 3. The research questions include managers and researchers as key respondents. This means that national agricultural research organizations are the research units and research managers and researchers are the observation units. This requires two levels of analysis: country (organizational) and individual levels analysis.

1.12. Thesis Outline

This thesis is divided into seven chapters and each chapter consists of sub chapters. The first chapter describes a brief history of NAROs in Sub Saharan Africa, introduction of agricultural research MIS and its' implementation in NAROs, the institutionalization problems encountered, institutionalization theories, the research goals, objective and questions. The second chapter describes the causal model based on organizational theory and the underlying literature and MIS implementation literature. Chapter three describes the research process model, the case study design, fieldwork experiences, data collection and analysis methods. Chapter four describes the four case study NAROs in detail and presents their history of MIS implementation and qualitative results of the case study research. The fifth chapter presents the results of two quantitative analyses: (1) the

comparative case study analysis based on comparison of statistical means and correlations, (2) the individual level analysis based on correlations and regression analysis. In chapter six of the thesis, the results are qualitatively discussed and finally in chapter seven the conclusions are drawn and recommendations and expert validation are made (see overview in figure 1.9).

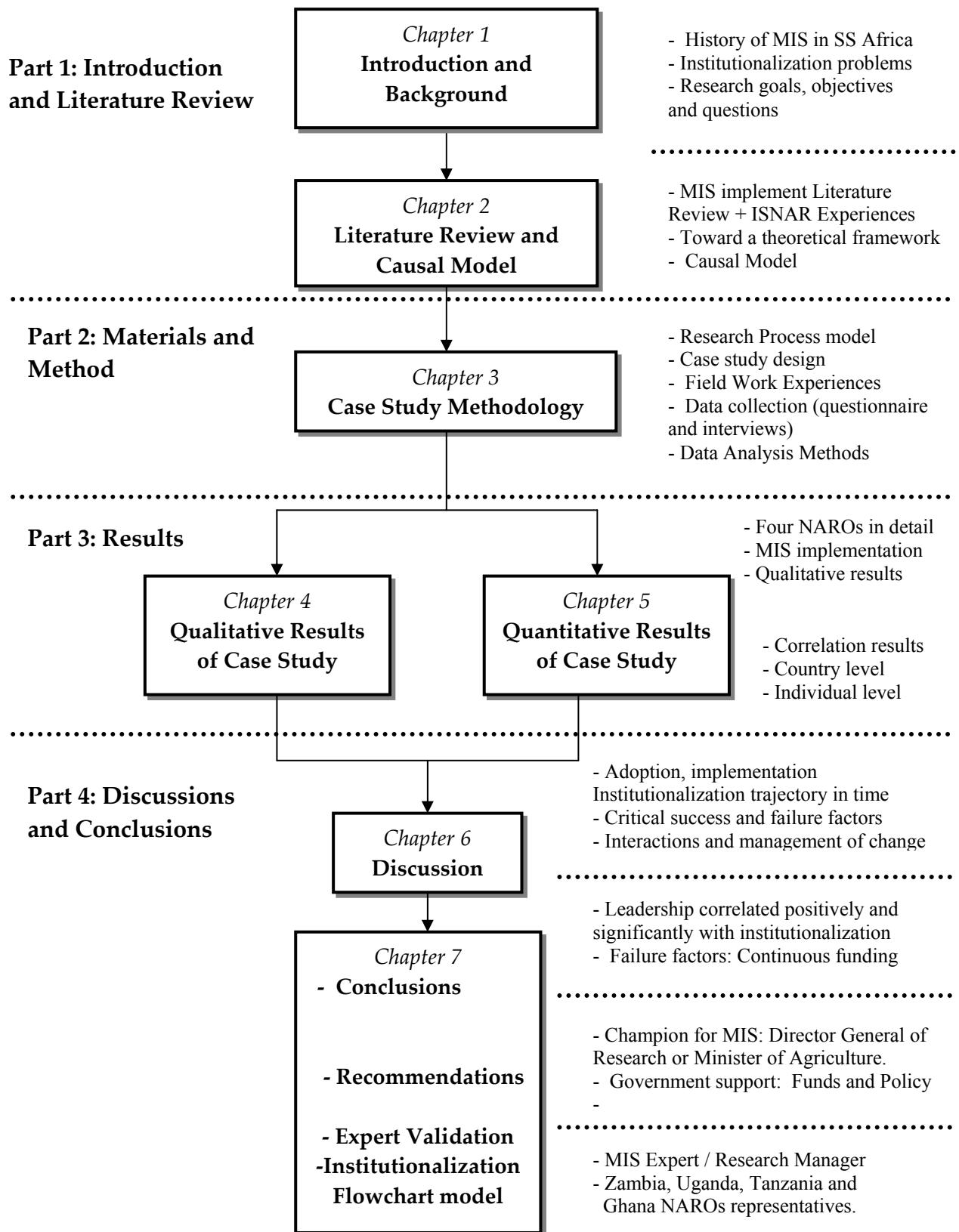


Figure 1.9: Outline of the thesis

Chapter 2. Literature Review and MIS Institutionalization Causal Model

2.1. Literature Review

Bearing the research problem (institutionalization of MIS) in mind, we recognize that not much literature has been published in this area especially regarding developing countries. For this reason we broadened the search for literature by including literature from the public and commercial sector in the northern part of the world. To guide our literature analysis we tried to map out the history of implementation and institutionalization of MIS in order to better understand the trend and the reasons for success and failure and how to improve institutionalization of MIS in NAROs.

Developed Countries

Literature on MIS implementation appeared in the 1960's and frequently in the early 1970's in western countries. The authors in this period defined implementation as management of change. Ackoff (1960) wrote that three main factors were responsible for implementation failure: lack of top management support, champions leaving the organization and users' resistance to change. Davis (1974) advocated user participation and communication in order to curb users' resistance. In the mid 1970's literature on implementation expanded. Authors were concerned with factors that would assist implementation processes. Studies by Lucas (1975) also confirmed user or client resistance as being instrumental for implementation failures. Other studies challenged these findings that mainly blamed users for implementation failures. Lucas (1974) advocated implementing systems in a user-led approach. Other approaches such as end-user computing and prototyping were recommended as solutions to overcome user resistance.

Management of Change

Studies in the late 1970s and early 1980s took into account not only before and after implementation phases of systems but also organizational change and user interaction issues (Markus, 1983). Markus; (1983) wrote that people resist MIS in organizations because of their own internal factors, because of poor system design and because of the interaction of specific design features with aspects of the organizational context of the system use. The organizational change model developed by behavioural scientists such as Kurt Lewin (1952) probably influenced these authors. Lewin devised a technique called “force field analysis”. Organizations as seen by outsiders are in a state of equilibrium. Inside the organization, there are driving forces that force them to change and restraining forces striving to maintain the status quo. Lewin described three phases that are required for change to take place in an organization:

- (1) Unfreezing: The disruption of the forces maintaining the existing state (state A) or level of behaviour in the organization. The organization can do this by introducing new information to show the performance gap and desired state envisaged.
- (2) Moving: The transition period (state B). Learning of new behaviours, values, attitudes and putting change in place for example through structure, technology, human processes and strategy (state C).
- (3) Refreezing: Stability period (desired state C). The organization is stabilized at a new state of equilibrium. Supporting mechanisms such as culture, norms, policies and structures could be used to reinforce the new organizational state.

Mora (2004) in his report on understanding the strategic process of implementing decision-making support systems (DMSS) wrote that authors of implementation research have used mainly two approaches: factor survey and case study approach. He suggested that analysis by other authors has shown that there is no standard framework for modeling and analyzing the DMSS implementation process. There are, however, main factors that can be observed from the factor survey method and key stages for the case study methods that are potentially associated with DMSS implementation success or

failure. He presented two tables describing the theoretical framework for the two approaches. The table containing the theoretical framework for the case study approach is interesting for our literature review because it helps us to visualize the change management models employed by different authors (table 2.1).

Table 2.1 Theoretical Framework for Case Study Approach for DMSS Implementation Process.

Lewin's Model	Roger's Model	Kwon and Zmud's Model	Mora et al's Model
	Knowledge		Ignorance
Unfreezing	Persuasion	Initiation	Promotion
	Decision	Adoption	
Moving	Implementation	Adaptation	Construction
Refreezing	Confirmation	Acceptation	Acceptation
		Use (performance satisfaction)	Institutionalization
		Incorporation	

The change management models in figure 2.1 appear to be similar and linked to Lewin's model (as the core model). Lewins' model with respect to change management has been described above. Rogers (1995) in his book *Diffusion of Innovations*, defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system. Rogers' definition contains four elements that are present in the diffusion of innovation process. The four main elements are:

- (1) Innovation - an idea, practices, or objects that is perceived as new by an individual or other unit of adoption.
- (2) Communication channels - the means by which messages get from one individual to another (the sender and receiver).

(3) Time - the three time factors are:

(a) innovation-decision process

(b) relative time with which an innovation is adopted by an individual or group.

(c) innovation's rate of adoption.

(4) Social system - a set of interrelated units that are engaged in joint problem solving to accomplish a common goal.

Rogers (1995) differentiated adoption process from diffusion process in the sense that diffusion process occurs within society, as a group process; whereas, adoption process pertains to an individual. Rogers defines "the adoption process as the mental process through which an individual passes from first hearing about an innovation to final adoption". He breaks adoption process down into five stages: awareness, interest, evaluation, trial and adoption. In the awareness stage "the individual is exposed to the innovation but lacks complete information about it". At the interest or information stage "the individual becomes interested in the new idea and seeks additional information about it". At the evaluation stage the "individual mentally applies the innovation to his present and anticipated future situation, and then decides whether or not to try it". During the trial stage "the individual makes full use of the innovation". At the adoption stage "the individual decides to continue the full use of the innovation". These individual adoption stages would be useful in this research because we are interested in finding out the stages and rate of adoption of MIS software by NAROs staffs.

Rogers (2003) in his book "*diffusion of innovations*" highlighted five essential ideas for the innovation decision process. He argued that potential adopters must go through five phases to reach the final decisions to continue or terminate the utilization of an innovation (see table 2.1). In the first phase (knowledge), they gain a basic understanding of what it is and how it works. In the second phase (persuasion), they can take a positive or negative attitude toward it. In the third phase (decision), they take actions to accept it or reject it. In

the fourth phase (implementation), they actually use it. In the fifth phase (confirmation), they examine how it has been used and make further decisions to use it or reject it based on the perceived benefits.

The first phase of the innovation-decision process entails seeking one or more of three types of knowledge about the innovation. Rogers described these as:

1. Awareness knowledge is information that an innovation exists.
2. How-to-knowledge consists of the information necessary to use an innovation properly, and
3. Principles knowledge consists of information dealing with the functioning principles underlying how the innovation works.

Rogers states that awareness and knowledge of an innovation can be made most efficiently through mass media.

Rogers (2003) also discussed three types of innovation decisions and five stages of innovation process in organizations. The three types of innovation decisions in organizations are: optional, collective and authority innovation decisions. Optional innovation decisions, choices to adopt or reject an innovation that are made by an individual independent of the decisions made by other members of the organization. Collective innovation decisions, choices to adopt or reject an innovation that are made by a consensus among members of the organization. Authority innovation decisions, choices to adopt or reject an innovation that are made by a relatively few individuals in the organization who possess power, high social status, or technical expertise.

According to Rogers, the five stages in the innovation process in organizations are grouped under two main stages: (1) Initiation and (2) Implementation. The initiation stage consists of two sub stages: (a) Agenda Setting (i.e. general organizational problems that

may create a perceived need for innovation) and (b) Matching (i.e. fitting problem from the organization's agenda with an innovation). The implementation stage consists of three sub stages: (c) Redefining/Restructuring (i.e. the innovation is adapted and reinvented to fit the organization, and organizational structures are altered), (d) Clarifying (i.e. the relationship between the organization and the innovation is defined more clearly) and (e) Routinizing (i.e. the innovation becomes an ongoing element in the organizations' activities, and loses its identity). He also referred to routinization as a closely related concept to sustainability or institutionalization, which is the degree to which an innovation continues to be used after the initial effort to secure adoption, is completed.

Other authors such as Kwon and Zmud (1987) suggested an innovation decision model for implementation of information systems in organizations. The stages of the model are: initiation, adoption, adaptation, acceptance, use (performance satisfaction) and incorporation. Each stage can be linked to a particular stage in Lewin's (1952) change model (see table 2.1). Regarding initiation, pressure for an organization to change can evolve from either need-pull or technology push forces. In each case, needs and appropriate technologies come together via idea and information exchanges. Adoption stage involves a decision by an organization to invest resources necessary to accommodate the change effort. The adaptation stage is similar to Roger's implementation stage. It refers to development, installation and maintenance activities. Also in this stage resources are spent to promote new behaviors to diminish opposing forces and to ensure that expected benefits from investments in new technologies are realized.

The three stages described above are mainly to facilitate innovations with the assumption that innovations are inherently good. It excludes post-adoption or post-innovation evaluation processes. Things can actually go wrong if misuse or resistance to use occurs while introducing many technological innovations. Adoption of inappropriate innovation or faulty implementation processes can be the reasons for misuse or resistance to use. For

these reasons, Kwon and Zmud (1987) introduced assessment stages to determine whether an innovation was appropriate or inappropriate. The stages are acceptance, use-performance-satisfaction. These stages are supposed to lead to implementation success but complete diffusion of an innovation throughout an organizations' tasks, people and structure will not occur if technical, motivational, social and political issues are not resolved. This reasoning led to the introduction of "incorporation" as a final implementation process (Kwon and Zmud 1987). Incorporation occurs when the innovation is being applied to it's full potential within an organization (Kwon and Zmud 1987). The use-performance-satisfaction and incorporation stages are similar to the institutionalization stage in Mora et. al's model and the model we are going to develop.

Discussion:

In this research we made use of ideas from the change models in table 2.1 to formulate our process model for institutionalization of MIS in Sub Saharan African NAROs. Our institutionalization process model is formulated as follows: Adoption, Implementation, Adaptation, and Institutionalization. For adoption, we used Rogers' adoption processes: Awareness stage: i.e. awareness of the existence and importance of MIS. Interest stage: i.e. interest in using MIS for research management purpose. Evaluation stage: i.e. evaluation of MIS software packages INFORM-R and INFORM-R Light for research management. Trial stage: i.e. trying out the modules in INFORM-R and INFORM-R Light. Adoption stage: i.e. the decision to use INFORM-R and INFORM-R Light for research management. For the implementation stage again we adopted Rogers' definition: The implementation stage is the stage of organizational change. It involves providing MIS Training, installing the software and hardware and using the MIS software packages for managing research information in NAROs. The adaptation stage is the stage of modifying INFORM-R and INFORM-R Light to suit organizational business processes (Kwon and Zmud's model becomes handy because at this stage resources were spent to modify the system and promote new behaviors). The Institutionalization stage is the stage of continuous use of

MIS and full integration of the system in research management cycle of NAROs. This stage is similar to the use-performance-satisfaction and incorporation stages in Kwon and Zmud's model (see chapter 6 for further discussion on our model).

In conclusion, the change management models described above appear to be similar but each author attempted to arrange and explain the stages in different ways.

Critical Success Factors for Information Systems Implementation

Studies in the late 1980s and 1990s were focused on adoption and critical success factors for implementation of information systems or information technology. Thong (1996) reported that top management support was a critical success factor for implementation of market decision support system (MDSS) in small business. Gottschalk (1999) provided a table (2.2) that showed studies related to information systems implementations. We modified this table to include relevant studies and to map the history of studies on implementation of MIS.

Table 2.2. Research studies related to MIS implementation.

Study	Implementation completion
Alter and Ginzberg (1978)	Control rests with users.
Ginsberg (1980)	Systems are accepted.
Lucas (1981)	System is installed.
Markus (1983)	Not abandoned or expensively overhauled.
Rhodes and Wield (1985)	Post application phase is consolidated.
Baier, March and Saetren (1986)	Programmes are adopted.
Nutt (1986)	Changes are installed.
Srinivasan and Davis (1987)	Systems are installed and used.
Lucas, Walton and Ginzberg (1988)	Adoption has occurred.
Leonard-Barton and	Innovation is adopted

Study	Implementation completion
Deschamps (1988)	and used.
Baronas and Louis (1988)	Change is accepted
Brancheau, Schuster and March (1989)	System is put to use.
Joshi (1991)	Change process completed.
Alavi and Joachimsthaier (1992)	Intended benefits are realized.
Floyd and Woodridge (1992)	Organization acts on new priorities.
Earl (1993)	
Boynton, Zmud and Jacobs (1995)	
Bradley and Hauser (1995)	Systems are accepted and used.
Griffith and Northcraft (1996)	Satisfaction with system is achieved.
Klein and Sorra (1996)	Committed use occurs.

The focus on critical success factors (CSF) was probably influenced by the work of (Rockart, 1979). Using critical success factors Rockart discovered that executives rarely knew what information they needed to run their businesses. It is therefore important to use CSF methods to help decision makers more clearly consider what their organization must do to be successful and the information they need to ensure that their activities take place effectively. Other authors such as Cashmore and Lyall (1991) stated that critical success factors are management aspects believed to be crucial to the success of an operation but not necessarily sufficient conditions for success. This means that the reasons for success are not yet completely understood but some general conclusions can be drawn (Vernon, 2001). Authors such as Li (1997), De Leone and Maclean (1992) reviewed critical success factors for information systems in general. Rainer and Watson (1995) reviewed MIS specific critical success factors. The authors argued that for implementation to be successful, the MIS must be developed to support a specific business need, executive

sponsors and champions are important, effective data management must be in place, a prototype must be released soon.

Studies in the early part of the 21st century revealed that groups of critical success factors are responsible for implementation and adoption success. These factors could be mixtures of technical and non-technical (social / organizational) issues. Mustafa (2000) reporting on his PhD thesis titled “critical success factors that affect implementation of innovation” concluded that two groups of critical success factors exist: the major group and the minor group. The major group consist of five factors: management commitment, planning and design, education and training, organizational communications, and employee involvement. Factors in the minor group are quite numerous to be listed in this paragraph. He however, concluded that three different stages of implementation lifecycle exist: Initiation, implementation and sustaining. The major group of critical success factors always exists in these three stages and the minor groups appear to support the major group in the implementation lifecycle. He alluded to critical failure factors in his report but did not have enough time to research this area.

Conclusion: Critical success factor is an important topic in this research. Many information systems (IS) implementations fail because organizations have not yet researched their critical success factors and incorporate them in the implementation process. In this research we will make use of lessons from the authors above to come up with an appropriate list of critical success and failure factors for MIS in Sub Saharan African NAROs.

Project Management and Management of change

Van der Weide et. al. (2003) in their book titled “project planning and management”, wrote that the most important reasons for failure of projects are:

1. No mission (just plan and start), wrong mission (political, subjective) or impossible mission
2. Team members are kept unaware of project objectives, outputs and situations
3. Early cancellation of the project
4. Complexity ignored
5. Resistance to change
6. Lack of mandate and resources (management makes too many decisions and does not provide resources)
7. Bad performance by the team members

Furthermore, the authors stated that a project is a change in a company. Change can create resistance among company members. To be successful however, a project manager (champion) must analyze the objective, bureaucratic and political realities in the company (Van der Weide et al 2003). The objective realities are the relevant facts, figures, assumptions, models, and reasons used to create the project and the feelings and opinions of the experts. Bureaucratic realities are the procedures and guidelines that govern the company for example decision-making, financial, external relations, legal, and ICT etc. Political realities are the divisional and personal agendas of the people in power in the company. Of the three realities, political reality is the less clearly observable reality within a company. The project manager must discover political realities through networking, personal relation building, informal contacts, intimate communication and lobbying. Finally, for projects to be successful, team members must communicate and negotiate.

Another successful method for understanding the strategic process of implementing projects is PRINCE. PRINCE, which stands for Projects in Controlled Environments, is a project management method covering the organisation, management and control of projects. The Central Computer and Telecommunications Agency (CCTA) now part of the Office of Government Commerce (OGC) first developed PRINCE in 1989 as a United

Kingdom (UK) Government standard for IT project management (Bradley et al 2005). PRINCE was originally developed for the needs of IT projects, but the method has also been used on many non-IT projects. It is the standard method for use in UK Government Departments and is used increasingly in the private sector, National Health Service (NHS) and Local Government. An increasing number of overseas Governments and multi-national companies have adopted the method, or integrated it within their existing project management approaches (Bradley et al 2005).

The latest version of PRINCE2 is designed to incorporate the requirements of existing users and to enhance the method towards a generic, best practice approach for the management of all types of projects. PRINCE2 is a process-based approach for project management providing an easily tailored, and scaleable method for the management of all types of projects. Each process is defined with its key inputs and outputs together with the specific objectives to be achieved and activities to be carried out. PRINCE2 consists of eight high level processes:

1. Starting Up a Project (SU)
2. Directing a Project (DP)
3. Planning a Project (PL)
4. Initiating a project (IP)
5. Controlling a stage (CS)
6. Managing product delivery (MP)
7. Managing stage boundaries (SB)
8. Closing a project (CP)

Starting up a Project:

The aim of starting up a project process is to set the project up in the correct way. It is a pre-project process that ascertains if the project would be worthwhile and viable before seeking commitment of resources. Its major input is the Project Mandate. It involves

identifying the senior decision makers required to make up the project board who will oversee the project. The project board selects a project manager. The reasons for the project are outlined in a Project Brief. The project approach is decided, as is the plan for the initiation stage, to give the project a firm foundation. The actual elements of Starting Up a Project are: appointing a Project Executive and a Project Manager, Designing a project management team, appointing a project management team, preparing a project brief, defining project approach, and planning initiation stage.

Directing a Project:

The functions of the Project Board are defined in the directing a project stage. The Project Board are responsible for the project and the Project Manager keeps the Project Board informed with regular reports. The day-to-day management of the project are left in the hands of the Project Manager. The Project Board only become involved at stage boundaries when they must approve progress so far and give the go ahead to the next stage. A fundamental principle of PRINCE2 is management by exception, which means the only other time the Project Board makes decisions about the project, is when the project is forecast to go off course. The actual elements of Directing a Project are: authorising initiation, authorising a project, authorising a stage or exception plan, giving ad hoc direction, and confirming project closure.

Planning:

Planning is a process involved throughout the project's life cycle. The actual elements of Planning are: designing a plan, defining and analysing products, identifying activities and dependencies, estimating, scheduling, analysing risks, and completing a Plan.

Initiating a Project:

This process is very important in PRINCE2. For a project to be approved it must be carefully planned to show how it will meet its goals and objectives. This requires making

detailed costs benefit analysis. These planning and analysis are used to create the main product of this process, the Project Initiation Document, which must be approved by the Project Board before implementation can start. The actual elements of Initiating a Project are: planning quality, planning a project, refining the business case and risks, setting up project controls, setting up project files, and assembling a project initiation document (PID).

Controlling a Stage:

PRINCE2 projects are divided into stages so the project can be more easily managed and controlled. The exact number of stages is not fixed; it depends on the size of the project and the degree of risk. This process covers the day-to-day management of the project by the Project Manager. The actual elements of Controlling a Stage are: authorising work package, assessing progress, capturing project issues, examining project issues, reviewing stage status, reporting highlights, taking corrective action, escalating project issues, and receiving completed work package.

Managing Product Delivery:

PRINCE2 is a product-based system. A product can be a physical thing like a book, or it could be a more intangible thing like a service agreement. In fact everything created by PRINCE2 including documents is a product. Products can be created by anyone including external suppliers. This process creates the products of the project and is where most of its resources are used. The actual elements of Managing Product Delivery are: accepting a work package, executing a work package and delivering a work package.

Managing Stage Boundaries:

According to PRINCE2 principles, each stage must be completed and approved by the project board before the go ahead is given to proceed to the next stage. The actual elements of Managing Stage Boundaries are: planning a stage, updating a project plan,

updating a project business case, updating the risk log, reporting stage end and producing an exception plan.

Closing a Project:

An important principle of PRINCE2 is that projects must be closed down in a controlled and orderly way. This involves evaluating the project's result (The Post Project Review). Any lessons learned are recorded, a handover document is created if necessary and a post implementation review is planned. The actual elements of Closing a Project are: decommissioning a project, identifying follow-on actions and project evaluation Review.

The processes starting up a project, initiating a project and closing a project are specific phases in a project. Three processes are involved in the implementation phase - controlling a stage, managing product delivery and managing stage boundaries. The process directing a project applies for the length of the project, while planning applies for all phases except the final one - closing a project.

Not all organizations that implemented PRINCE2 actually achieved success in managing their projects. Successful implementation of PRINCE2 relies on the integration of the PRINCE2 process with existing business processes and buy-in at the appropriate management level (Borup, 2004). Successful implementation of PRINCE2 comes from those organizations that are able to separate accreditation (passing the PRINCE2 exams) from learning PRINCE2 principles and how they are best applied locally. The point stresses the importance of adaptation of MIS to suite NAROs research structures and its integration into management processes. Borup (2004) also suggested that before implementing PRINCE2 an organization might first want to identify its level of project management maturity. With this benchmark it can then expect to get the best out of the method, as it will have an accurate comprehension of where improvements need to be made.

Humphrey (1987) developed the software capability maturity model (CMM). CMM is a framework for assessing how reliable is the success of organisations' projects. It was designed to help United States (US) military assess their software suppliers. CMM has five maturity levels, which describes key attributes that would be expected to characterise an organisation at each level. Humphrey suggested 5 steps for CMM:

Level 1: Ad hoc. (Most firms are here) No procedures, no standards. Success depends on individual effort.

Level 2: Repeatable. Projects managed and current projects tracked. Success repeatable.

Level 3: Defined. Standards have been defined. All projects use a tailored version.

Level 4: Managed. Metrics are applied to ensure the quality of the outcome

Level 5: Optimising. The ideal situation: continuous improvement through quantitative feedback from processes.

Conclusion: Ideas from project planning and management method by Van der Weide et. al, PRINCE2 processes and CMM will be useful for developing a model for planning and managing an MIS project in NAROs (see chapter 7).

Institutionalization

Studies on institutionalization of information systems started appearing in literature towards the end of the 20th century and the beginning of the 21st century. De Man (1996, 2000, 2003) coined the phrase “institutionalization of geo-information technology” to refer to the integration of geo-information technology within organization and institutional processes. He suggested that success or failure of institutionalization of geo-information technology in organizations would depend on both technical and non-technical factors. In terms of non-technical factors, culture and participation are key factors for institutionalization (De Man 2003).

This finding is in line with Hofstede (2001) who reported that national culture plays a prominent role in the adoption of communication technologies. He suggested that cultural dimensions of individualism/collectivism and uncertainty avoidance could be used to predict the ease and speed of technology adoption. When new communication technology for example mobile phone, Internet etc. is introduced, countries that score high on uncertainty avoidance will be slower in adopting the new technology compared to countries that score low. In other words countries that avoid risk are more likely to be slow in adopting new technology.

Hofstede (2005) in his discussion on organizational models and national cultures wrote that power distance and uncertainty avoidance affects peoples thinking about organizations. He classified four models of organizations as depicted by classical authors: pyramids of people by Henri Fayol (1841-1925, French), well-oiled machines or bureaucracy by Max Weber (1864-1920, German), village markets or scientific management by Frederick Taylor (1856-1915, American), and family model by Sun Yat-sen (1866-1925, Chinese). Base on these models he plotted the position of 50 countries and three regions of the world on a power distance and uncertainty avoidance chart (see figure 2.1).

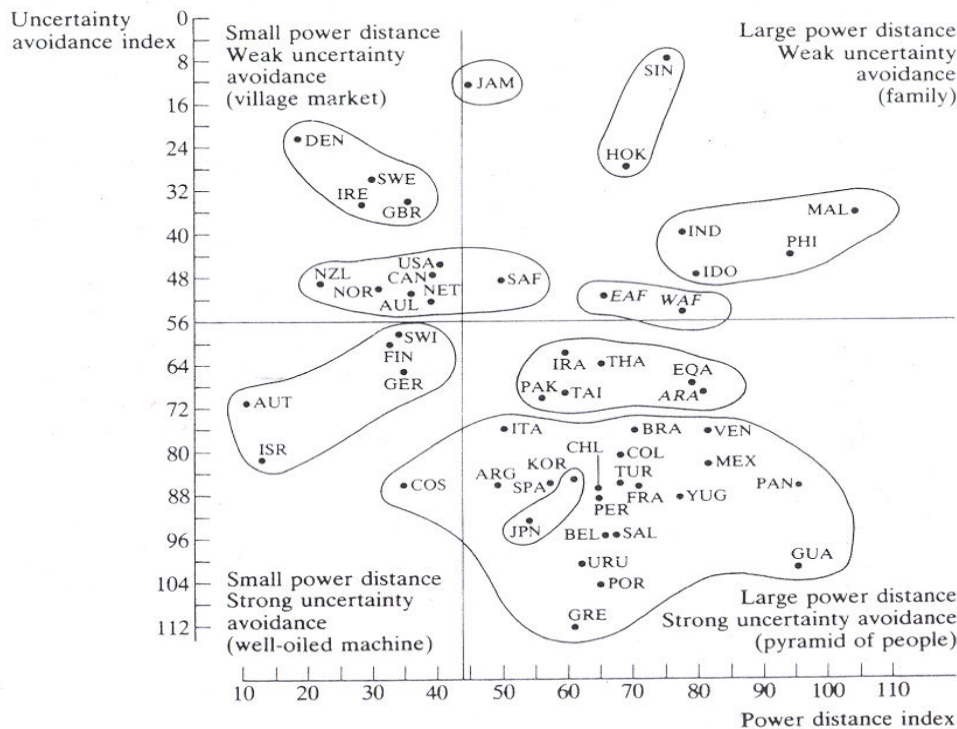


Figure 2.1: The position of 50 countries and three regions on the power distance and uncertainty avoidance dimensions (Source: Hofstede 1991).

Legend:

EAF = East Africa

WAF = West Africa

SAF = South Africa

Four groups of countries were identified: small power distance strong uncertainty avoidance (well-oiled machine), small power distance weak uncertainty avoidance (village market), large power distance strong uncertainty avoidance (pyramid of people), and large power distance weak uncertainty avoidance (family). According to Hofstede's classification, Sub Saharan African countries fall under the large power distance weak uncertainty avoidance (family) model.

Hofstede (2005) also projected Henry Mintzberg's five organizational configurations on a power distance-uncertainty avoidance matrix with preferred coordination mechanisms. He identified these classifications:

1. Adhocracy. Key part: support staff (sometimes with operating core). Coordinating mechanism: mutual adjustment. Weak uncertainty avoidance and small power distance (village market, Great Britain).
2. Professional bureaucracy. Key part: the operating core. Coordinating mechanism: standardization of skills. Small power distance strong uncertainty avoidance (well-oiled machine, Germany).
3. Full (Machine) bureaucracy. Key part: the techno-structure. Coordinating mechanism: standardization of work processes. Large power distance strong uncertainty avoidance (Pyramids of people, France).
4. The divisionalized form. Key part: the middle line. Coordinating mechanism: standardization of outputs. USA.
5. The simple structure. Key part: the strategic apex. Coordinating mechanism: direct supervision. Large power distance weak uncertainty avoidance (Family model, China and Africa).

The family model has a ruler as the country's family head or boss and whatever structure exists is based on personal relationship. In countries with large power distance, dependence on more powerful people is a basic need, which can be a real motivator. In Asian and African countries a leader is labelled the master because his power is based on tradition and charisma more than on formal position. The difference between China and Africa in Hofstede's model is that Africa is short term oriented. Musa et al (2005) in their analysis of adoption of technology in Sub Saharan Africa concluded that ICT infrastructure such as mobile phones and laptops were used as status symbol and not for enhancing standards of living.

Conclusion: The finding by Hofstede is useful because it enabled us to visualize and analyze the power and organizational structure in Sub Saharan Africa and how it may be enhanced to promote institutionalization of MIS in Sub Saharan African NAROs.

Developing Countries:

As stated above, literature on MIS implementation and institutionalization in Sub Saharan African countries is scarce. However, we tried to find IT literature that is related to the research problem in developing countries and compare it with literature from developed countries. West-view special studies (1992) report on policy issues in microcomputers applications for developing countries stated that computers awareness was zero in West African before 1960 (Jaiyesimi 1992). Nowadays, the situation has changed. The level of computer awareness has risen to a good level today. The first computer was installed in Ghana in 1962. According to Jaiyesimi, Nigeria has the highest growth rate in terms of market expansion of microcomputers. Micro computing has an important future in West Africa but the major barriers are:

1. Lack of maintenance support for computers. This has turned the area into a dumping ground for computers. There are few maintenance organizations with adequate capacity to meet the demand of the region.
2. Lack of high calibre personnel with well-rooted and broad-based appreciation for computing.
3. Inadequate infrastructure, specifically poor telecommunications and unreliable electricity supplies. In terms of telecommunications, the situation is slightly better today compared to the period when the Westview report was published. The number of fixed telephone lines and mobile telephones has increased but the major problem nowadays is constant supply of electricity to power computers.
4. Lack of national policy on computing.

Olorunsola (1997) reported that the major problems of MIS implementation in Nigerian universities were due to inadequate collection of data from students and staff and lack of cooperation from people responsible for data management. Data collection was also observed to be a problem in institutionalizing INFORM-R/INFORM-R Light in NAROs

(see chapter 1). The report by Olorunsola (1997) in essence supports our argument. Peterson et. al. (1997) using the case of personnel information system implementation in Kenya, wrote that “effective adoption of information systems requires progressive government officers: saints (champions according to Ackoff 1960) who will shoulder the risk of the reform”. They argued that it also requires that the resistors of the systems (demons) be managed and that the technical experts (wizards) be appropriate and the system be kept simple. These suggestions by Peterson et. al. (1997) could be useful as recommendations to NAROs in Sub Saharan Africa.

Broadman (1992) using ideas from management tools developed by the MAC group consulting firm in Cambridge Massachusetts, suggested four key factors to manage adoption of information technology in developing countries. “The management systems, the structure, the organizational culture, and the people, especially the importance of leadership, must be considered for successful implementation”. Broadman used the model of organization change described above to examine the adoption of microcomputers in Kenya and Indonesia government ministries. He found out that four management factors were principal determinants of the extent to which microcomputer improves the quality of decision-making. The first factor was leadership support, which proved to be essential to using microcomputers to improve decision-making. The second was the training system, especially training in the use of information, which strongly determined the people’s ability to use microcomputer to improve decision-making. The third was the incentive system in the ministries. The use of microcomputers by ministry staffs provided incentives such as higher status, satisfaction in using advanced technology and easing of workload. The fourth factor was power structure of the ministry. In ministries where power structure obstructed the use of microcomputers to improve decision-making, it was difficult to institutionalize.

Broadman reported that institutionalization of microcomputer use in the Ministry of Finance in Indonesia was considered to be the process by which microcomputer use becomes a stable, valued, and recurring pattern of behaviour. The experience of the Indonesia Ministry of Finance suggests that two factors were important for institutionalizing microcomputers. The first factor was the ability of government staff to choose, alter and develop microcomputer systems. Staffs of the Centre for Analysis of Finance Information were able to develop and modify microcomputer systems. This gave the directorate confidence to invest in microcomputers without fear of outsourcing the task to outside advisors. This factor suggests the importance of adaptation of information systems to promote institutionalization. Another important factor was that those who support microcomputer use must have control over critical resources. Ministry headquarters perceived microcomputer use to be positive whereas district office heads perceive it to be negative. The report also suggests that those involved in institutionalizing MIS must gain the support of those controlling critical resources.

2.2. ISNAR Experiences

The lessons learned from ISNAR's MIS implementation interventions in developing countries are represented in the critical success factors for agricultural research MIS (Vernon 2001). These included:

- Ensuring NAROs' awareness of their information needs
- Sensitization of NARO managers and researchers about MIS is important not only at headquarters but also at remote stations
- A champion in top management plus an operational sponsor from senior management
- Careful selection of practitioners: at least 2 MIS practitioners at each site
- Involvement of scientists, the primary source of data, from an early stage
- Production of outputs from the system soon

- Data quality
- Decentralization of MIS (from Headquarters to stations)
- Budgeting for MIS at headquarters and research stations.
- Institutionalization: Full use of MIS for PM &E has not yet been achieved.

2.3. Towards a Theoretical Framework.

Based on the literature review and ISNAR experiences we developed a theoretical framework for this research (see table 2.3). In this table we attempted to group most factors mentioned in the literature review under five main factors (leadership, organizational culture, organizational capacity, external operating environment, and institutionalization). The table will serve as a reference for the development of a causal model for institutionalization of MIS in Sub Saharan African NAROs (see figure 2.2).

Table 2.3. Theories and literature supporting MIS institutionalization causal model

Main Factor	Sub Factor	Supporting literature	Author
Leadership	Leadership involvement	1. IS implementation failure: Lack of top management support, Champions leaving the organization	(1) Ackoff (1960)
		2. Top management support	(2) Thong (1996)
		3. Management commitment	(3) Mustafa (2000)
		4. Power distance and uncertainty avoidance	(4) Hofstede (2005)
		5. Progressive government officers (saints)	(5) Peterson et. al. (1997)
		6. Leadership Support	(6) Broadman (1992)
		7. Definition of Leadership	(7) Lucey (2005)

Main Factor	Sub Factor	Supporting literature	Author
		8. Leadership	(8) Van der Weide et al (2003)
Organizational Culture	Culture	1. Culture and participation 2. National culture 3. Power distance and uncertainty avoidance 4. Organizational Culture is a powerful motivating force	(1) De Man (2003) (2) Hofstede (2001) (3) Hofstede (2005) (4) Broadman (1992)
	Incentives/Reward Systems	1. Higher status, satisfaction in using advanced technology and easing of workload (Indonesia and Kenya) 2. Incentives and institutional development 3. Incentives	(1) Broadman (1992) (2) Israel (1989) (3) Van der Weide et al (2003)
	Transparency of information sharing	1. Transparency of net chain	(1) Hofstede et al (2004)
Organizational Capacity	Information Management Capacity	1. Computer awareness in West Africa 2. Lack of high calibre personnel in West Africa 3. Training in the use of information for decision-making 4. Team quality 5. IT education for managers and IT policy development	(1) Jaiyesimi (1992) (2) Jaiyesimi (1992) (3) Broadman (1992) (4) Van der Weide et al (2003) (5) Beulens (1992)

Main Factor	Sub Factor	Supporting literature	Author
		by managers	
	ICT Infrastructure	1. ICT Infrastructure used as status symbol in Africa 2. Poor telecommunications and unreliable electricity supplies. 3. Lack of maintenance support for computers 4. Lack of mandate and resources 5. Organizations having the right and functioning ICT infrastructure in place	(1) Musa et al (2005) (2) Jaiyesimi (1992) (3) Jaiyesimi (1992) (4) Van der Weide et al (2003) (5) Beulens (1992, 1996)
	Adoption	1. Innovation decision process 2. Unifying model of adoption in information systems 3. Process of implementing decision support system 4. Cultural dimensions of individualism/collectivism and uncertainty avoidance	(1) Rogers (2003), (2) Kwon and Zmud (1987), (3) Mora (2004) (4) Hofstede (2001)
	Adaptation	1. Staff ability to develop and modify microcomputer systems (Indonesia) 2. Adaptation can lead to adoption	(1) Broadman (1992) (2) Douthwaite (2002), Schrest (1999)
	Organizational	1. Power Structure	(1) Broadman (1992)

Main Factor	Sub Factor	Supporting literature	Author
	Structure	obstructed use of microcomputers (Indonesia and Kenya) 2. MIS can create power and shift the position of power in organizations 3. Political Reality	(2) Hobbs (1999) (3) Van der Weide et al (2003)
	Resistance to change	1. User Resistance to change 2. User participation and communication. 3. Poor system design and interaction between system and organization. 4. Resistance to change	(1) Ackof (1960) (2) Davis (1974, 1975) (3) Markus (1983) (4) Van der Weide et al (2003)
	Management of change	1. Management of change: Force field analysis 2. Successful Project Management 3. Prince2 project management Processes 4. CMM methodology 5. Innovation decision processes model 6. Unifying model of adoption in information systems 7. Soft system methodology	(1) Lewin (1952), (2) Van der Weide et al (2003). (3) Bradley et al, 2005 Borup, 2004, (4) Humphrey (1987) (5) Rogers (1995, 2003) (6) Kwon and Zmud (1987) (7) Checkland (1990)
External Operating	Government	1. Sub Saharan	(1) Beye (2002)

Main Factor	Sub Factor	Supporting literature	Author
Environment	Support	African Gov't Investment in Agric research in 1960s 2. Decline in Gov't Investment in Agric research in late 80s and 90s. 3. Bureaucratic and political realities in organizations 4. Policy instability in Sub Saharan Africa	(2) Byerlee (1998) (3) Van der Weide et al (2003) (4) Idachaba, 1998
	Donor Support	1. Funding of Agric research 2. Budgeting use as control mechanism by donors	(1) Roseboom (2002) Van der Weide et al (2003) (2) Bruneau (2001)
Institutionalization		1. Institutionalization of geo-information technology 2. Institutionalization in education 3. Institutionalization as final stage of innovation adoption process 4. Institutionalization of MIS not achieved in NAROs.	(1) De Man (1996, 2000, 2003) (2) Kramer (2000) (3) Kishore and Mclean (1998) (4) Balaguru et.al. (1994), Vernon (2001), Webber (199, 2000, 2001, 2002)
	Data collection	1. Inadequate collection of data in Nigerian universities 2. Information on past and current research activities lacking	(1) Olorunsola (1997) (2) Beye (2002)
	Decision making	1. INFORM for	(1) Nestel and

Main Factor	Sub Factor	Supporting literature	Author
		decision making 2. MIS for decision making	Govert (1991), Vernon (2001) (2) Lucey (2005)
	Performance of NAROs	1. MIS for human resource improvement 2. Organizational performance assessment model	(1) Brush and Kramer (1997) (2) Lusthaus (1995, 2002), Peterson (2003)
	PM&E and Reporting in NAROs	1. PM and E institutionalization 2. Research management processes and MIS	(1) Horton (2000) (2) Vernon (2001)

Table 2.3 presents an overview of the main factors, sub factors and the underlying literature supporting the causal model in section 2.4.

2.4. MIS Institutionalization Causal Model

A causal model is a model used to explain relationships between dependent and independent variables. The MIS institutionalization causal model was developed during the Mansholt research methodology course in Wageningen in 2002 (see Verschuren 1999) and subsequent meetings with Prof. Beulens and others. The factors used for the model was derived from the literature review in this thesis and the framework came from ideas from organizational assessment framework developed by Universalia and the Canadian International Development Research Centre (IDRC) (Lusthaus et al, 1995, 2002), ideas from general management literature and Information systems implementation literature, and ideas from ISNAR experiences with MIS implementation in developing countries NAROs. The intent of the model was to guide data collection and analysis in four Sub

Saharan NAROs and to represent the causal relations needed to generate explanations of the findings on institutionalization of MIS in these NAROs.

IDRC –IDB Organizational assessment framework

An organization is made up of people working together to achieve a shared goal (Lusthaus 2002). Frameworks for assessing organizations can help to present the model of the organization, for example the organization as a political arena or as an open system (Horton 2000). The Universala - IDRC organizational assessment framework was first developed in 1993 and published in 1995 (Lusthaus 2002). It was used for analysing the strength and weaknesses of organization in relation to their performance and for strengthening capacity of research centres and NGOs supported by IDRC capacity development initiatives. IDRC and Inter-American Development Bank (IDB) published a second edition of the framework in 2002 for improving performance of organizations generally. The model stipulates that an organization's performance is a function of its operational environment, motivation and capacity. Operational environment is defined as the organizations' external environment, while capacity and motivation refer to the organizations internal environment.

Operational environment has to do with the political, social, legal, and economic context under which the organization is operating. Organizational capacity is related to the resources owned by the organization, for example, human, infrastructure, and financial resources. It also includes organizational structure, management systems and its linkages with other organizations. Organizational motivation is related to factors that influence the direction where the organization is heading and the energy displayed in the activities. Organizational motivation is influenced by factors such as organizational leadership, culture and incentives. Organizational performance is measured in terms of its effectiveness, efficiency and sustainability. Effectiveness is the degree to which the organization achieves its goal, efficiency is the degree to which costs are minimized and

sustainability is the degree of maintaining continued relevance and acquiring financial and other resources.

The IDRC–IDB framework is good because it is flexible to adapt to different organizational types (Lusthaus 2002). We adapted it into the MIS institutionalization model because it is defended in general management literature. Operating environment relates to organizational external environment, which are the major forces outside the organization that may potentially impact the success of the organization. An organization must adapt to its external environment or cease to exist. Organizational culture theory, and leadership theory are general management theories related to motivation. Human resources theory is a general management theory related to organizational capacity and motivation. Adoption, adaptation and institutionalization are general management theories related to management of change. Organizational performance assessment has its roots in the field of management theory. Worldwide, public- and private sector organizations are confronted with increased demands for accountability and performance. Studies have shown that an organization can perform when it fulfils its management objectives. Peterson et. al. (2003) developed an organizational performance system (OPAS) and one institute in a developing country that recently implemented the system observed a decline in publications, which came as a surprise to management; this finding prompted a search for reasons and remedies.

Another reason for adapting IDRC–IDB framework to our model was because IDRC–IDB framework was designed for strengthening capacity and performance of research centres and NGOs in developing countries.

MIS Institutionalization Causal Model (contd.)

Since this MIS institutionalization case study research is to bring about improvement in research management in NAROs, we modified the IDRC - IDB organizational assessment framework and applied it to NAROs in Sub Saharan Africa (see figure 2.2).

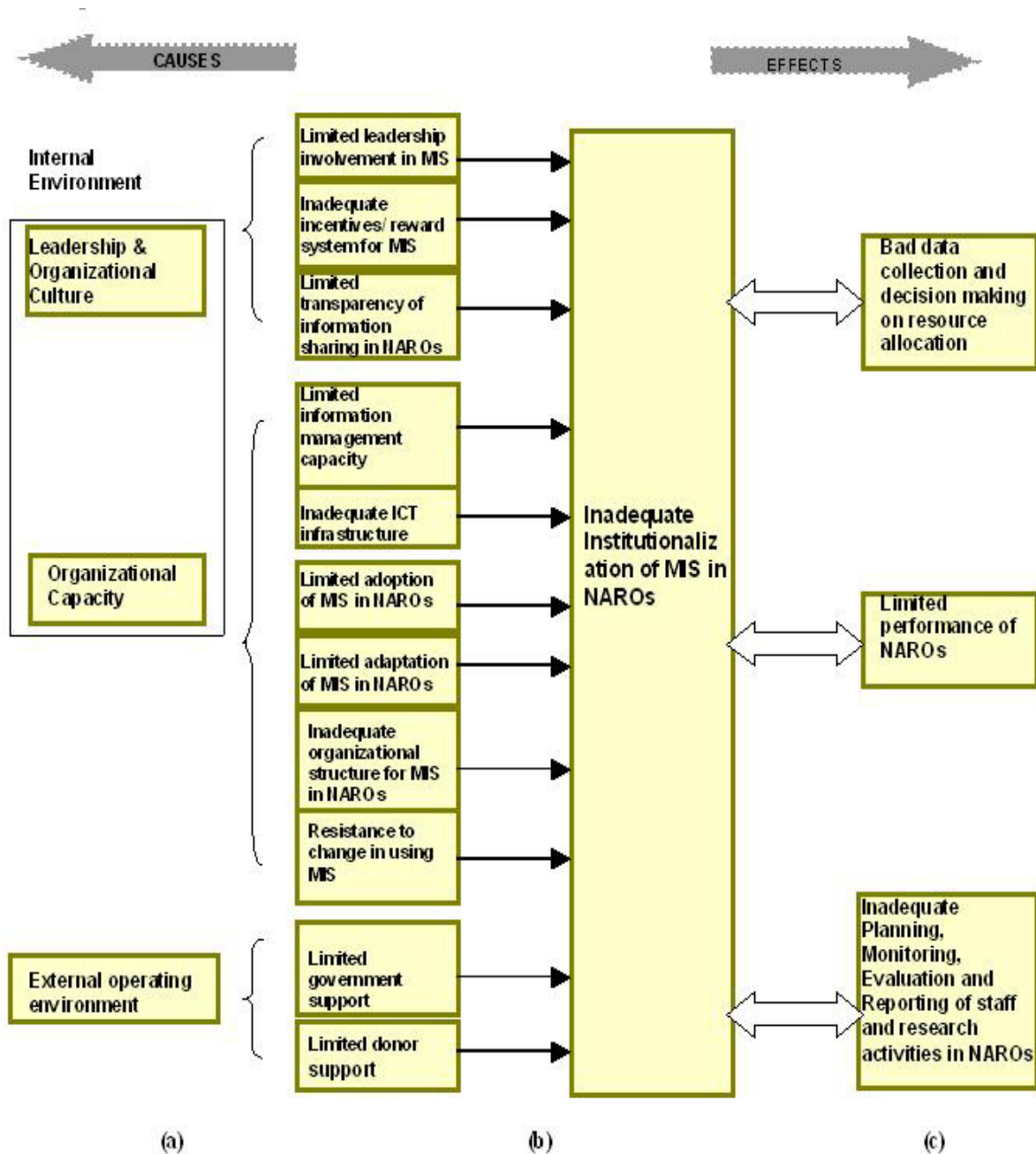


Figure 2.2: Causal Model of Institutionalization of MIS in Sub Saharan African NAROs.

Legend:

The model is divided into three parts:

- (a) the independent variables: causes of inadequate institutionalization of MIS in NAROs,
- (b) the dependent variable: inadequate institutionalization of MIS in Sub Saharan NAROs, and
- (c) the effects of inadequate institutionalization of MIS in NAROs.

The left arrows point to the causes of inadequate institutionalization and the right arrows point to the effects of inadequate institutionalization.

The model stipulates that institutionalization of MIS is a function of NAROs leadership/organizational culture, organizational capacity and operational environment. Leadership/organizational culture and organizational capacity refer to NAROs' internal environment while operational environment is defined as NAROs external environment.

We used the causal model for this research in order to try to better understand the relationships that exist between the critical success factors and institutionalization of MIS. There are many factors that affect institutionalization of MIS as described in the literature above but the factors in our causal model were chosen because they were relevant to the problem statement, goals and objectives of this research. The factors are defined and the reasons for choosing them are also elaborated in the terminology section of this chapter (see section 2.5).

Leadership and organizational culture refer to internal factors in the organization:

- Limited Leadership involvement in MIS
- Organizational culture
- Inadequate Incentives and reward system for MIS
- Limited Transparency of Information Sharing in NAROs

Organizational Capacity refers to resources, knowledge and skills of the organization:

- Limited Information management capacity (Skills and knowledge of staff)
- Inadequate ICT Infrastructure in NAROs
- Limited Adoption of MIS software package in NAROs
- Limited Adaptation of MIS software package in NAROs
- Inadequate Organizational structure for MIS in NAROs
- Resistance to change in using MIS

Operational environment: the external environment in which NAROs carry out their activities

- Limited Government (political and financial) support
- Limited Donors (political and financial) support

Institutionalization of MIS:

- Inadequate Institutionalization of MIS (Extent of Institutionalization of MIS and continuity)
- Bad Data collection and Decision-making on resource allocation
- Inadequate Planning, Monitoring and Evaluation: Use of MIS for Planning, Monitoring, Evaluation and Reporting of staff and research activities
- Limited Performance of NAROs (in terms of quality and quantity of research outputs).

2.5. Terminology and their Usefulness in the Causal Model

Internal Environment

Leadership

Lucey (2005) defined Leadership as the ability to influence the behaviour of others. Leadership in organizations includes the leader being able to exert influence within a working group so that the group or organization may achieve its task or objectives. A leader is different from a manager. Managers are people who do things right and leaders are people who do the right things (Lucey, 2005). Leadership involvement of NARO managers in institutionalization of MIS means NARO managers are able to influence, motivate, steer and inspire their staff to participate in institutionalizing MIS in their organization and ensuring its' continuity. In this research we will evaluate the roles played by top managers (Director Generals, Directors of research, Directors of administration/finance, Directors of PM&E and institutes/stations Directors) and

researchers in the institutionalization process. We will also evaluate their levels of involvement and how they used INFORM-R and INFORM-R Light for decision-making.

ISNAR's MIS guidelines states that NAROs top management should be heavily involved in managing, setting direction, supporting resource allocation and ensuring that the task of institutionalizing MIS as a change process is accomplished. They should have a good overview of the MIS software package for PM&E and what it requires in terms of staff time and the benefits for the organization. They should be active users of the system and should demand outputs from the system and ensure that it is used for priority setting, planning budgeting, monitoring and evaluation.

Organizational culture

Organizational cultures are the values, beliefs, customs, traditions and meanings held by people in an organization, in terms of how the organization operates and how best to behave in it (Broadman 1992). These values and beliefs etc. strongly influence peoples' behaviour. Organizational culture is therefore a powerful motivating force (Broadman 1992). In order to implement organizational change, for instance institutionalization of MIS, it is important to identify the existing values, beliefs etc. and determine which of these must change in order to ensure successful institutionalization. In this research, we evaluate the strengths and weaknesses of NAROs information management culture and how they affect institutionalization of MIS and we intend to change NAROs staffs existing attitude and behaviour towards information management (as described in the problem statement, see chapter 1).

Incentives / reward system

According to English dictionary, incentive is defined as something, such as the fear of punishment or the expectation of reward that induces action or motivates effort.

Disincentive is something that prevents or discourages action; a deterrent or negative motivational influence.

An organizational incentive is understood to be the way the organizations' reward structure encourages or discourages productivity and creativity of its staff. Israel (1989) reflecting on his experiences as project policy adviser with the World Bank wrote that individuals within an organization and organization as a unit operate in response to incentives or influences produced by external and internal factors. External factors may be political and cultural environment or general economic situation. Internal factors may be organizational and managerial structure. He also pointed out that institutional mechanisms could cause the loss of some incentives. For instance inadequate rewards and punishments within an organization could reduce or eliminate feedback and leave people in the same position regardless of whether the impact of their actions is positive or negative.

In this research, incentives include peer recognition and prestige of MIS implementers, remuneration, access to grants, opportunity for staff promotion and intellectual freedom. We will evaluate the availability of the above-mentioned incentives and specific incentives associated with MIS such as: timely reporting on activities, time reporting, scoring of staff performance assessment in the MIS and quality of decisions made by managers. We will also evaluate disincentives that frustrated institutionalization of MIS.

Transparency in information sharing

In English dictionary, transparency is defined as the full, accurate, and timely disclosure of information. Hofstede et al. (2004) in their recent book on transparency of chains defined transparency of netchain as "the extent to which stakeholders have a shared understanding of, and access to, the product-related information that they request without loss, noise, delay and distortion". Product-related information in the widest sense may

include e.g. information about raw materials, production processes, labour circumstances, or environmental impacts (Beulens and Beers 2003). Product-related information can serve various aims, e.g. preserving identity, food safety, or adding value). Loss means that information is not transmitted: it affects completeness. Noise means that an actor adds non-relevant data to information: it affects relevancy. Delay means that an actor delays information: it affects timeliness. Distortion means that an actor changes the information either by accident or on purpose, or fails to update it if the product changes, so that the information no longer actually describes the product: it affects validity.

The benefits of transparency are the following: Transparency can enhance trust and reduce transaction costs between organizations (Hofstede et. al. 2004). It can help to ensure quality control of products and the processes from which they are generated. In crises situations in public organizations, transparency or better communication among public bodies can help tackle the problem and avoid panic by the public.

Transparency in this research is understood to be the willingness of NAROs staffs to provide and share research related information e.g. research inputs and outputs freely within and outside the organization. The transparency factor is relevant to our causal model because it was mentioned and discussed in the problem statement (see chapter 1). If NAROs staffs were transparent it would increase the level of trust, data collection and information dissemination in and outside NAROs. In this case study we would evaluate the level of transparency in sharing information in NAROs and how it affects institutionalization of MIS.

Information Management Capacity

Information Management Capacity for the purpose of this research is understood to be the skills and knowledge required to use information systems / decision support systems to collect, store and process data into information, generate reports, and the skills required to

disseminate (communicate) information to managers, researchers etc. within the organization and stakeholders outside the organization for the purpose of decision-making and administration. This also means the ability to use computer hardware, software (databases) and networking facilities for decision-making and administration.

Beulens (1992) in his inaugural speech for Professorship stressed the importance of education for managers and IT users on IT applications in the future. He stated that managers must take responsibility of developing corporate IT policies for the realization of strategic applications. IT users must participate and use the applications in the correct manner. In this research, we will evaluate the information management capacity level of NAROs managers and researchers in using INFORM-R, INFORM-R Light and other information systems packages. Specifically, we will evaluate their capacity in performing data capture, entry, manipulation (querying) and retrieval, preparation of reports, information dissemination, information interpretation, decision making skills and database design skills.

Information and communication technology (ICT) Infrastructure

ICT Infrastructure for the purpose of this research is defined as computer hardware, software, and networking facilities used to collect, store and process data into information, and disseminate (communicate) information to managers, researchers etc. within NAROs and stakeholders outside the organization.

Beulens (1992, 1996) also stressed the importance of having the right and functioning ICT infrastructures in place for successful information systems implementation. In this research, we will evaluate the level of computer hardware, software and networking facilities in NAROs and how the availability or non-availability (where and when needed) of these infrastructures affected institutionalization of MIS.

Adoption of MIS (INFORM-R and INFORM-R Light)

Rogers (2005) defined adoption as a decision to make full use of an innovation as the best course of action available. Rogers in his book diffusion of innovations 5th edition proved that adopters of any new innovation or idea could be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%), based on Bell curve mathematic division. He suggested that each adopter's willingness and ability to adopt an innovation would depend on their awareness, interest, evaluation, trial, and adoption. In this research we use Rogers' definition of adoption and extended it with implementation and use.

Adaptation of MIS (INFORM-R and INFORM-R Light)

CGIAR research on adoption of technologies has shown that adaptation of an innovation can lead to its' adoption and use (Sechrest, 1999). Douthwaite (2002) published a book based on his PhD thesis at the International Rice Research Institute (IRRI) one of the 15 CGIAR institutes. Douthwaite reported that in 1994 the German development cooperation (GTZ) funded the Philippines Rice Research Institute (PhilRice) to adapt the stripper-harvester for farmers in the Philippines. Neither PhilRice nor IRRI were able to standardize the quality of the machines produced by large manufacturers, as a result farmers did not adopt it. Four years of research and adaptation of the machine to suit local conditions by IRRI resulted in the adoption of the technology by Philippine farmers.

Adaptation of INFORM-R and INFORM-R Light is understood to be the process of customizing the systems to suit NAROs research management processes (planning, budgeting, monitoring, evaluation and reporting) and research structures (divisions, programs, projects and experiments). In this research, we will evaluate the extent of adaptation of INFORM-R and INFORM-R Light in Sub Saharan African NAROs: the types of modification made and whether or not the adaptation was successful.

Organizational Structure

Organizational structure does not involve only the formal lines and boxes in the organizational chart but also the division of labour for instance the power distribution, communication, and reporting structures and accountability structures. Very often, the informal power distributions in organizations are different from the formal chart (Broadman 1992). To achieve organizational change, for instance to institutionalize an MIS, it is important to understand the power distribution and based on that to shift power to support institutionalization (Broadman 1992). In this research we will evaluate how NAROs organization structures affected institutionalization of MIS.

Operating External Environment

The external environment is understood to be the forces outside the organization that determine its operation and shape. By assessing organizational external environment we mean assessing its' opportunities and threats. In this research we will assess government and donors support environment and how they affected institutionalization of MIS in NAROs. Donors and governments are the primary source of funds for research and MIS activities in Sub Saharan African NAROs. It is therefore important to evaluate how their support or lack of support affected institutionalization of MIS.

Government Support

By government support we mean the level of political support and contribution of resources by governments to Sub Saharan African NAROs. The resources are government funding to support staffing, purchase of ICT infrastructure and training etc. for the MIS project in the NARO. It is important to investigate whether or not the decision to allocate resources by government bureaucrats to NAROs is very political. Government support also means the degree to which the government provides political and policy stability to the NARO. Policy instability has been a major factor that contributed to instability of NAROs in Sub Saharan Africa (Idachaba, 1998).

In this research, we will evaluate how government (political and financial and technical) support affected institutionalization of MIS. We will also evaluate the trend of government support in NAROs.

Donor support

Donors are people and organizations that are external to NAROs. By donor support we mean the level of donor funding and technical support. Technical support refers to the provision of outside (expatriate) people, (so-called) experts for the MIS project in NAROs. In this research, we will evaluate the extent to which donors' financial and technical support positively or negatively affect institutionalization of MIS in NAROs.

Critical Success Factors (CSF)

Rockart (1979) defined critical success factors as the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organization. They are the few key areas where things must go right for the business to flourish. For this research, critical success factors are understood to be the key factors promoting institutionalization of MIS in NAROs.

NAROs Performance

NAROs performance is measured in terms of its effectiveness, efficiency and sustainability. Effectiveness is the degree to which NAROs achieve their goals, efficiency is the degree to which costs are minimized and sustainability is the degree of maintaining continued relevance and acquiring financial and other resources. By internal performance we mean NAROs internal effectiveness, efficiency and sustainability. By external performance we mean NAROs external effectiveness, efficiency and sustainability.

2.6. Detailed Research Questions

Based on the above-mentioned causal model and the research questions in chapter 1.10, we developed detail research questions (which is presented in Annex 3).

2.7. Conclusion

Past and current literature focused mainly on implementation and adoption of IT, IS, MIS and ICT in developed and developing countries. Studies on institutionalization of information systems appeared in literature towards the end of the 20th century and the beginning of the 21st century. This shows the importance attached to institutionalization as the final stage of introduction of information systems in organizations or any social setting. Studies on institutionalization of MIS that deal with local organizational and technical factors in Sub Saharan Africa and particularly in the agricultural sector are scarce in past and current literature. This research attempts to fill this gap in literature and provide a better theoretical basis for explaining the critical success factors, critical failure factors, management of change and the many and complex interactions within organizations that influences peoples' behaviour, in particular their reaction to change in the institutionalization of MIS in Sub Saharan African NAROs.

In the next chapter, we report on how we used the MIS institutionalization causal model described above to design and perform four case study researches in Sub Saharan African NAROs.

PART 2 MATERIALS AND METHODS

Chapter 3. Research Design

3.1. Research Process Model



Figure 3.1 Process model of the case study research.

Legend:

The model is divided into four parts:

- (a) Literature review
- (b) Design of questionnaire, Data collection using face to face interviews
- (c) Qualitative and quantitative data analysis (SPSS software)
- (d) Recommendations for better ways of institutionalizing MIS in NAROs.

ZARI: Zambia Agricultural Research Institute

NARO: National Agricultural Research Organization (Uganda)

DRD: Division of Research and Development of the Ministry of Agriculture in Tanzania.

CSIR: Council for Scientific and Industrial Research (Ghana).

Remark: The vertical arrows separate the research phases.

Based on our analysis of factors in the causal model, MIS implementation literature and our knowledge of MIS implementations in NAROs we developed a questionnaire which I used to conduct face-to-face interviews in four Sub Saharan African NAROs namely NARO – Uganda, CSIR – Ghana, DRD – Tanzania and ZARI – Zambia. Analysis and comparisons of the results from the four case study countries would enable us to come up with recommendations for institutionalizing MIS in NAROs in Sub Saharan Africa and possibly NAROs in other regions of the world.

3.2. Case Study Methodology

3.2.1. Introduction

Case study methodology is a research strategy, which is used by researchers to understand the dynamics present within single settings. Case studies can involve either single or multiple cases, and numerous level of analysis. They typically combine data collection methods such as archives, interview, questionnaires, and observations. The evidence may be qualitative, quantitative or both. Case studied can be used to accomplish various aims: to provide description, test theory or generate theory.

In the process of designing this case study, we examined different methodologies proposed by different authors. Insights from these methods enabled us to choose the appropriate case study approach for this research. Eisenhardt (1989) wrote that the process of inducting or building theories from case studies involves eight steps: specifying a research question, selecting cases, designing research tools, collecting data, analyzing data, shaping and reshaping hypotheses, reviewing theoretical literature, and reaching a conclusion.

Discussion: We made use of Eisenhardt's method partly but since we were not building theory from scratch we considered other methods as well.

Whetten (1989) described four essential elements as building blocks for scientific theory development:

- (a) What?: which factors (variables, constructs, concepts) should be considered as part of the explanation of the social or individual phenomena of interest? Two criteria are important here: Comprehensiveness (are all relevant factors included?) and Parsimony (should some factors be deleted because they add little additional value to our understanding)
- (b) How?: how are these factors related? This involves using arrows to connect boxes, which typically introduces causality. The “what” and “how” elements constitute the domain or subject of the theory.
- (c) Why?: what are the underlying psychological, economic, or social dynamics that justify the selection of factors and the proposed causal relationships? (In other words, what are the theory’s assumptions? Why are the factors selected?)
- (d) Who?, Where?, When?: these questions concerns how a theory (or model) can be validated, generalized and it’s limitations.

Discussion:

We made use of Whetten’s method in the development of our MIS institutionalization causal model (see chapter 2). The ‘what’ element was used in identifying the dependent and independent variables in the causal model, the ‘how’ element was used in connecting the variables in the causal model, the ‘why’ element was used in table 2.3 and section 2.5 of this thesis. The ‘who’ element was used in identifying the respondents (researchers and managers in Sub Saharan African NAROs), the ‘where’ element was used in identifying the case study countries and the ‘when’ element was used in specifying the period in which this research should focus. Again since our research is not limited only to theory building from scratch we considered other methods as well.

Checkland (1990) developed soft system methodology (SSM) as an approach for solving soft problems, which have large social, political and human activities components. Hard problems are distinguished from soft problems because they can be well defined and definite solutions can be found. Soft problems are not problems per say but problems situations, which are difficult to define. Checkland proposed seven stages for using SSM for solving soft problem situations:

1. Find out about the problem situation. Conduct basic research into the problem area. Who are the key players? How does the process work now? etc.
2. Express the problem situation through Rich Pictures. As with any type of diagram, more knowledge can be communicated visually. A picture is worth a 1000 words.
3. Select how to view the situation and produce root definitions. From what different perspectives can we look at the problem situation?
4. Building conceptual models of what the system must do for each root definitions. You have basic "Whats" from the root definitions. Now begin to define "Hows".
5. Comparison of the conceptual models with the real world. Compare the results from steps 4 and 2 and see where they differ and are similar.
6. Identify feasible and desirable changes. Are there ways of improving the situation?
7. Recommendations for taking action to improve the problem situation. How would one implement the changes from step 6?

Discussion:

Checklands' SSM is relevant to our research because it deals with steps on how to manage change and recommendations for taking action to improve problem situations. We made

use of many aspects of SSM in this research but my feeling is SSM is too generic for that reason we considered other case study method that is specific to MIS.

This research project adopted the MIS case study design approach as described by Yin (1989, 1993, 2002, 2003), to explain the critical success and failure factors for institutionalization of MIS. Yin stated that to be able to design a good MIS case study, it is important to take these points into consideration:

- Define the case
- Decide whether to do a single or multiple case studies. If multiple, decide whether they will be done in parallel or in sequence; and if in sequence, it is important to state the order.
- Decide how the case will be related to time, participants and relevant evidence
- Describe what one is seeking to prove, conclude or observe.
- Decide the type of interview, whom to interview and for how long
- Decide what to do with other sources of evidence and what would happen if things change drastically during the field work
- Decide what to do with notes and other materials during write-up.
- In generalizing to other cases, it is useful to list several possible conclusions related to the current case study separately; then list several possible conclusions that may be related to other MIS case studies and then compare the difference.

Discussion:

The case for this research was stated in the problem statement (see section 1.6). We performed multiple case studies in sequence and the order was as follows: Zambia, Tanzania, Uganda and Ghana. With regards to time, we investigated the extent of institutionalization of MIS at the time of this research in the four NAROs i.e. January 2004 and also reflected on the period from 1995 to 2004 (see chapter 6: discussion section). In

this research we seek to get insight into factors promoting and frustrating institutionalization of MIS in the four NAROs.

A questionnaire was developed based on variables in the causal model in figure 2.2 and the research questions. A face-to-face interview method was used to obtain data from managers and researchers in the four case study countries. Their location is shown in figure 3.2. Annual reports and historical data sets and documents from NAROs and ISNAR were also collected. They were used to triangulate and corroborate the results from the interviews.

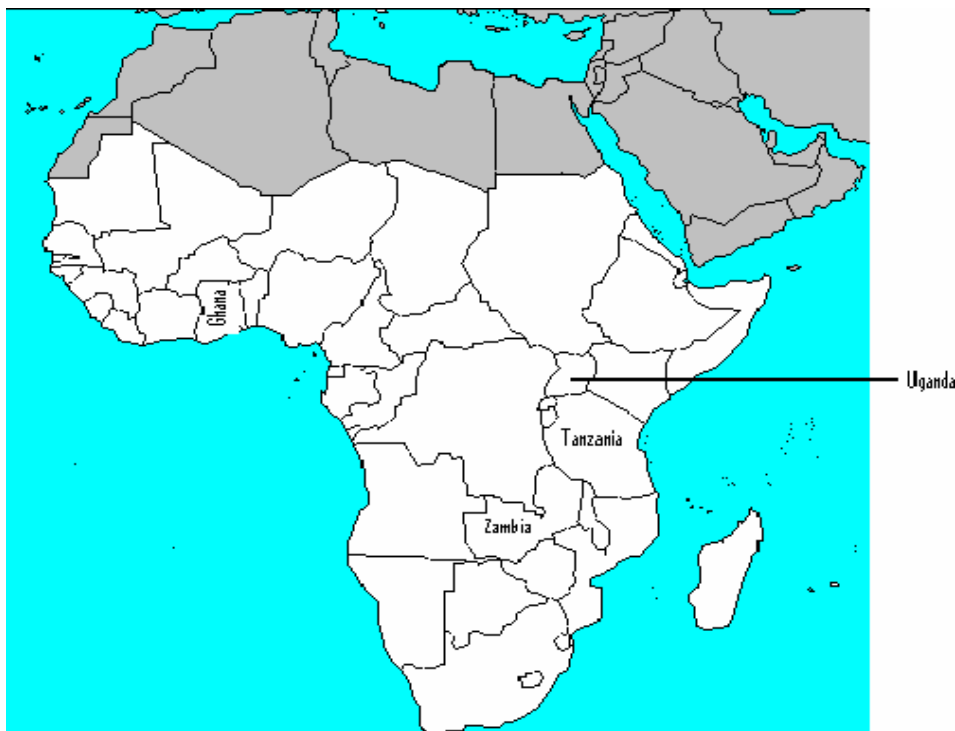


Figure 3.2: Map of Sub Saharan Africa

Adapted from World Regional Geography GEG 101 Online website.

3.2.2. Selection of Case Study Organizations

National Agricultural Research Organizations (institutes or stations) in the case study countries were involved in the research. In the case of Zambia, the Zambian Agricultural

Research Institute (ZARI) at Mt Makulu, Chilanga Lusaka was selected for the research because INFORM-R was initially tested here for the first time in 1995 and implemented in 2000. In Uganda we selected NARO: The National Agricultural Research Organization in Entebbe. NARO has implemented INFORM since 1992 and INFORM-R Light since 2001. The Council of Science and Industrial Research (CSIR) in Ghana was our third choice because this organization has also implemented INFORM since 1994 and INFORM-R Light since 1997. The Division of Research and Development (DRD) of the Ministry of Agriculture in Dar es Salaam Tanzania was our fourth choice because it has implemented INFORM since 1993 and INFORM-R Light since 2000. The idea for this research was to compare the best case with the worst case and come up with a better recommendation for institutionalization of MIS in NAROs.

3.2.3. The Study Team

To conduct the study in these countries, we formed a team with the MIS National coordinators of each country and the station or institute MIS practitioners. The National Coordinators are staff responsible for the in-country coordination, training and implementation of MIS in NAROs. MIS practitioners were responsible for the day-to-day operation of the MIS at each station/institutes (their duties were for instance data capture & entry, processing, preparation & distribution of reports at station or institute level). The National Coordinators and MIS practitioners were my informants (an informant is someone who furnishes linguistic or cultural information to a researcher). I referred to them here as informants just for helping in the logistics of the research. But regarding the research itself, they filled in questionnaires and participated in the interviews just like other respondents. The informants assisted me to organize the interviews and ensure that relevant and reliable data were collected. They were selected on the basis of their work experience on MIS and knowledge of their NARO.

3.2.4. Selection of Respondents

Respondents were people who filled in the questionnaire and gave answers to the interview questions. The research questions included managers, and researchers as key respondents. Managers were selected because of the leadership problems, and researchers were selected because of the resistance to change problems described in the research problem statements. By research managers we mean senior-level staff responsible for directing and controlling researchers and research activities (programs, projects and experiments). This includes top management (Director General, institutes/stations directors, head of administration and finance) and middle management (program and project leaders). By researchers, we mean all staffs within the organization that are responsible for the implementation of research activities. This includes senior scientists, junior scientists, technicians and MIS coordinators. The respondents were selected randomly.

3.2.5. Pre-trial Field Research Process: Expert Consultation

In the process of designing the research, I had several meetings with my Promotor and Co-promotor. Their advice and recommendations were useful in shaping the research and coming up with a useful case study design.

After designing the case study and developing the questionnaire, three professional staffs from ISNAR, who are knowledgeable in the area of MIS implementation, case study methods, PM&E and developing countries were consulted for expert validation of the questionnaire. They critically evaluated the questionnaire and provided very useful contributions. The questionnaire was also validated with thirteen participants who attended the international MIS workshop at ISNAR in December 2003. Among these participants, 10 came from the Indonesian Agency for Agricultural Research and Development, three from international organizations: International Rice Research Institute (IRRI – The Philippines), International Centre for Insects and Plant Ecology (ICIPE –

Kenya) and the International Centre for Integrated Mountain Development (ICIMOD – Nepal).

To get an impression from a research organization in a developed country, I validated the questionnaire with the Director of management at the agricultural economics institute (LEI) in The Hague. This exercise was very useful because I learned about how LEI was institutionalizing its Management Information System.

I also made use of the questionnaire to interview the Zambia MIS national coordinator, who was pursuing his MSc degree in natural resource management and GIS at the international earth science institute in Enschede. This preliminary interview was useful for improving the questionnaire and structuring the interview process. The final version of the questionnaire was sent to the MIS national coordinators of the four case study countries to distribute to respondents before field research.

3.2.6. The Most Important People and Observations

The research design indicated research managers and researchers as key respondents and MIS practitioners as key informants. During this research in the four case study countries I was able to interview the respondents and informants as planned (see activity schedule in annex 5). The total number of respondents and informants interviewed was 49. The breakdown with respect to countries was: Zambia 8, Tanzania 15, Uganda 11, and Ghana 15. Zambia had few respondents because of high rate of researchers attrition and some were not available at the time of the research.

3.2.7. Assessment of Time Spent

The questionnaire had 18 questions with sub questions. These questions were derived from 8 major variables namely: institutionalization, leadership involvement, information

management capacity, organizational culture, external support: government and donors, organizational structure, critical success factors and management of change. I sent the questionnaire to the MIS national coordinators of the four countries before travelling to the field. The questionnaires were subsequently distributed to the respondents and informants. Those who received the questionnaire and read it on time were able to answer the questions within 40 minutes while those who did not read the questionnaire spent about an hour. One and half hours were spent on group interviews with researchers. In contrast about 20 to 30 minutes were spent on interviews with director generals except the Director General of Zambia agricultural research institute, who took a bit longer than an hour.

3.2.8. Assessment of the Open and Closed Questions

The open questions were very detailed and useful for the interview process. They enabled the respondents and informants to discuss in detail, factors promoting and hindering MIS institutionalization in NAROs. Most respondents and informants were satisfied with the number of questions and interview time except a few who suggested reduction of questions. In essence, all questions in the questionnaire were based on the causal model. The questions related to institutionalization were developed to establish the extents of institutionalization of the MIS in NAROs. Institutionalization is therefore regarded as the dependent variable. The other factors such as leadership involvement, information management capacity, organizational culture and structure, external support: government and donors were the independent variables. They were discussed in detail in order to better understand their effects on institutionalization of MIS in NAROs. Questions related to critical success factors were developed to identify and summarize key success and failure factors based on the independent variables mentioned above and other new variables that arise from the field. The questions related to management of change were meant to help to recommend a better way of working for institutionalizing MIS in NAROs.

The open questions played a qualitative role while the close-ended questions were used to confirm the qualitative results in chapter 4.

3.2.9. Statistical Methods

By using quantitative analysis for this research, we were interested in analyzing relationships that exist between the independent variables in the causal model (leadership involvement, adoption, adaptation, ICT infrastructure, government support, donor support, and information management capacity) and the dependent variable (institutionalization of MIS). To achieve this aim, we made use of Correlation, Scatter plots and Regression analysis in SPSS software.

Correlation

Correlation is a measure of linear relationship between two variables, Field (2000). Correlations can be positive, neutral, and negative. Positive correlation would mean that the more an independent variable in the model exist or is being practiced by NAROs, the more MIS would be institutionalized. Neutral or no correlation would mean institutionalization of MIS would stay the same regardless of the time and effort of NAROs in improving that variable. Negative correlation would mean the more the independent variable is being practiced by NAROs, the worse institutionalization of MIS would become. To know whether two variables are related, it is useful to calculate the covariance. The standardized covariance value is known as a correlation co-efficient (symbolized with the letter r). It is the primary measure of correlation. Correlation coefficient can have a value between -1 and $+1$. A correlation coefficient of $+1$ means that the variables are positively correlated, and a coefficient of -1 indicates negative relationship. Coefficient of zero indicates no relationship at all.

A closely related companion measure of linear correlation is the coefficient of determination, symbolized as r^2 , which is simply the square of the correlation coefficient. The coefficient of determination can have only positive values ranging from $r^2=+1.0$ for a perfect correlation (positive or negative) down to $r^2=0.0$ for a complete absence of correlation. The advantage of the correlation coefficient, r , is that it can have either a positive or a negative sign and thus provide an indication of the positive or negative direction of the correlation. The advantage of the coefficient of determination, r^2 , is that it provides an equal interval and ratio scale measure of the strength of the correlation. In effect, the correlation coefficient, r , gives you the true direction of the correlation (+ or —) but only the square root of the strength of the correlation; while the coefficient of determination, r^2 , gives you the true strength of the correlation but without an indication of its direction.

Regression

Correlations can tell us about the relationships between variables but they are not able to tell us about the predictive power of the variables. The term regression literally means backward movement. The basic concept is the same as correlation, but the word movement is added into regression. That is essentially two variables, moving together. When we measure the linear correlation of two variables, what we are in effect doing is laying out a straight line that best fits the average "together-movement" of these two variables. That line is referred to as the line of regression, and it used not only as a device for helping us to visualize the relationship between the two variables but it can also serve as a basis for making rational predictions (Field 2000).

When we perform the computational procedures for linear correlation and regression, what we are essentially doing is defining the straight line that best fits the bi-variate distribution of data points. The criterion for "best fit" is that the sum of the squared vertical distances between the data points and the regression line must be as small as possible. The

slant of the resulting line will correspond to the direction of correlation (upward, +; downward, —); and the tightness of the data points around the line will correspond to the strength of the correlation. You can think of the regression line as representing the average relationship that exists between X and Y, as observed within a particular sample. The location and orientation of the regression line are defined by two quantities, referred to as regression constants:

a = the point at which the line crosses the Y axis (the 'intercept'); and

b = the rate at which the line angles upward or downward along the X axis (the 'slope').

Scatterplot:

A scatterplot is a standard method for graphically representing the relationship that exists between two variables, X and Y, in the case where each particular value of X_i is paired with one particular value of Y_i .

Statistical significance

In most areas of scientific research, the criterion for statistical significance is conventionally set at the 5% level. That is, an observed result is regarded as statistically significant—as something more than a mere fluke—only if it had a 5% or smaller likelihood of occurring by mere chance coincidence. Otherwise, it is regarded as statistically non-significant (Lowry, 2005).

3.3. Data Analysis

Qualitative and some quantitative data were generated from 49 respondents and informants. Four NAROs were the research units and research managers and researchers were the observation units. A PC-based sound recorder was used to record the proceedings of the face-to-face interviews. Thereafter, a database called “MIS institutionalization” was developed for data entry and storage. For open-ended questions with categories to choose, we counted (frequency) the numerical responses of

respondents/informants, ranked the counts and then plotted a clustered bar to compare the categories and NAROs. After that we used the remarks made by respondents during the interviews to make qualitative analysis. For closed-ended questions with ordinal category variables (category variables with qualitative order e.g. awareness, interest, evaluation, trial etc.), it would not make sense to compare means so we computed minimum, median and maximum and made comparisons. For closed-ended questions with interval variables (1,2,3,4,5 etc), we computed means, standard deviations, least significant differences (LSD), and plotted a clustered column charts in SPSS and Excel software. We also analyzed correlations and linear regression.

Discussion

The choice to make use of case study methodology for this research was appropriate because we were interested in obtaining detailed information about how NAROs were institutionalizing MIS and what factors were promoting and frustrating institutionalization. We were also interested in observing and describing what was actually happening on the ground. If we chose the survey method, there is no guarantee that we will have all data needed for our analysis. One can easily send questionnaires to these organizations and wait for their responses but experience from other research show that the rates of return of questionnaires are usually between 5 to 10% that is if you are lucky. The limitations of this study are that it is not an experiment but an observational study. Therefore it is not possible to show cause – effect relationships. It is possible however, to analyze statistical relationships. The sample size (N=4: Countries) is small and it is in principle not possible to generalize our results to other NAROs outside the case study. But lessons learned from this research could be useful to other NAROs in Sub Saharan Africa and other parts of the world wishing to institutionalize MIS.

3.4. Conclusion

In general, the interviews and data collection in the four countries were very successful. The research enabled NAROs managers and researchers to discuss critically and in detail the major factors promoting and hindering MIS institutionalization in their organizations. The results of the case study research presented in the next chapters will hopefully provide useful information for improving institutionalization of MIS and research management in the four countries and probably other NAROs in developing countries.

PART 3 RESULTS

Chapter 4. Four Explanatory Case Studies

4.1. Introduction

By conducting four case studies in Sub Saharan African countries we intended to answer three questions: (1) to what extent is MIS institutionalized in Sub Saharan African NAROs? (2) What key factors promoted (critical success factors) and frustrated (critical failure factors) institutionalization of the MIS in Sub Saharan African NAROs? (3) How does institutionalization of MIS improve research management and performance of Sub Saharan African NAROs? This section of the thesis describes the four NAROs and presents the results obtained from the questionnaire and interviews. In each case we present the mission, vision, mandate, organizational structure, activities, history of MIS implementation and the results of the interviews based on the dependent and independent variables in the causal model, and CSF / CFF for each NARO. Finally, SWOT (strength, weaknesses, opportunities and threats) analysis for the four NAROs is presented in four separate tables.

4.2. The Zambia Case

Zambia Agricultural Research Institute (ZARI)

Introduction:

The Zambia Agriculture Research Institute (ZARI) is one of twelve departments in the restructured Ministry of Agriculture and Cooperatives (Final Restructuring Report of the Ministry of Agriculture and Cooperatives, 2003 Revised). The Director of ZARI is accountable to the Permanent Secretary of the Ministry of Agriculture. ZARI is a NARO that conducts basic and applied research in soils and crops for public good, food security, and for the promotion of a sustainable agricultural productivity. The institute has well

established research infrastructures in nine stations scattered through out the country and supplemented by smaller sub-stations.

In the 1997 organisational structure of the ministry of agriculture, the function of agriculture research was placed under the Department of Research and Specialist Services (DRSS). The importance of research functions was overshadowed by this arrangement as it was regarded as a sub-section of the department and hence its previous name “Soils and Crops Research Branch (SCRB)”. In 2003 the Management Development Division recommended that Zambia Agriculture Research Institute be created as a core department in the Ministry in order to strengthen the research function.

The main objective of the institute is to provide appropriate and efficient services to farmers by generating and adapting crop technologies, which will increase and diversify agricultural production. This will include the development of low cost sustainable farming systems for all major agro-ecological zones and farm sizes through participation of both public and private sectors in research activities.

Mission: The mission of ZARI is to contribute to the improvement of the welfare of the Zambian people through provision of technologies that enhance household food security and equitable income, generating opportunities for the farming community and agricultural enterprises while ensuring maintenance of Zambia natural resource base.

Vision: The vision of the ZARI is to become a centre of excellence that will provide scientific leadership in the generation and transfer of improved and appropriate technologies through partnerships involving stakeholders and beneficiaries.

Organizational Structure:

The Director of ZARI is the head of the organization. There are two branches under the Director, the Technical Services Branch and Research Services Branch. A Deputy Director, who is responsible for technical operations of the institute, heads the Technical Services Branch. Technical operations involve generation, adaptation, and dissemination of improved technologies that increase agricultural productivity. The Technical Services Branch is divided into four divisions, each headed by a Chief Agricultural Research Officer:

1. Plant Protection and Quarantine,
2. Crop Improvement and Agronomy,
3. Soils and Water Management and
4. Farming Systems and Social Sciences.

The researchers operating under this Branch are not only stationed at Mount Makulu, but can be stationed at any of the other nine research stations.

The Research Services Branch is responsible for the management, coordination and networking of the research system including the gathering, storing and dissemination of information. It is based on an agro-ecological approach. The Technical Services Branch is responsible for generating research content and research products.

The agro-ecological approach of the Research Services Branch divides the country into three regions based mainly on rainfall. These three regions are: Region I with the least amount of rainfall receiving less than 600mm per year (part of Southern and Eastern provinces), Region II with medium rainfall receiving between 600mm and 1000mm per year (Eastern, Central, Lusaka and parts of Western and Southern Province) and Region III with the heaviest rainfall receiving above 1000mm per year (Northern Province, Luapula Province, part of Copperbelt and North-Western Province)

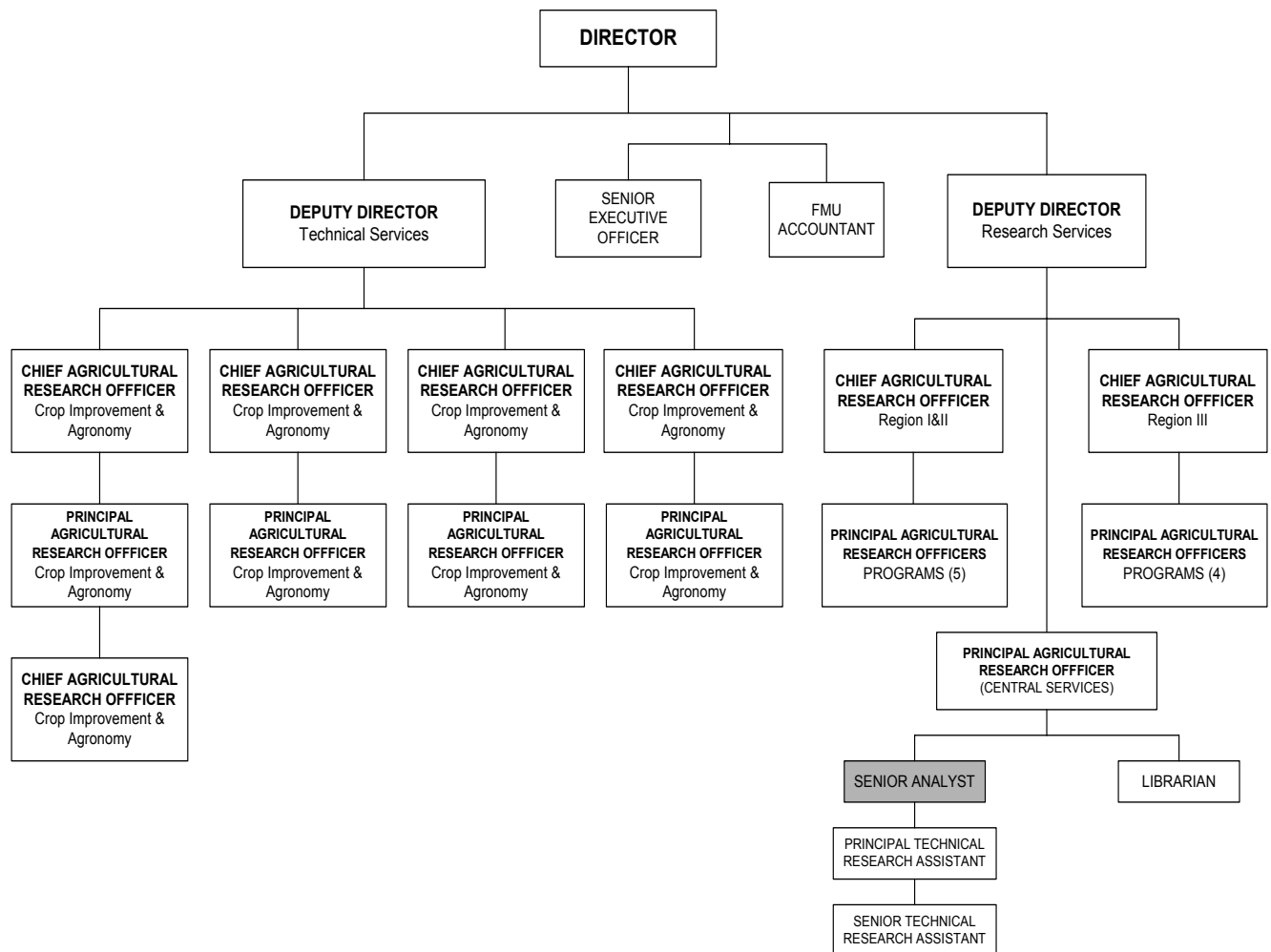


Figure 4.1: Organizational Structure of ZARI.

Source: Zambia Agriculture Research Institute Restructuring Report to Management Development Division

There are nine research stations in the country serving each of the nine provinces. Apart from conducting research, zonal research stations run outreach and farming systems programs in partnership with farmers and other stakeholders. The Biometrics Unit, which is part of the Central Services, is playing a pivotal role in the management of information processes. Under the Central Services falls also the library, which offers soils and crops information to the general public as well as to staff members within ZARI on new advances in science and technology e.g. The Essential Electronic Agricultural Library (TEEAL). The Central Services department falls directly under the Deputy Director of Research Services.

Activities:

The main activities of ZARI are technology development, resource base management, and provision of regulatory and advisory services. Technology development is carried out in crops for variety development and improvement as well as generating improved agronomic practices. Plant protection research is another important area of technology development, which aims at minimizing crop losses caused by pests and diseases. Technology development in soils research is mainly about soil fertility improvement and maintenance for sustained agricultural development.

Crops, soils and plant protection technology development follows a farming systems approach which involves testing and adapting technologies to farmers' socio-economic conditions.

History of MIS at ZARI:

ISNAR assisted and collaborated with the ZARI in the development and implementation of INFORM-R from the early 1990s to the beginning of the 21st century (Webber, 2000). The system has been used by this organization for monitoring on-going research activities, evaluation of completed research activities and aggregating information on all research personnel. It was implemented mainly at its headquarters in Mt. Makulu. This resulted in implementation difficulties such as: inadequate capture of data from remote research stations, station managers not having access to the same detail of information as managers at the national level, etc. Thus the ZARI management decided to decentralize the system to outlying research stations in order to minimize these implementation difficulties and promote efficient information management and usage culture within its organization. But in the late 1990s, ZARI had no funds to continue with implementation and institutionalization of INFORM-R.

Fortunately for ZARI, in 1999 the World Bank funded the Zambian government under the Agricultural Sector Improvement Program (ASIP). ASIP was introduced because the

government led agricultural sector performance study showed that the level of agricultural production in Zambia was low, and was very often affected by weather variations, especially by drought. ASIP had many sub-programs and “agricultural service” was one of these. The main objective of this sub-program was to increase agricultural production by improving their agricultural research and extension service. The Ministry of Agriculture took a number of initiatives to improve agricultural production to meet the challenges of food security and poverty reduction. Improving the research services was one of these initiatives.

ISNAR was invited by the Ministry of Agriculture to provide technical assistance in different areas to ZARI. One of these areas was establishing and updating a management information system for agricultural research and assisting in its decentralization to the outlying research stations. In 1999, ISNAR organized a 4-stage International Training and Implementation Project to introduce the newly developed INFORM-R and INFORM-R Light to NAROs. The stages were (a) a preparatory distance learning set of exercises (b) a 2-day sensitisation workshop for senior research managers, (c) a workshop for MIS practitioners and finally (d) support visits by ISNAR MIS staff to each participating countries. Four ZARI staffs were invited to participate in the distance-learning course. In April 2000, three staffs and two top managers participated in the workshop in The Hague, the Netherlands. In June 2000, ISNAR was invited to organize an in-country implementation and institutionalization workshop (see figure 4.2).



Figure 4.2: Participants of the MIS in-country implementation workshop in Zambia (2000).

This workshop was the fourth phase of the MIS training and implementation project organized by ISNAR for developing countries national agricultural research organizations. The workshop took place at River Motel, about 70 kilometres south on the outskirts of Lusaka. Twenty-seven people from ten research stations (Mount Makulu, Misamfu, Mutanda, Mochipapa, Mansa, National Irrigation Research Station, Msekera, Mufulira, Mongu and Kabwe) participated. The following categories of participants were present: members of Research Management Team (8), Station Managers (9), and Research Scientists (10).

During the workshop participants developed an action plan to institutionalize MIS in the ZARI. In December 2000, a follow-up and technical backstopping visit was conducted by ISNAR to support the institutionalization of INFORM-R in ZARI. In 2001, ISNAR invited

the MIS national coordinator to The Hague and provided him additional technical training on INFORM-R and the institutionalization process. In 2002, the Zambia MIS coordinator conducted another in-country MIS training bringing together the station managers in Zambia. The Michigan State University through the USAID/Food Security Research Project (FSRP), an NGO based in Zambia, supported this workshop. ZARI continued with the institutionalization of MIS until the time of this case study research in January 2004.

The case study was conducted at ZARI's headquarters at Mt. Makulu, Mochipapa Research Station in Choma (South of Lusaka), and Kabwe Research Station in central province of Zambia (see map of Zambia in figure 4.3). The results of the case study research are presented below.



Figure 4.3: Map of Zambia.

Source: University of Texas library collection:
<http://www.lib.utexas.edu/maps/africa.html>

Results of the Interviews

A. Extent of Institutionalization of MIS in ZARI

The MIS was used for data collection, data processing into information and decision-making in ZARI's management processes of priority setting, planning, budgeting, monitoring and reporting. It was also used for tracking activities for example experiments and human resources. With respect to planning processes, it was used to see which researcher is working on what. It was used at the central services at the headquarters in Mount Makulu. Program Officers also used it at research stations. They sent data back to the headquarters for inputting or updating the central database. The MIS was used for monitoring of on-farm research programmes. Top research management used the priority setting; planning and budgeting aspect of the system, while MIS practitioners used the monitoring and evaluation part of the system and researchers used the reporting part. The interactions between top Management, MIS core team and researchers were good. The system was not used for financial accounting (especially the expenditure aspect was largely neglected).

Table 4.1: Integrating MIS in Research Management in ZARI Zambia

Research	INFORM-R source- doc.	Month
General Annual Planning Meeting at ZARI Hdqrs: Peer Review, Priority Setting, Planning and Budgeting	Annual Reports, Completed Research Proposals forms, Budgets forms, List of projects, Directory of Researchers	September
Data capture: Experiments and Projects	Experiments and Project detail forms	October
Start of Financial and Research year	Management cycle	November
Board of Trustees Review Meeting	List of Experiments, Projects and Programs. Projects and Programs budgets. Lists of Researchers and their projects Organization budget/expenditure	December
Data Capture for 1 st Interim Report	Data Capture and Data Entry Forms for first interim report	January
Merge, Process & Produce 1 st Interim Report. Disseminate to managers and researchers	1 st Interim Report	February
MIS Workshop to share experience among MIS team Regional Meeting of NARO and Stakeholders to monitor and consider research priorities	INFORM-R Workshop Number of Experiments in each Commodity, Number of Experiments in each Commodity Group, Number of Experiments in each Main Discipline, Allocation of resources across agro ecological zones	March/April
2 nd Interim Data Capture: Results	Data Capture and Entry Forms- Experiments Results, 2 nd Interim reports form	May
Preliminary Proposals development for Planning	Data Capture and Entry Forms- Research proposals	June
2 nd Interim Reports generated & shared	2 nd Interim Reports	June
Stations /Institutes Meeting to review, plan and budget for projects	Experiments - Proposals, Interim reports, Budgets	July
Annual reports for all Experiments	Experiments – Annual reports	December
Data Capture: Project Proposals	Projects Proposal Forms	August
Production of Annual Report for Annual Meeting and the public	Annual Reports	August

Table 4.1 illustrates the approach used by ZARI Zambia for institutionalizing MIS in their annual research management cycle.

B. Results based on the Independent Variables in the Causal Model

1. Leadership and Organizational Culture

Leadership:

In terms of leadership role for MIS in ZARI, the Deputy Director of Research was the champion and also a user of the system. He recognized INFORM-R as an important management tool because it can capture every resource that is available in the organization, thus enabling easy management of the organization. As a patron, he participated in the April 2000 MIS training workshop for Director Generals conducted at ISNAR in The Hague, The Netherlands. He also supported and participated in the MIS in-country implementation workshop in Zambia. In that workshop he informed his staff that, “hands-on exercise was the most important aspect of the training workshop”. He seemed to have a keen interest in computers and MIS and always liked to challenge himself on practical aspects of information technology.

ZARI middle managers and researchers were mainly users of the system while MIS national coordinators facilitated MIS workshops and were involved in training and sensitization of MIS practitioners, managers and researchers on the need to institutionalize the system. They were also involved in organizing data entry, querying and generation of reports for managers and researchers.

In terms of using MIS for decision-making, national leaders said MIS was used (1) to determine how well targets were being met, (2) to check budget performance and (3) to decide on where to place scientists in terms of transfers. MIS national coordinators said

INFORM-R was used for making decision during priority setting exercise that took place in the organization. The reports from the system were printed out and the information was used in allocating funds to protocols (experiments). Researchers said they used INFORM-R for reporting about their experiments. They did this by filling in questionnaires on experiments status e.g. planted, weeded, fertilized, harvested, report written etc. They provided reports at the end of experimentation for inputting into the database.

Organizational Culture

According to most respondents, the main strength of ZARI's information management culture lies in transparency in management. Management was said to be very transparent despite lack of funds to run the projects. Another important strength was a strong reporting tradition within ZARI. Researchers provide their reports on time and the biometrics unit manage the data in INFORM-R and make it accessible to managers, researchers and stakeholders. This aspect has so far been good but feedback mechanism has dwindled due to inadequate resources.

A major weakness of ZARI's information management culture was low level of commitment by researchers partly due to dwindling government support in the last few years. Researchers were always looking for consultancies, where they could make some extra money and spend less time on conducting research and producing useful research reports. In some research stations data were accumulated but never acted on, partly as a result of inadequacies in resources for execution.

Organizational Culture: Incentives

Timely reporting is a major incentive for MIS in ZARI. For instance when tracking a trial, the first year you don't expect much, the second year is when one starts monitoring and preparing results. Finally, the third year you start concluding and coming up with

recommendations. The use of MIS enabled researchers to report problems and research findings in a timely fashion. Respondents from ZARI headquarters and stations said time reporting and the quality of decisions made by managers were other incentives that promoted institutionalization of MIS.

Organizational Culture: Disincentives

Funding for MIS was said to be the major disincentive affecting institutionalization. Most MIS Practitioners have been trained but follow-up activities did not take place because of lack of funds. IT professionals in private companies receive ten times the amount of salary paid to ZARI IT staff. This makes it difficult to retain staff in the Biometrics unit, even after investing in training them. The Biometrics unit needs to have five staff members but currently only two staffs are working in all areas of MIS, ICT and also helping staff with printing, providing paper etc. Lack of recognition of MIS practitioners was said to be another disincentive. Researchers were simply turned into MIS practitioners without clear prospects for the future.

Organizational Culture: Transparency

The level of transparency in sharing research and management information in ZARI was high. Respondents said ZARI management was also transparent. During annual planning meetings, all researchers are invited to participate. They present their research results and new proposals and get feed back from fellow researchers and management. However, there was no match between planned activities and allocation of funds. Administration expenditures were absorbed in research activities. Furthermore, each research station had an MIS Practitioner who submits data to the central research station for distribution to other scientists. But some staff members, especially the support staff, were not aware of the MIS and what it can do for the organisation.

2. Organizational Capacity

Information Management Capacity (Knowledge and skills)

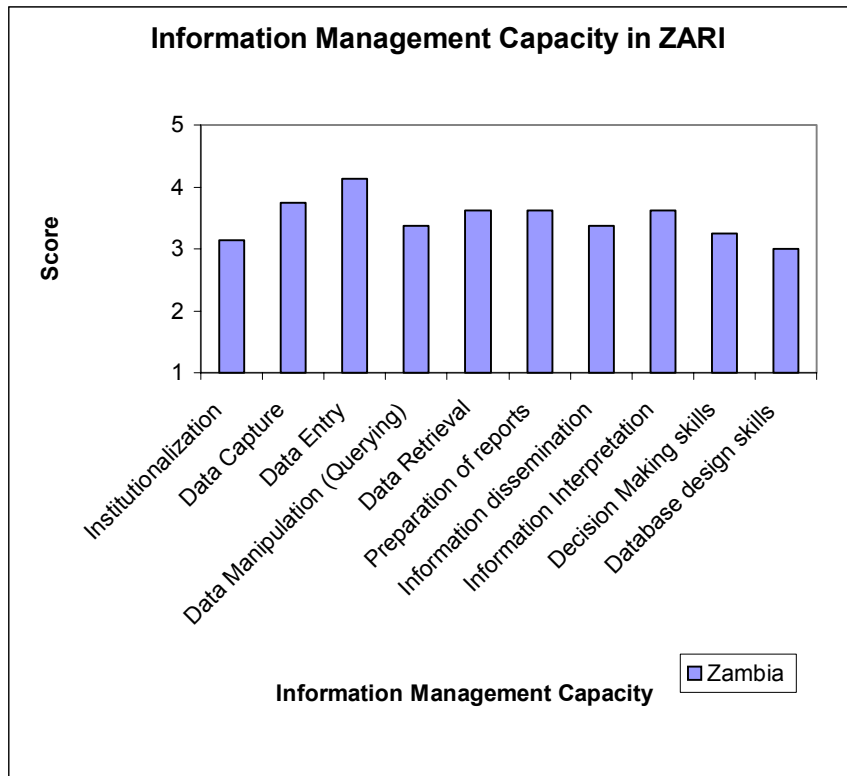


Figure 4.4: Information Management Capacity in ZARI Zambia.

Score 1 = Inadequate, 2 = Poor, 3 = Moderate, 4 = Good, 5 = Highly adequate.

Information management capacity of ZARI staff appeared to be good in most areas. The result showed that they were good at data capture, data entry, data retrieval, and information interpretation.

Good information management capacity in ZARI was obviously promoting institutionalization of MIS. In terms of extra training, ZARI top management said they would like to have extra training on querying databases, and report preparation. During annual meetings they used the outputs from INFORM-R for discussion; therefore, they would need more training in decision-making skills. Furthermore, ad hoc questions arise

in the organization very often, so they would need more training in querying the database to be able to provide answers to any question. They did not do very well in information dissemination. It would be important to have training in this area so that they can be able to disseminate their research results and new technologies to communication (extension) workers, farmers and the general public.

Middle managers, researchers and MIS practitioners said they would require extra training on database design, querying databases and web-based MIS. The national coordinator said, "As an individual, I don't require any training but if we employ another person, he would definitely require training. I would require training in web-based MIS. Dissemination of information was good but because of lack of paper sometimes reports could not be printed. Long training on MIS has been given to the MIS practitioners at Biometrics unit so it should not be used as an excuse".

ICT Infrastructure:

The level of Computer Hardware, Software and network facilities for MIS in ZARI was between inadequate and moderate according to respondents and informants. Computer hardware and software was not a very critical issue as at the time of this research but network facilities remain a source of worry.

The availability of ICT infrastructure enabled communication and information flow within ZARI, increased the moral and motivation of staff, facilitated data and information processing and facilitated decision making processes on time. This was, however, only to some extent since out of the ten research stations only four have dial-up Internet services (Mt. Makulu, Misamfu, Mochipapa and Mutanda).

Once data is captured, it can easily be entered and processed in INFORM-R. It was easy to exchange information between research stations and when reports were needed, they were easily submitted. Scientists were able to harmonize their work and avoid duplication of

efforts. INFORM-R facilitated efforts to build on past research, as information was stored for future use.

Non-availability of ICT infrastructure affected institutionalization of MIS in ZARI. Some stations like Mt Makulu and Mochipapa have Internet connection but the others are not yet connected. Even those stations that have Internet connections still face problems because the Internet connections at the time of this research were unsustainable due to poor funding and lack of phone lines. This has affected data collection from these stations. Lack of Internet connection resulted in communication problem between headquarters and stations. All stations need this facility for effective communication. Electricity is not a problem in Zambia as compared to some other African countries so if there is Internet connection then communication will become a lot easier. Another problem was lack of PCs after MIS training. This resulted in MIS practitioners losing their skills and moral. Some practitioners have not been able to apply some of the skills learnt so far. Outdated computers (with low memory and hard disk space) restricted the use of advanced software and large databases. Technology is fast changing yet in a third world country like Zambia, outdated PCs are still in use.

Adoption:

All respondents and informants from the three research stations (Mt Makulu, Mochipapa and Kabwe) said INFORM-R was adopted in their organization, except one respondent from Mochipapa who said they were at the trial stage. At the time of this research, these stations were at the stage of implementing or using the system for managing research.

Adaptation:

According to respondents and informants, INFORM-R was fairly adapted in ZARI. The research structure in INFORM-R is organized around programs, projects and experiments whereas the ZARI research structure is organized around divisions, programs, teams and

experiments. Some research activities reports in ZARI required being reported by divisions or teams so they had to adapt the system to these needs. The adaptation was mainly about replacing project level with team level and adding a new division level to the research structure in the database. The adaptation was done at the headquarters and it was quite successful but the main problem was, after each adaptation it takes long to distribute the software to research stations due to funding problems. Furthermore, research stations have no staff with database design skills due to high rate of attrition of trained MIS practitioners.

Resistance to Change and Solutions:

In general ZARI management did not resist institutionalizing the MIS. The main issue was that initially ZARI staff did not understand the usefulness and purpose of an MIS. Researchers perceived MIS to be time consuming because of filling in of forms and quarterly updating of information. This problem was solved by raising awareness among staff and management about MIS. Top management and MIS practitioners were given an opportunity to participate in MIS training at ISNAR. After that awareness, training was also given to staff and Managers in Zambia.

3. External Operating Environment

Government Support:

Government support was said to be very positive. Respondents however, said government could do better than the current situation. Most financial support to research and its activities came from donors. The current government of Zambia has put agriculture as the most important area and priority for government attention. But the problem was that funds for agriculture were not forthcoming, inadequate and releases to ZARI to carry out research activities including MIS was untimely. Zambia is one of the most highly indebted poor countries (HIPC) and donors have put conditional ties for

government to meet before writing off all or part of its debt. This has put government in a tight corner and resulted in further reductions in allocation of funds for research.

It is worth mentioning that the Government of Zambia made a bilateral understanding with ISNAR to support INFORM-R in ZARI. But the Government had other priorities and the lack of funds made it difficult for ZARI top management to institutionalise MIS. Respondents however, said the trend of government political support to ZARI was high. The government has been following with keen interest the advances made by ZARI in matters relating to MIS. The MIS coordinator for ZARI made a significant contribution to the first ever workshop called by the Ministry of Agriculture and Cooperatives on MIS held in the tourist capital, Livingstone in 2003.

Respondents and informants advised the Government of Zambia (through the Ministry of Agriculture and Cooperatives and Ministry of Finance) to change by releasing government funds on time and to provide policy guidelines for institutionalizing MIS. The policy itself should not be seen as the end of the problems. Its implementation also has to be ensured. The advantage of policy is that it can help to pinpoint what is to be done when there are conflicts. Finally, the government was advised to identify key actors (champions) for MIS.

Donors Support:

Respondents rated the trend of donor financial and technical support to ZARI as somehow positive. Donors for example the World Bank provided funds and forged a link with ISNAR to deliver MIS training and institutionalization activities at ZARI. These funds had positive effects on MIS institutionalization because it enabled ZARI staff to acquire knowledge on MIS for research management. The knowledge gained during MIS was useful for the ZARI MIS National Coordinator in identifying and taking advantage of other opportunities in ICTs. In October 2002 ZARI took part in the Round-table workshop on livelihoods organised by the International Institute for Communication and Development (IICD) to harness the use of ICTs for development. At the time of writing

this case study ZARI was one of the four organisations to have successfully completed a project proposal accepted for funding out of 19 organisations. This could lead to massive investment in ICT facilities and training for ZARI.

On the negative aspect of donors, respondents said they sometimes contribute to a drastic end to projects and lack of continuity. These factors affected institutionalization of MIS in ZARI because after the ASIP project there were no funds available to do technical backstopping and data collection in the remote research stations. During the ASIP project, the Ministry of Agriculture and Cooperatives had Internet connection at its headquarters in Mulungushi House, Ridgeway. But as soon as the ASIP funds ran out, the website was withdrawn from the World Wide Web because of insufficient funds.

When asked, what should change about donors, respondents said:

All donors should agree on a common reporting format, be more demanding on technical reporting and tie funding to how far the MIS has been institutionalized.

4. Critical Success and Failure Factors

In the questionnaire and interview respondents were requested to choose what they thought were the critical success and failure factors for institutionalization of MIS. We counted their choices and plotted bar charts. The number of respondents and informants from ZARI were eight. Factors that had less than four counts were not considered as critical success or failure factors.

Critical Success Factors:

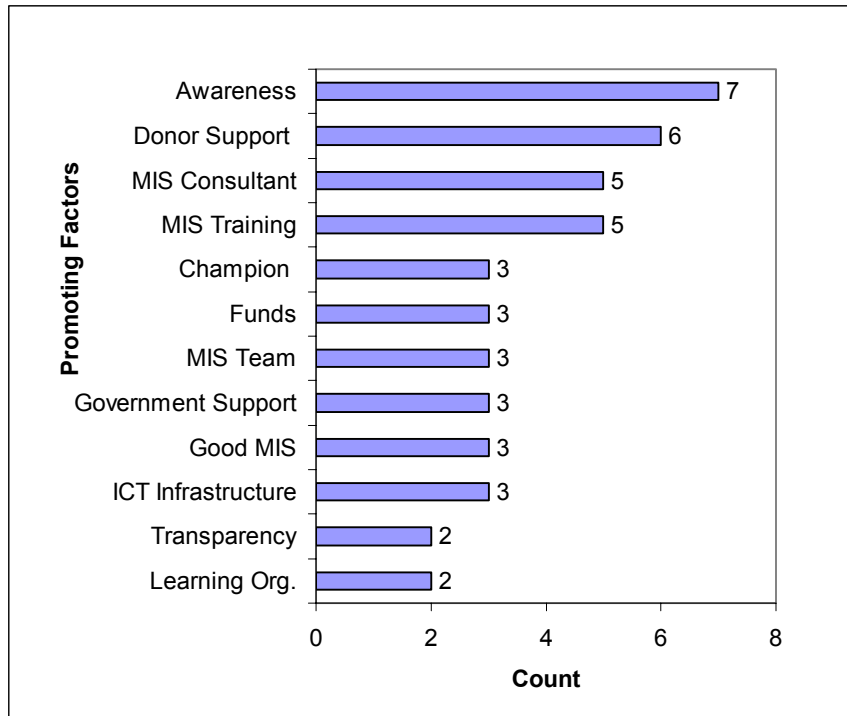


Figure 4.5: Critical Success Factors for Institutionalization of MIS in ZARI

Y-axis = Critical Success Factors promoting institutionalization of MIS

X-axis = Count: Number of respondents out of eight who scored the CSF.

The result (in fig. 4.5) so far reveal that the critical success factors promoting institutionalization of MIS in ZARI were ZARI's awareness of its information needs, donor support, MIS training and the technical services provided by MIS consultants.

Critical Failure Factors:

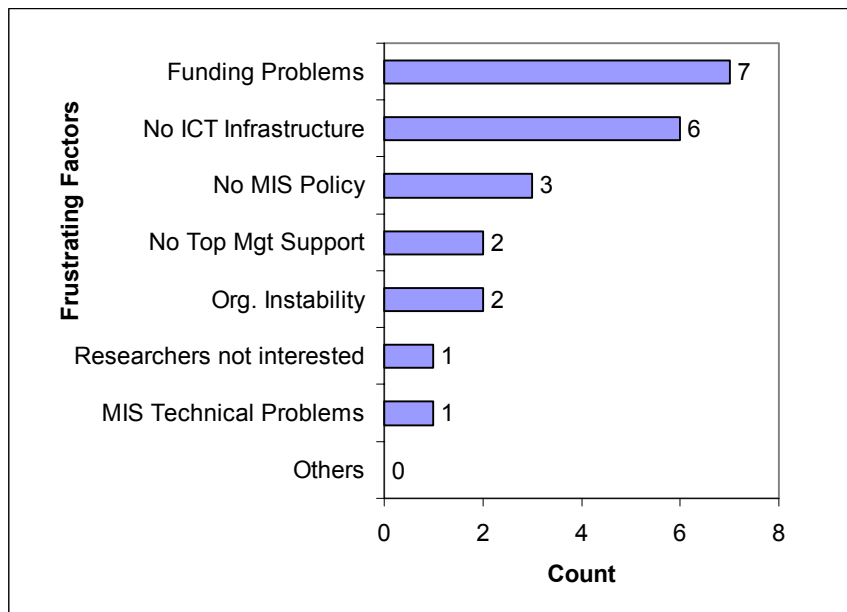


Figure 4.6: Critical Failure Factors frustrating institutionalization of MIS in ZARI

Y-axis = Critical Failure Factors frustrating institutionalization of MIS

X-axis = Count: Number of respondents out of eight who scored the CFF.

The critical failure factors frustrating institutionalization of MIS were funding problems and lack of ICT infrastructure. This indicates that most respondents think that if ZARI have more funds it would be able to purchase more ICT infrastructure, which in turn will be used to promote institutionalization of MIS.

4.3. The Uganda Case

National Agricultural Research Organization (NARO) of Uganda

NARO of Uganda originated by merging several research institutes, stations, technology verification centres (TVCs) and district farm institutes (DFIs) under one umbrella organization. NARO was established in November 1992 under the Statute enacted by the government of Uganda as a semi-autonomous corporate body and became fully functional in 1993 (URL: <http://www.naro.go.ug>).

Mission: The mission of NARO is to contribute towards improving the welfare of the people of Uganda by increasing the productivity and utilisation of crops, livestock, fisheries and forestry resources in a sustainable manner.

Vision: To be come a centre of excellence spearheading generation and transfer of improved and appropriate agricultural technologies in collaboration with its partners and clients, leading to sustainable development.

Mandate: NARO's mandate is to undertake, promote and co-ordinate research and to ensure dissemination and application of research results in all aspects of crops, fisheries, forestry and livestock. Integration of research is emphasised, as a measure needed to avoid wasteful overlapping and duplication of research so as to make the most efficient use of available research resources.

Organizational Structure: The Board of Trustees (BOT) leads NARO's governance. The minister of agriculture appoints BOT members based on their expertise. BOT members are responsible for policy formulation and policy enactment for NARO. They also control the activities of the management committee (MC). The management committee is responsible for policy execution and management of organization. The Director General (DG) is the

head of NARO. He operates at NARO Secretariat otherwise referred to as NAROSEC in Entebbe. The DG is accountable to the Board. Two deputy director generals (one in charge of research and the other in charge of outreach) assist the DG. Other units are the accounts, human resource and administrative units with their respective managers.

NARO also has a monitoring, planning, and evaluation unit (MEPU) with its Director. The MIS department is located within MEPU. NAROSEC is responsible for the management and administration of NARO activities but also conduct limited research activities about issues that cut across the research institutes. Most researchers work within the research institutes and stations distributed over the country.

NARO has nine research institutes namely:

1. Agricultural Engineering and Appropriate Technology Research Institute (AEATRI)
2. Coffee Research Institute (CORI), Kituza Mukono
3. Forestry Resources Research Institute (FORRI), Kifu Mukono
4. Fisheries Resources Research Institute (FIRRI), Jinja
5. Food Science Research Institute (FOSRI), Kawanda
6. Livestock Health Research Institute (LIRI), Tororo
7. Kawanda Agricultural Research Institute (KARI)
8. Namulonge Agricultural and Animal Research Institute (NAARI)
9. Serere Agricultural and Animal Research Institute (SAARI), Soroti

The institutes are semi autonomous and they are responsible for the implementation of approved research activities. Directors who are responsible for the administration and management of researchers and research activities head the institutes. The institutes have accounts, human resource and administrative units with their respective managers.

There are 68 Technology Verification Centres (TVCs) including 18 District Farm Institutes (DFIs) located in various agro-ecological zones scattered all over the country. Twelve of these 18 DFIs, have become agricultural research development centres (ARDC) –

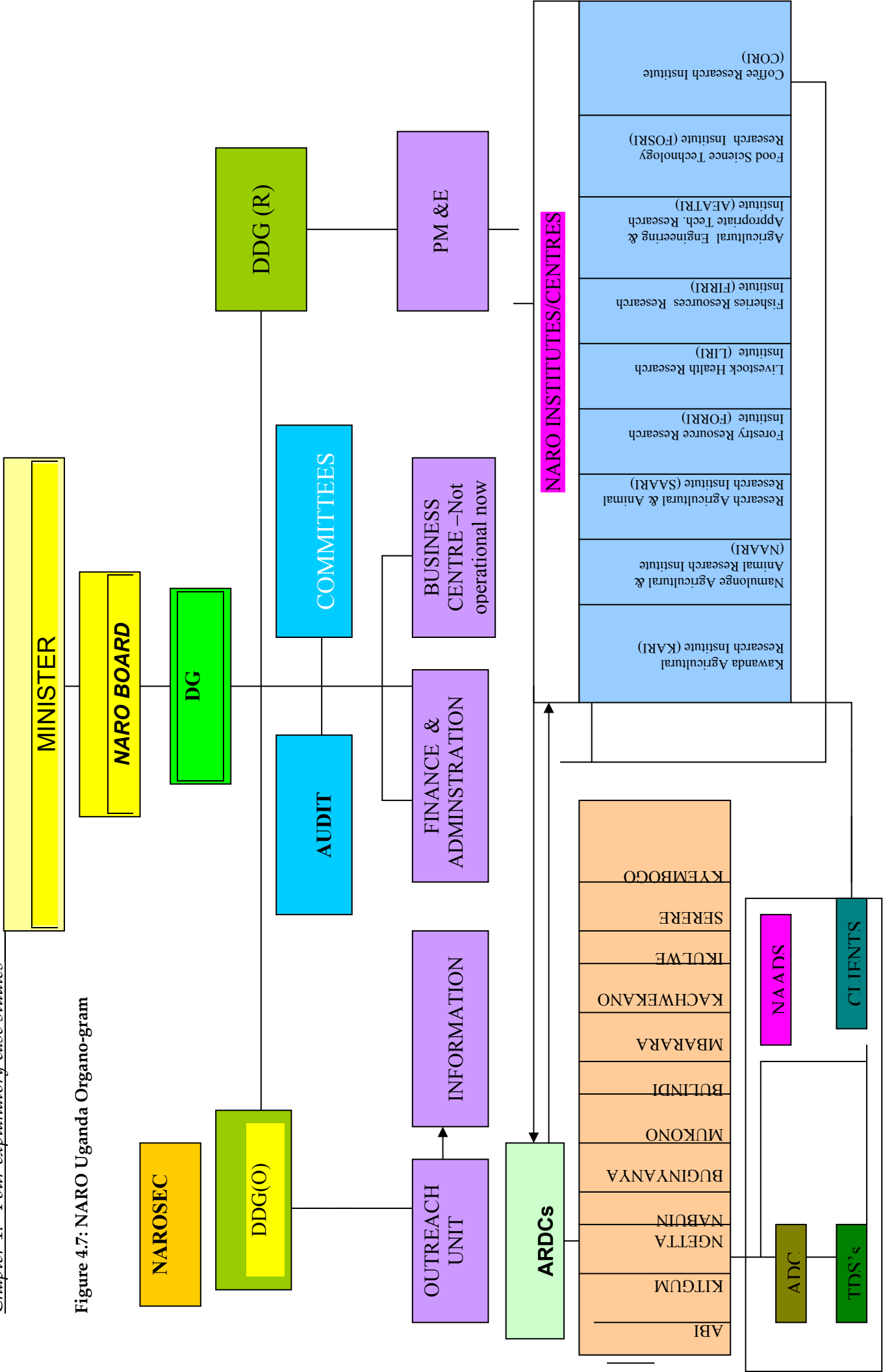
[http://www.naro.go.ug/About NARO/NARO ARDCs.htm](http://www.naro.go.ug/About%20NARO/NARO_ARDCs.htm) with the aim to bring research closer to the clients as shown below;

NARO has twelve agricultural research and development centres namely:

1. Kachwekano ARDC
2. Mbarara ARDC
3. Ngetta ARDC
4. Bulindi ARDC
5. Mukono ARDC
6. Abii ARDC
7. Serere ARDC
8. Kitgum ARDC
9. Nabuin ARDC
10. Buginyanya ARDC
11. Ikulwe ARDC
12. Kyembogo ARDC

It should be noted that Kyembogo ARDC was taken up by Kabarole District to become the District Agricultural Training and Information Centre (DATIC).

Figure 4.7: NARO Uganda Organo-gram



History of introduction of MIS

When NARO was established, one of the immediate objectives of its management was to improve information management and communication to enhance the management of the scattered institutes, stations, TVCs and DFIs. To this effect, an Information policy and strategy was formulated to facilitate the attainment of an efficient information and communication system and a Management information system for agricultural research was established for research and human resource planning, monitoring and evaluation (Baguma, 2001).

ISNAR assisted NARO in the introduction of MIS in 1993. The MIS database at that time was called INFORM – information for agricultural research managers which was based on Reflex, a flat file software. This though useful was very unfriendly to users because users had to learn many computer codes. A number of suggestions were put forward to ISNAR to develop better MIS Software. NARO participated greatly in the development of the new user-friendly system (INFORM –R/ Light).

After the development of the systems in 1999, seven NARO staff participated in the MIS distance-learning course organized by ISNAR. Five out of the seven staff were trained at ISNAR (The Hague) for two weeks in the April 2000 MIS training of trainers and implementation workshop. Three top managers joined the group in the last two days. The participants developed a plan of action for the implementation of the new system. Early 2001, MIS in-country distance learning course was organized by NARO. About 35 NARO staffs participated in the course. In April 2001, NARO in collaboration with ISNAR conducted an in-country MIS training and implementation workshop at ARDC Mukono Uganda (see figure 4.8). Twenty-two staffs attended the training workshop and NARO top managers joined them on the last day. The goal of the workshop was to provide participants with opportunities to develop knowledge, attitudes, and skills required to implement an MIS in NARO institutes so that managers can be availed with accurate and

up-to-date information necessary for decision-making. The workshop participants were also exposed to the concepts and principles of PM&E since MIS feeds the PM&E system.



Figure 4.8: A cross section of MIS training and implementation workshop at Mukono Uganda (April 2001)

At the end of the workshop PCs and printers were distributed to several institutes and INFORM-R Light was installed on each of these computers. The new system became operational in all NARO institutes from then onwards. In October 2001, the ISNAR resource person and NARO MIS coordinator performed technical backstopping and follow-up visits to support the implementation and institutionalization of the system in all institutes of NARO (Webber, 2002). The MIS national coordinator was active on MIS activities at all fronts. While working at NAROSEC and providing technical support to the institutes, he also participated as a resource person in most MIS workshops conducted by

ISNAR in other Sub Saharan African countries and in The Netherlands. NARO continued with the institutionalization of MIS until the time of this case study research.

The case study was conducted at NARO's headquarters in Entebbe, Namulonge agricultural and animal research institute (NAARI), and Kawanda agricultural research institute (KARI). Namulonge and Kawanda are research institutes situated just outside Kampala (see map of Uganda in figure 4.8. below). The reason for choosing these two institutes and the headquarters was because we wanted to compare the best practice and the worst. The results of the research are presented below.



Figure 4.9. Map of Uganda

Source: University of Texas library collection:

<http://www.lib.utexas.edu/maps/africa.html>

Results of the Interviews

A. Extent of Institutionalization of MIS at NARO

INFORM-R Light was used at NAROs' headquarters for providing research progress to top management, providing some information to the human resource management for staff development, and for compiling relevant information for the development partners. INFORM – R Light is currently being used directly by the Director of monitoring, evaluation and planning unit (MEPU), and the deputy director general (DDGR). The system was not being used adequately by the institutes due to too many and frequent institutional changes. It was used to some extent in feeding quarterly reports that were then submitted to the headquarters. Proper use of the outcome /result of individual institutes were done at headquarters.

Table 4.2: Integrating MIS in Research Management in NARO Uganda

General, Research and Extension	INFORM-R Light source- <i>doc.</i>	Month
Priority Setting	Menu – Annual cycle	November
Quarterly experiment report	Experiment – Interim reports	December
Considerations of priorities,	Management cycle	December
Definition of objectives,		January
Stakeholder workshops		February
Preparation of Financial budgets,	Management cycle – Planning	February
Submission of Financial budgets preliminary research proposals	Experiment budgets	
Preparation of research reports + budgets for continuing experiments	Experiment budgets	
Peer review	Management cycle	February
Start of financial year (<i>Fiscal year</i>)		June
Preparation of final research proposals (<i>Seasonal crops-commodities</i>)	Data entry - Research proposals	June-July
Program/center committees for approval of research	Data entry - Research proposals	March
Quarterly experiment report	Experiment - Interim reports	March
Institute committee for approval of research	Data entry - Research proposals	March
Board meeting for approval of research at Institute level	Data entry - Research proposals	
Half monthly experimental report (Seasonal crops)	Experiment - Interim reports	April
Annual reports for all Experiments	Experiment – Interim reports	December

Table 4.2 illustrates the approach used by NARO Uganda for institutionalizing MIS in their annual research management cycle.

B. Results based on the Independent Variables in the Causal Model

1. Leadership and Organizational Culture

Leadership:

The monitoring, evaluation and planning unit (MEPU) and top management played leadership roles for institutionalizing MIS in NARO Uganda. The Director of MEPU was the champion for MIS. He was responsible for ensuring that the information derived from the MIS was used for decision making in planning, budgeting, monitoring, evaluation and reporting. As Director of MEPU, he searched and obtained resources for training of practitioners and provision of equipment -computers and printers to each institute. He was prepared to distribute part of MEPU budget to activities if they became compliant. He was also heavily involved in the MIS training but lost track because of the recent NARO review. The top management participated in the 2000 MIS workshop conducted by ISNAR in The Hague. They had hands-on experience of INFORM-R Light. In NARO, they used the system to control staffs to deliver by demanding accountability in form of research reports, budgets and expenditure.

The MIS national coordinator was responsible for the implementation and general management of the system. He facilitated training and sensitization workshops and trained others in the use and management of the system. He was involved in the initial design phases of the system as well as the modification and coordination. He also entered data and generated some information for specific needs, to ensure that the system is institutionalized. The institute MIS practitioners were responsible for data collection, entry and generation of reports for institute directors and researchers. In terms of use of MIS for decision-making, INFORM-R Light was used to decide on funding replenishment, and research projects/activities that should be continued, modified or stopped.

Organizational Culture:

Strong reporting tradition was the main strength of NARO's information management culture. It was a requirement in NARO that every research activity should be reported on to ensure continuity in flow of funds. At the institute level, quarterly progress reports were compiled by program heads and forwarded to the MIS Practitioner for input into INFORM-R Light.

The major weaknesses of NARO's information management culture were data accumulated but never acted on, secrecy and lack of commitment. A number of top managers especially the Institute Directors and project leaders were not committed to ensuring that they have a functional MIS. It might reveal some information that should have been secret. A lot of data accumulated and was never acted upon by the MIS practitioner because of regular computer breakdowns and some delays in retrieving data from the database.

Organizational Culture: Incentives

According to respondents, the major incentive that promoted institutionalization of MIS in NARO was the quality of decisions made by managers. The second incentive was scoring of staff performance assessment in MIS. Informants said if this exercise is done continuously in MIS, then researchers will find it rewarding to provide accurate and more information into the MIS and this then can be used for various decisions. The third incentive was timely reporting on research activities. Only one respondent mentioned time reporting as an incentive. This probably means that NARO did not use MIS for reporting on time spent by its' researchers.

Organizational Culture: Disincentives

In terms of disincentives, respondents and informants from NAROSEC said career prospects of MIS practitioners was a major disincentive that affected institutionalization of MIS. Researchers were converted to MIS practitioners but their career prospects were not

being balanced and thus MIS Practitioners felt cheated to do more work coupled with their research projects. Besides no promotion avenues and no training opportunities especially at higher degree levels were made available to MIS practitioners. Poor reward systems for staff generally and greatly affected MIS institutionalization since this had a bearing on staff leaving the organization. Performance assessment of staff does not recognise MIS outputs as important compared to other research outputs. MIS practitioner's efforts may not attract any clear performance rating, so that was why scientists were not interested.

Organizational Culture: Transparency

The level of transparency in sharing research and management information in NARO was fair. However, there were some pockets of unnecessary delays from the respective programs in providing quarterly reports. Some scientists do not want to share with colleagues what they were doing and some do not even want to tell management what funds they have got and from where, let alone informing them of the progress of the research.

2. Organizational Capacity

Information Management Capacity (Knowledge and skills)

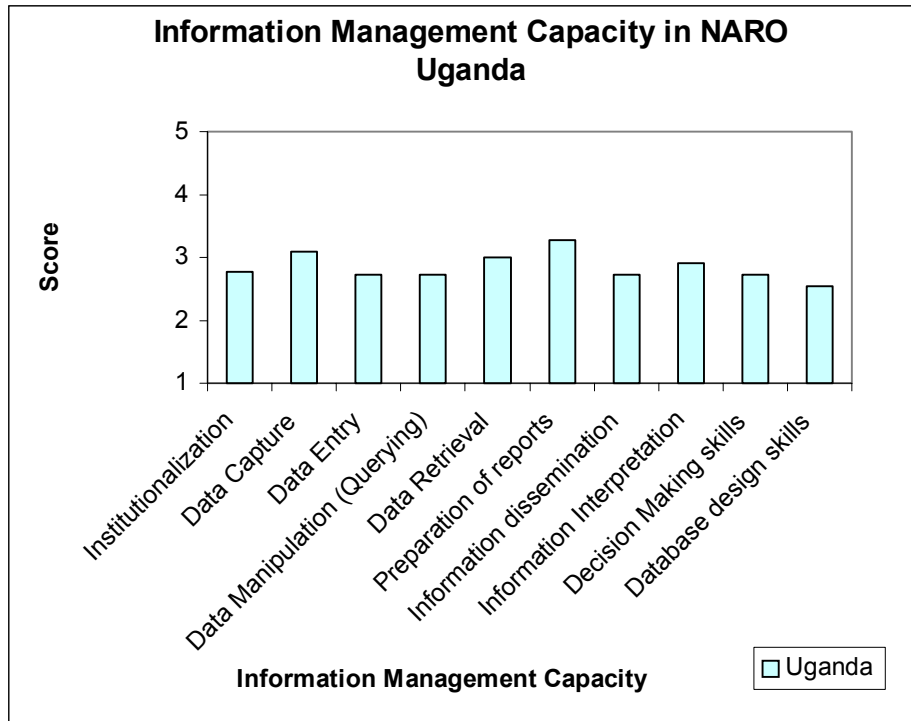


Figure 4.10: Information Management Capacity in NARO Uganda.

Score 1 = Inadequate, 2 = Poor, 3 = Moderate, 4 = Good, 5 = Highly adequate.

Information management capacity of NARO staff appeared to be moderate in all areas. The data showed that it correlated with the level of institutionalization. In terms of extra training, top management would like all managers to be trained on INFORM-R Light and if possible a web-based version. Researchers would like to have training in all areas while MIS practitioners said they would like to have training in database design and web-based MIS. This would enable them to develop dynamically active databases that can be updated on the web.

ICT Infrastructure:

The level of Computer Hardware, Software and network facilities for MIS in NARO was between inadequate and moderate according to informants and respondents. NAARI and

KARI libraries said their infrastructure levels were inadequate. At the time of this study, some NARO institutes like NAROSEC, FIRI and KARI had LAN but there were few computers and there was a lack of up-to-date software. The availability of ICT infrastructure increased the moral and motivation of staff and facilitated data entry and information processing. MIS practitioners got access to ready computers & printers after in-country implementation training in 2001. This increased their motivation to institutionalize MIS. Availability of LAN and Internet in some institutes helped in transfer of files.

In terms of non-availability of ICT infrastructure, lack of enough computers to all staff impeded the distribution of the MIS software to every staff to get familiarised with the system. If ICT infrastructure had been made available to all units, this would have facilitated the transfer of data and reduced the time taken to merge documents and files. Outdated computers restricted the use of advanced software and large databases: For example, an IT student from Nkumba University designed a human resource database. It required installation of Windows 98 but the personnel computer could not accommodate it and that led to non-adoption of the database.

Adoption:

At the time of this research, INFORM-R Light was at the use stage at NARO secretariat in Entebbe. It was at the implementation stage in NAARI Namulonge, and in KARI Kawanda, it was at the trial stage. This implies that there is variation in the level of adoption of MIS in NARO Uganda. The headquarters and some institutes appeared to be progressing better than others. KARI stands out as the worst in terms of adoption.

Adaptation:

INFORM-R light was fairly adapted in NARO Uganda. According to an informant, the adaptation was about replacing the program level with thematic level in the research structure and also changing the ID format so as to take care of the budgeting codes. The

adaptation was said to be very successful at NARO headquarters in Entebbe. But at the research institutes (NAARI and KARI) respondents said lack of computer hardware, software (MS Windows and ACCESS Database) and consumables, funding, and few staff with database design skills were the main problems to adaptation.

Resistance to Change and Solutions:

The main reason why some NARO staff resisted using an MIS was because of bad experience with MIS in the past. The old MIS software (INFORM) was technically difficult to manipulate by managers. The MIS practitioners were the only staff that had good knowledge of the system. When the new INFORM-R Light was introduced in the organization, many staff members were trained to use the system but new problems surfaced. Management did not include MIS in the terms of reference of staff so researchers perceived MIS as an administrative burden. They occasionally resisted compiling research reports and making them available for entry into INFORM-R Light. There was also the transparency issue: quite often researchers do not want to share data especially when it came to data related to activities not funded by or through the parent organization. Data is the lifeblood of MIS, if researchers resist providing the required data for input into the system then the system will become incomplete and unusable.

Raising awareness among staff and management about MIS partially solved the resistance problem: This is a very important solution to ensure acceptability of the system. If users are not sensitized they will not know the importance of the system and they will therefore not provide the relevant data on time.

3. External Operating Environment

Government Support:

The trend of government support was said to be positive in NARO. The government through bilateral agreements acquired money from the World Bank and provided it to

NARO to train staff in MIS, purchase computers and follow up. This was part of the bigger ARTP II project. Respondents and informants advised the government of Uganda to release funds in a timely fashion so that research activities including MIS can be carried out on time. This they believe would improve efficiency. They also advised government to ensure a clear link between ministry of agriculture and ministry of finance and NARO. This was because the ministries of finance, agriculture and NARO are not well coordinated to work together. Respondents believe the systems within the ministries should be standardised so as to avoid inconsistencies in funding.

Donors Support:

The trend of donor support to NARO was rated as somehow positive. Respondents said these positive contributions of donors affected institutionalization of MIS in NARO: Donors funded MIS training and implementation. This enabled NARO staff to gain knowledge on MIS and computer skills. They insisted on getting meaningful reports that required some kind of analysis that required an MIS capacity. This factor motivated NARO management and MIS practitioners to implement INFORM-R Light. Donor funds enabled the purchase of computer hardware and software that was distributed to all research institutes after MIS training. Other positive aspects of donors were: forging links with ISNAR to deliver MIS training and technical backstopping to NARO institutes, and enabling NARO staff to exchange information at the global level.

On the negative side, respondents said donor projects do not follow a participatory planning approach. According to an informant, “donor projects are quite often developed without involving the implementers. Ideas are already pre-conceived and all the plans almost completed. In this regard one cannot ensure that the MIS fields for PM&E are taken care of in the project proposal or subsequent implementation”. Other respondents said several donors demand different reporting formats. This made it difficult to use one system. Respondents and informants requested donors to change in the following ways:

Donors should support joint planning of research projects. They should also agree on a common reporting format, as this would ensure that MIS is used for managing the jointly planned projects. Donors should be more demanding on technical reporting and tie funding to how far the MIS has been institutionalized.

4. Critical Success and Failure Factors

In the questionnaire and interview respondents were requested to choose what they thought were the critical success and failure factors for institutionalization of MIS. We counted their choices and plotted bar charts. The number of respondents and informants from NARO were 10. Factors that had less than five counts were not considered as critical success or failure factors.

Critical Success Factors

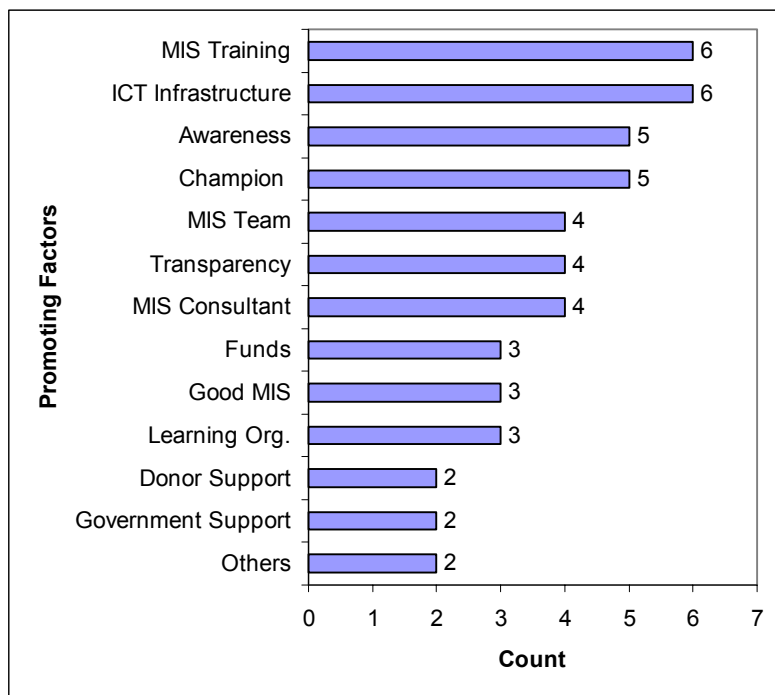


Figure 4.11: Critical Success Factors for Institutionalization of MIS in NARO Uganda.

Y-axis = Critical Success Factors promoting institutionalization of MIS

X-axis = Count: Number of respondents out of eight who scored the CSF.

The results (in fig 4.11) show that the critical success factors promoting institutionalization of MIS in NARO were MIS training, ICT infrastructure, presence of a champion for MIS and the organization's awareness of its information needs. ICT infrastructure was said to be a critical success factor by NARO respondents probably because after the MIS training workshop in 2001, new computer hardware and printers were distributed to all research institutes. Not all institutes got what they wanted but in principle it raised staff moral and enable INFORM-R Light to be installed.

Critical Failure Factors:

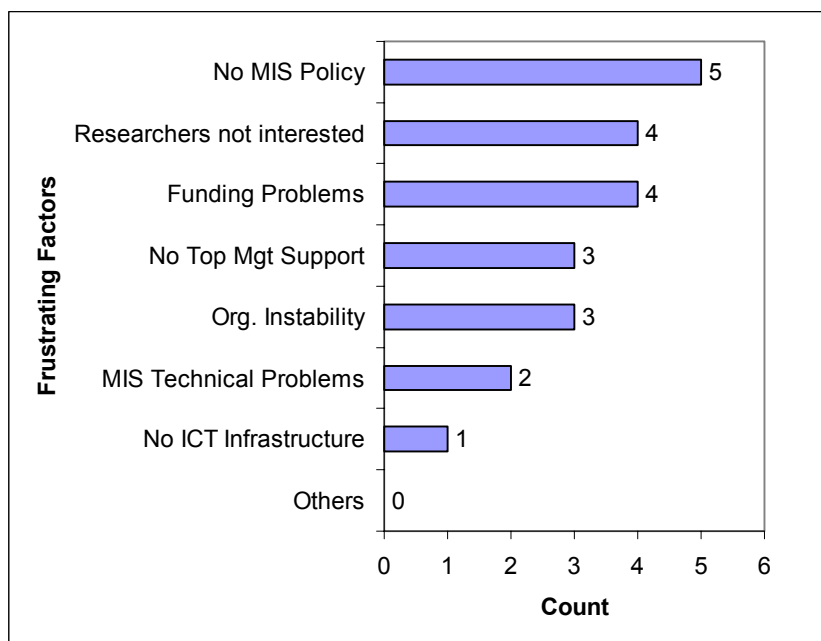


Figure 4.12: Critical Failure Factors frustrating institutionalization of MIS in NARO Uganda.

Y-axis = Critical Failure Factors frustrating institutionalization of MIS

X-axis = Count: Number of respondents out of eight who scored the CFF.

The critical failure factors frustrating institutionalization of MIS in NARO (fig. 4.12) were lack of MIS policy, funding problems and researchers not interested in research management.

4.4. The Tanzania Case

Ministry of Agriculture and Food Security (MAFS): Division of Research and Development (DRD)

Introduction

DRD is one of the four departments of the ministry of Agriculture and Food Security of Tanzania.

Mission: To conduct client oriented demand driven and cost effective research.

Mandate

DRD is charged with the mandate to coordinate and conduct research in crops, livestock, socioeconomics, agro-forestry, soil and water management and agricultural engineering (<http://www.drd.mafs.go.tz>). Recently, the livestock component was merged with another ministry. DRD's other mandates are to develop, adopt and adapt appropriate technologies with the aim to contribute to conservation of the natural resource base and enhancement of sustainable agricultural production systems.

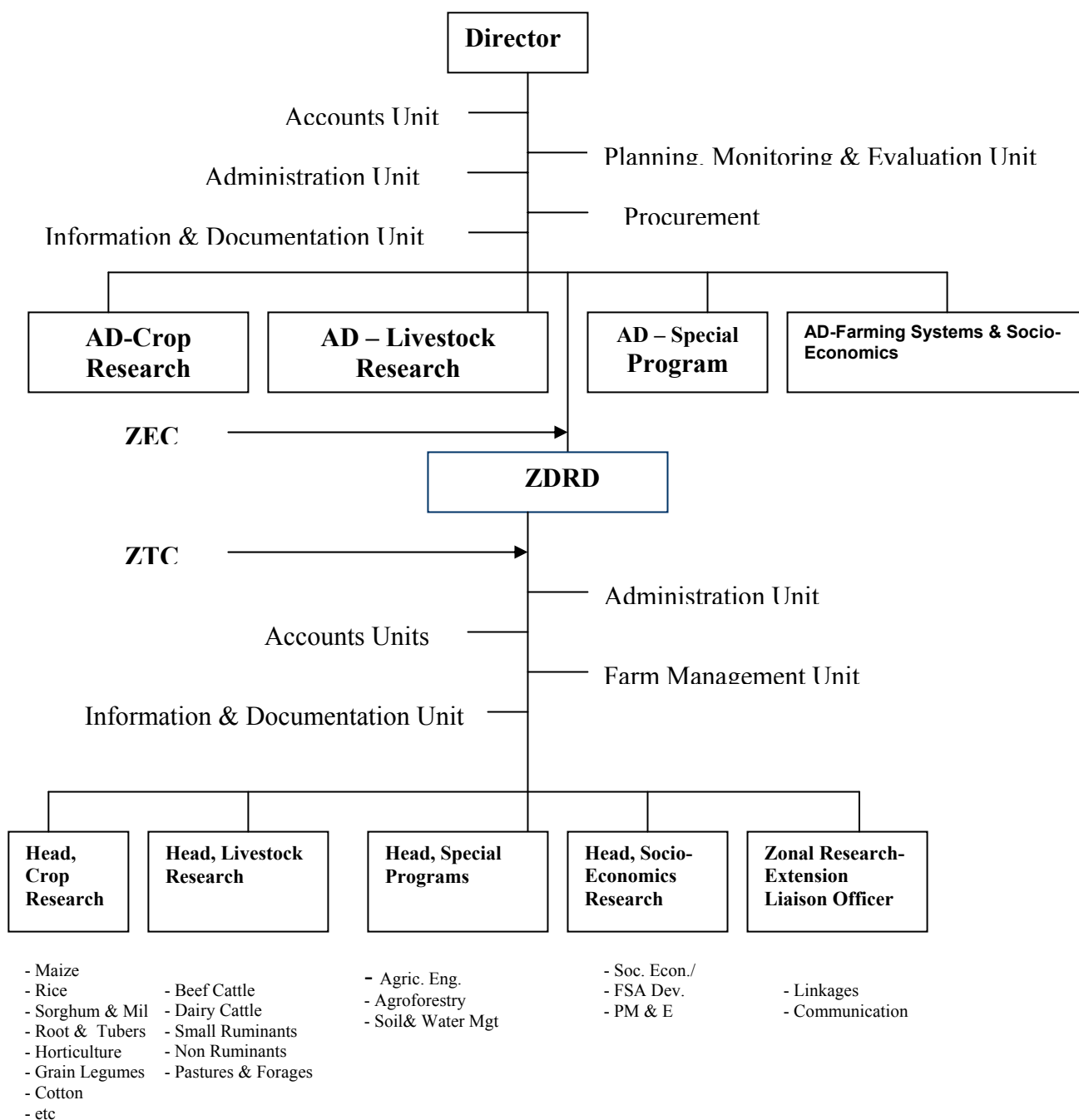
Organizational Structure:

The top management of DRD at the national level in Dar es Salaam is led by the Director of Research and Development, who is accountable to the Permanent Secretary of the MAFS. Three assistant directors in charge of crop research, livestock research and special programmes assist the director. There are five support units: planning, monitoring and evaluation unit with MIS as a subunit, information and documentation, accounts, procurement and administration. At the zone level, DRD has 17 research centres/stations distributed among seven agro-ecological zones: western, eastern, southern, northern, central, lake and southern highland zones. The zonal research centres are lead by Zonal

Directors Research and Development (ZDRD), who are accountable to the Director of Research Development at the national level. The Zonal Research Coordinators (ZRC) assists the ZDRD. About 336 researchers, 411 technicians and 557 support staff constitute the total workforce of the DRD. The zonal research centres conduct all kinds of research but special emphasis is on location specific adaptive research. They collaborate with commodity research teams, farming systems teams and communication (extension) workers within the zone.

Figure 4.13: Organizational structure of DRD Tanzania.

**ORGANIZATION CHART FOR
THE DEPARTMENT OF RESEARCH AND DEVELOPMENT
(1999/2000)**



History of introduction of MIS in DRD Tanzania

ISNAR introduced INFORM (based on Reflex software) in DRD formerly called DRT (Division of Research and Training) around 1993. The institutionalization of the system was however, slow due to: (i) lack of computer facilities (ii) inadequate skills to operate the system (iii) inadequate awareness among research managers and scientists (Kasuga, et al 2002).

INFORM activities started to take shape in DRD in 1998 when the second phase of the Tanzania Agricultural Research Project (TARP II) started. Fortunately efforts to institutionalize INFORM in DRD coincided with ISNAR's initiative to convert the old Reflex-based INFORM System into MS Access-based INFORM –R and INFORM-R-Light. As a result, three DRD's staff received training in MIS techniques. The trained staffs were key in the implementation of INFORM-R Light in DRD. As from year 2000 a number of activities were implemented. These included (i) training of 14 MIS Practitioners from the zones (see figure 4.14) (ii) sensitisation seminars of research managers and scientists (iii) data collection on research activities and staff to establish the DRD INFORM-R Light database.



Figure 4.14: Participants of the MIS in-country implementation workshop in Dar es Salaam Tanzania (2000).

The implementation of MIS in the DRD although encouraging but came along with some new challenges. These were mainly (i) new emerging information needs (ii) the need to integrate MIS with planning monitoring and evaluation (iii) inadequate knowledge on database management. In order to respond to the new challenges, a four-weeks training course was organized at ISNAR to gain more skills in database management techniques. The training was conducted from 18 November to 20 December 2002, when three staff attended. DRD continued with the institutionalization of MIS until the time of the case study research.

The case study was conducted at DRD's headquarters in Dar es Salaam, Livestock Production Research Institute Mpwapwa (central zone), and Agricultural Research

Institute Ilonga (eastern zone). See map of Tanzania in figure 4.15. The results of the research are presented below.



Figure 4.15: Map of Tanzania.

Source: University of Texas library collection:

<http://www.lib.utexas.edu/maps/africa.html>

Results of the Interviews

A. Extent of Institutionalization of MIS at DRD Tanzania

INFORM-R Light system was mainly used at the DRD headquarters. It was partly used by research managers at department level and by a few zonal directors. It was used as a database for personnel administration and research projects and to some extent used for Library services. It was very often used for searching staff particulars and literature. Management used the human resources information from the MIS for instance staff by listing qualifications, age and specialization for staff promotion. The Director of Research and Development used the information on staff distribution by zones and age groups for making decisions on planning of research activities. The Training Officer uses the information from INFORM-R Light for planning training opportunities.

Table 4.3: Integrating MIS in Research Management in DRD Tanzania

LEVEL	PERIOD	ACTIVITIES	MIS REPORTS
Station	May - August	-Project proposal formulation - Peer review	-On-going research projects -Directory of researchers and their specialties
Zone	Sept - December	-Internal Protocol review Meeting -Technical Committee Meeting -Executive Committee Meeting	-Resources - Human, Physical financial - Researchers time - Research Annual reports
Station/Zone/ Nation	January – June	Disbursement of Funds Execution of projects Monitoring and evaluation	Approved projects Research Budgets Projects quarterly reports

Table 4.3 illustrates the approach used by DRD Tanzania for institutionalizing MIS in their annual research management cycle.

B. Results based on the Independent Variables in the Causal Model

1. Leadership and Organizational Culture

Leadership:

The MIS champion at DRD was the head of planning, monitoring and evaluation. As patron and a manager with interest he ensured that MIS practitioners were facilitated. He and the training officer participated in the MIS workshop for managers organized by

ISNAR in 2000 in The Hague. He also supported training of MIS zonal practitioners in Dar es Salaam and was willing to support further training of researchers and managers. Unfortunately, I was not able to interview the Director General of DRD because of his busy schedule. One zonal Director from Ilonga interviewed said he personally facilitated installations of INFORM-R Light at his research station.

DRD had three MIS national coordinators. They participated in various training since 1994. They were also involved in database design, sensitization and report generation for managers and researchers. They also facilitated the activities of the zonal MIS practitioners. The researchers interviewed said they played the role of users of the system but they were not given appropriate training.

In terms of using the system for decision-making, I was not able to get a clear response from the top managers. But the middle managers interviewed said they used the system to make decision on personnel issues for instance when there was need to transfer staff, allocate staff to a station/program, send someone for courses and appraise a staff member. Researchers interviewed said they used the system to advice management on the status of projects, for instance, the end date and financial status.

In terms of involvement in institutionalization, top managers interviewed did not rate themselves very high. One top manager from a zone said, "the zonal MIS coordinator and his assistant were directly involved. My involvement was only as a head of institution giving a go ahead". The national coordinators said they championed sensitization and use of MIS at the national and zonal level. While researchers said they were less involved because there were no formal procedures, no initiatives were taken to include them in the institutionalization process.

Organizational Culture:

The main strength of DRD Tanzania in terms of information management culture was a strong reporting culture, which is strict and timely. This practice has been in place for many years even before the introduction of sophisticated MIS. DRD headquarters receives reports from zones quarterly and through annual meetings. Delayed documents after deadline are simply kept aside for the next cycle or year. This strong reporting tradition is sadly enough still being done in MS Word. At the time of this interview, DRD had not started to use INFORM-R Light for progress and annual reports. Many Microsoft Word files were collected from researchers and compiled into annual and progress reports. The problem they encountered was that sometimes it was difficult to locate the owners of the Word files and some files were even lost in the process. It is important, however to mention that DRD has up-to-date personnel information, which has enabled top management to make timely decisions on training and promotion of staff.

Data accumulated and never acted on and secrecy characterized the major weaknesses of DRD's information management culture. The organization has lots of data in paper files and they have not been entered and processed in an electronic database. If the organization becomes serious and processes these data into information it could generate useful reports for publications and for the development of the country. According to respondents, the senior cadre of the research staff are said to be a hindrance to progress in information management. They lack computer skills and are therefore likely not to support the junior staff to spent time on data processing. The junior staffs also prefer to do things at their own time. According to a top manager, "the cultures inherited are those that the localities are used to, for example the "Ndugu concept" otherwise meaning comrade, is applied without regard to duty. If a manager demands a junior staff to perform an activity, he or she may reply "comrade I will do it tomorrow" and s/he will never be penalized because s/he is a comrade.

Organizational Culture: Incentives

Scoring of staff performance in MIS and the quality of decisions made by managers were the major incentives that promoted institutionalization of MIS in DRD. Each year every staff member is assessed according to performance and this enabled top management to make decisions on promotion, rewards, etc. According to one respondent: “incentives at DRD are not specific but the demand for reports is what drives institutionalization of MIS. Peer recognition is usually given informally for example an early break off from duty than usual due to some good work done”. Training opportunities were also mentioned as an incentive for institutionalization of MIS at DRD.

Organizational Culture: Disincentives

Recognition of MIS practitioners in terms of career prospects affected institutionalization. MIS is seen as a new discipline in research activities at DRD therefore it was not given high priority. MIS at the zonal level is taken as a concept just starting; therefore not enough effort, resources, time and commitment had been made by managers to institutionalize it. Researchers were not bound to submit information. Some managers do not use MIS reports in their decision making process. More training and practice is needed for MIS institutionalization at the zonal level.

Organizational Culture: Transparency

The level of transparency in sharing information at DRD was moderate. Monitoring of research progress reports was the main source of transparency. Respondents complained that scientists at research stations were eager to share information but this was not possible because the MIS activities were concentrated at the national level. Data were not frequently collected from stations, analysed and shared in the zones. Another reason for the moderate level of transparency was because very few joint headquarters and station wide conferences were held within a year and only those who can afford it were able to

attend. Furthermore, financial decisions were made at the national level and transcended to the stations.

2. Organizational Capacity

Information Management Capacity (Knowledge and skills)

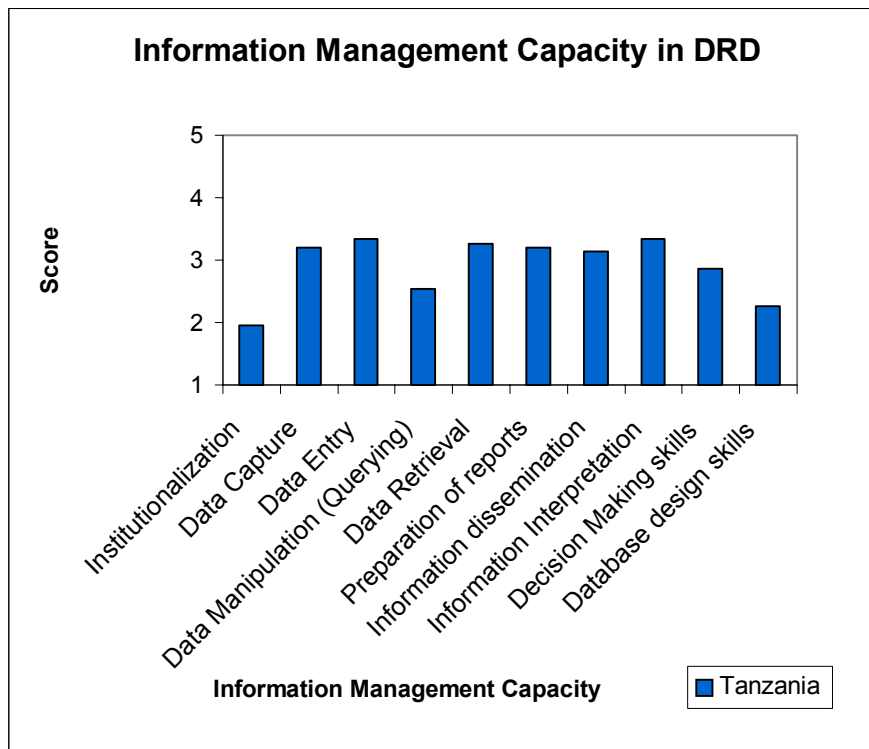


Figure 4.16: Information Management Capacity in DRD Tanzania.

Score 1 = Inadequate, 2 = Poor, 3 = Moderate, 4 = Good, 5 = Highly adequate.

Information management capacity of DRD staff appeared to be moderate in all areas except database design. Their level in this area was more or less similar to their level of institutionalization of MIS. In terms of extra training on MIS, one top manager said they would need extra training because training is a continuous process. A middle manager said they would need more training than top managers. They would need training not only on MIS but on priority setting, monitoring & evaluation as well. Researchers said they would require training in all areas because they haven't had any yet. While MIS practitioners said they would need extra training on database design. This they believe

would enable them to adapt INFORM-R Light on their own or with less assistance from ISNAR.

ICT Infrastructure:

The level of Computer Hardware, Software and network facilities for MIS in DRD was moderate according to informants and respondents. In terms of computer hardware Ilonga was the best followed by DRD headquarters and Mpwapwa. According to one respondent, in Ilonga, some computers were linked to a LAN, but there is need for more connectivity so that more scientists can have access. At the time of this research, there were no Internet facilities available but the computer centre was well organized. According to one respondent at DRD headquarters, “outdated hardware and software kept INFORM-R Light lagging behind. There are few materials and supplies but the will to acquire is there, but action is hampered by other factors like funds and priority”. In other words, what this respondent meant to say is that they were not able to run INFORM-R Light on old computers running on Windows 1995 and MS ACCESS 2. For INFORM-R Light to run successfully, it requires at least Windows 1998 or later versions with MS ACCESS 1998 or later versions.

However, availability of ICT infrastructure increased the computer use skills of scientists and improved the quality of reports produced at least in the stations in which ICT facilities have been installed. At least communication and relay of information between institutes in the country has been made easier and quicker through e-mail and fax.

Regarding non-availability of ICT infrastructure, lack of PCs for MIS practitioners after MIS training greatly affected institutionalisation of MIS within DRD. Scientists were exposed to too few PCs, which had to be shared with so much workload. Lack of Internet connection made it very difficult to get information from other institutions.

Adoption:

In terms of adoption, all respondents said they were at the awareness stage while informants (MIS Coordinators) at the headquarters (Dar es Salaam) and the zones (Mpwapwa and Ilonga) said they were at the implementation stage. According to one respondent “This implies that DRD MIS practitioners are more knowledgeable than others, so there is need for sensitisation and training of other users”. Indeed this observation show that MIS National Coordinators, MIS practitioners and researchers are at different stages of development therefore the call for general sensitization and training is relevant and would promote adoption and institutionalization.

Adaptation:

Adaptation of INFORM-R Light at DRD was moderate. Research activities in DRD were conducted at zonal level; the focal point was therefore the zones and programmes. For that reason, fields such as zones and sub-programs were added to the research structure of INFORM-R Light design. Technicians and support staff were also added to the human resources table. Adapting INFORM-R Light structure to suit DRD research structure resulted in changing the relationships design, table design, query design, forms and reports design. The adaptation was quite successful. According to informants the main problem was that some top staff did not notice the difference probably due to low level of use.

Resistance to Change and Solutions:

The main reason for resistance to use MIS at DRD was because of lack of awareness of INFORM-R Light and its benefits. Managers supported the training of MIS practitioners selected from all the zones in Tanzania. But they have not been trained on how to implement and institutionalize MIS. The national coordinators made some progress at the headquarters and in some institutes such as Selian Agricultural Research Institute (SARI), Mpwapwa Livestock Production and Research Institute. The system is yet to be

decentralized to the other zones and research stations. Zonal MIS practitioners have been trained but researchers, who are the main providers of data, have not been trained on MIS and the software package (INFORM-R Light). Researchers in the zones still compile their annual and progress reports in Word documents and send them to the headquarters for compilation.

Training on MIS was one step taken by the organization to partially solve the resistance problem. In 2000, DRD had an MIS champion who is also head of PM&E unit and Project Manager for TARP II. He supported MIS activities to a great extent. Respondents, however suggested that top management need to raise awareness continuously among researchers and management on the importance and benefits of an MIS. Outputs from INFORM-R Light should be distributed to DRD staff continuously.

3. External Operating Environment

Government Support:

Government support was positive because it has to match donors' contributions with funds for paying staff salaries and purchasing and maintaining equipments. Specifically for MIS, the support so far is political and not financial or technical. Respondents and informants advised the MAFS to release funds on time because some research programmes are season bound e.g. rainy season. Therefore, the government should release funds on time before the rainy season. The government should also increase their matching funds to the donor funds. They also advised government to ensure clear links between MAFS and Ministry of Finance and sensitise DRD staff on the importance and use of ICT.

Donors Support:

Respondents and informants in general rated the trend of donor support to MIS at DRD to be somehow positive. Donor support is directed to general budget and training at DRD.

Management made use of part of these funds to finance MIS activities. Donors assisted in promoting MIS through funding and training activities. Donor funds were also used to purchase some computer hardware and software that were installed in the institutes.

On the negative side, respondents and informants said donors lack continuity in their support to DRD. Whenever donor funded projects come to an end all other research projects also come to an end. They sometimes withdraw computers at the end of their projects. Winding up of donor funding partly affected the institutionalization of MIS at DRD. Respondents and informants said they were interested in partners for development and not just donors. They advised partners to: fund long-term projects for example five to ten years, agree on common reporting format and tie funding to how far the MIS has been institutionalized. This would motivate DRD staff to continue with the institutionalization of MIS.

Critical Success and Failure Factors:

In the questionnaire and interview respondents were requested to choose what they thought were the critical success and failure factors for institutionalization of MIS. We counted their choices and plotted bar charts. The number of respondents and informants from DRD were 15. Factors that had less than seven counts were not considered as critical success or failure factors.

Critical Success Factors

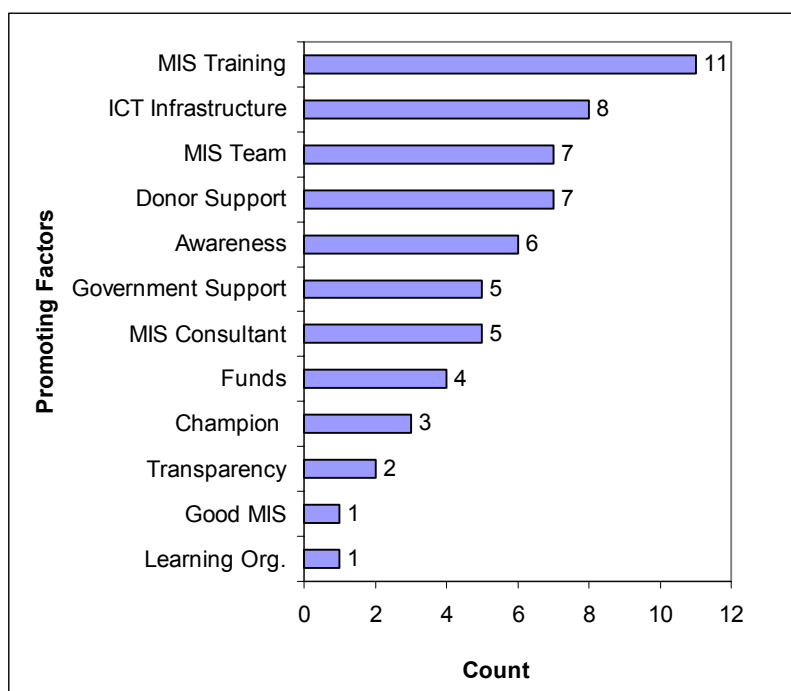


Figure 4.17: Critical Success Factors for Institutionalization of MIS in DRD

Y-axis = Critical Success Factors promoting institutionalization of MIS

X-axis = Count: Number of respondents out of fifteen who scored the CSF.

The result (in fig.4.17) so far show that the critical success factors promoting institutionalization of MIS in DRD were MIS training, ICT infrastructure, MIS team and donor support.

Critical Failure Factors:

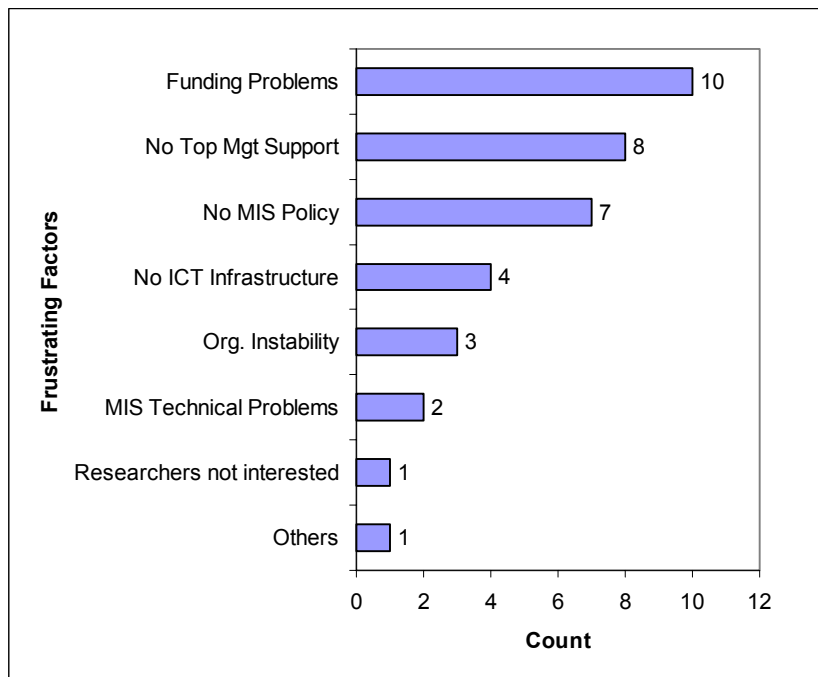


Figure 4.18: Critical Failure Factors frustrating institutionalization of MIS in DRD.

Y-axis = Critical Failure Factors frustrating institutionalization of MIS

X-axis = Count: Number of respondents out of fifteen who scored the CFF.

The critical failure factors (fig. 4.18) frustrating institutionalization of MIS in DRD were funding problems, lack of top management support and lack of MIS policy.

4.5. The Ghana Case

Council for Scientific and Industrial Research (CSIR) Ghana.

Introduction:

CSIR is the central body that organizes and coordinate scientific research in Ghana. It was established as far back as 1968 and re-established in its present form by CSIR Act 521 in 1996.

Objectives:

The objectives of CSIR are to establish effective linkages with the relevant institutions and agencies within and outside CSIR. Further, to enable national agricultural research systems (NARS) to set research priorities, formulate science and technology plans and monitor their implementation. Furthermore, the sector promotes the transfer of technology to business. Finally, the organization coordinates national research funds for Agriculture, Fisheries and Forestry.

Vision:

The vision of CSIR is to become a centre of excellence in research and development by generating technologies that are responsive to the demands of the privates sector and socio-economic development.

Mandate

The mandate of the CSIR is to advise government and to encourage scientific research that is of importance to the development of industry, technology, agriculture, health and environment.

The distinctive features of the 1996 Act are the emphasis accorded private sector concerns and the introduction of market principles into the Council's operations through the commercialization of research. In this connection the Council is expected to generate part of its income through the sale of its products and services, and to institute a system of contract research.

Currently, it consists of one secretariat and three coordinating committees:

- Agriculture, Fisheries and Forestry Sector (AFFS)
- Health, Medicine and Environment (HME)
- Industry, Natural and Social Sciences (INSS)

AFFS was created from the national agricultural research program (NARP) in 1996 by an act of parliament.

Organizational Structure:

The head of the organization is the Director General. The statutory governing Council is made up of 21 members. These include representatives of selected Ministries (Agriculture, Health, Trade and Industries, and Environment, Science and Technology), the universities, various productions and commercial agencies and associations (Mines, Industry, Commerce, Engineers, Ghana Academy of Arts and Sciences, Farmers), National Development Planning Commission, CSIR Directors, senior staff of CSIR, among others. The CSIR Act requires that 40% of the membership of the Council be drawn from the private sector.

Committee Structure:

Sectoral Research Coordinating Committee

For the coordination of research nationwide, the Council established under the office of the Director-General, three Sectoral Research Coordinating Committees in the following sectors:

- Agriculture, Forestry and Fisheries
- Environment and Health
- Industry, Natural and Social Sciences

Each of these Committees operates under a technical division of the CSIR Secretariat and is headed by a Deputy Director-General (DDG).

Institutes, Centres and Projects of the Council

Currently the Council exercises control over the following institutes, centers, and Projects throughout the country.

- Agricultural Services Sub-sector Investment Project (AgSSIP)
- Animal Research Institute (ARI)
- Building and Road Research Institute (BRRI)
- Crops Research Institute (CRI)
- Food Research Institute (FRI)
- Forestry Research Institute of Ghana (FORIG)
- Institute of Industrial Research (IIR)
- Oil Palm Research Institute (OPRI)
- Plant Genetic Resources Centre (PGRC)
- Science and Technology Policy Research Institute (STEPRI)
- Savannah Agricultural Research Institute (SARI)
- Soil Research Institute (SRI)
- Water Research Institute (WRI)

Each of the institutes and centres of the CSIR is manned by a Management Board appointed by Council. In the discharge of its duties, the Board exercises general supervision of the institute for which it has responsibility. As shown in the organizational structure (figure 4.19) to enhance effective management and coordination of research activities each of these institutes has been assigned to one of the three Sectoral Research Coordinating Committees.

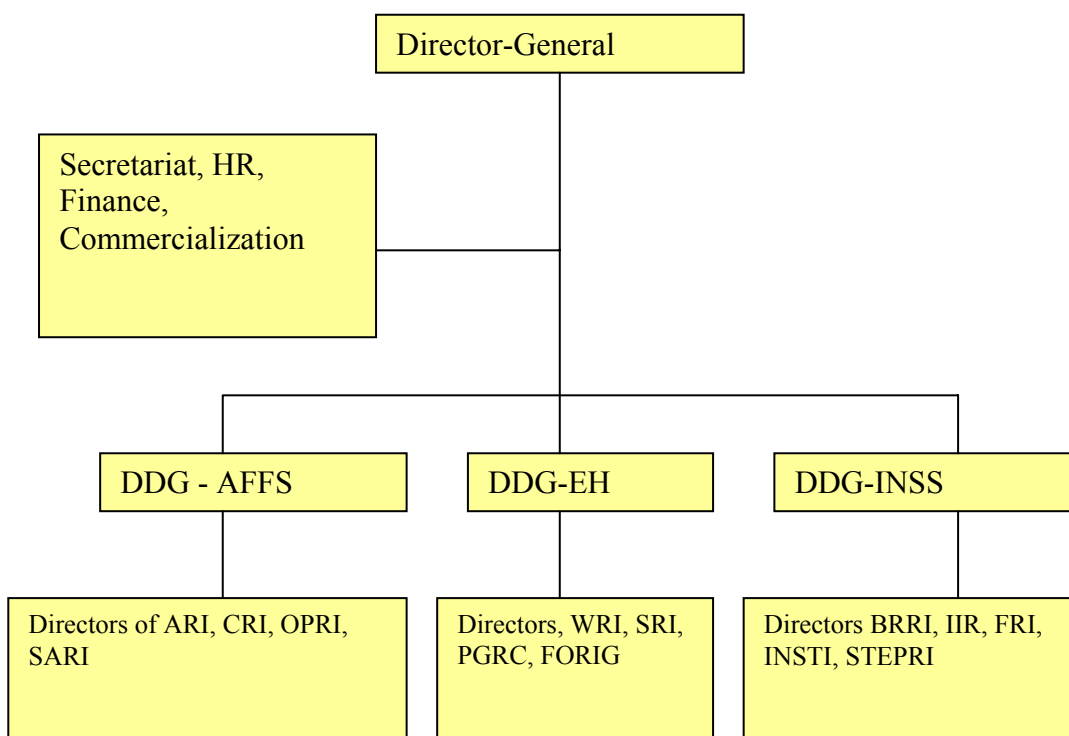


Figure 4.19: Organizational structure of CSIR Ghana.

Legend:

DGG: Deputy Director General
FORIG: Forestry Research Institute
Admin: Administration
HR: Human Resources

Activities:

The headquarters carry out administrative functions while research institutes and stations perform agricultural research and development activities. Data generated from the research activities and the personal data from staff are stored and processed in a management information system meant for the purpose of research management.

History of introduction of MIS in CSIR

CSIR of Ghana, under its National Agricultural Research Project (NARP) implemented the former flat file Management Information System, INFORM, with technical support from ISNAR and financial support from the World Bank during the early 1990s. INFORM training was provided to CSIR staff in 1992. Data collection, entry and information generation went smoothly and INFORM databases on human resources and research activities were established at CSIR. In 1994, the system was used extensively to generate information for setting priority for NARP Agricultural Research Strategic Plan and for Human Resource Development Plan (Setsoafia, 2001). The major problems encountered were: frequent changes in the leadership of the monitoring and evaluation section (Setsoafia, 2001), INFORM based on REFLEX was not a relational database, infrequent use of the system by MIS practitioners. Between 1997 and 1999, ISNAR developed two new user-friendly versions of MIS software called INFORM-R and INFORM-R Light. Six of CSIR employees took part in the in-Country Distance Learning on INFORM-R Light organized by ISNAR in 1999. In 2000, only one out of the six employees participated in the training and implementation workshop in The Hague. None of CSIR's managers participated in the top management sensitization workshop. The reason was probably lack of funds.

Fortunately for CSIR, in 2001, CTA in collaboration with ISNAR sponsored and organized an MIS workshop for English speaking African agricultural research organizations (Webber, 2001). Two CSIR staff participated in this two weeks workshop in The

Netherlands. They returned to CSIR equipped with knowledge, skills and action plan for implementing and institutionalizing MIS in their organization. The plan to implement MIS appeared not to have worked out within that year. In 2002, under a new programme, the Agricultural Services Sub-Sector Investment Programme (AgSSIP) sponsored by the World Bank, funds were made available for the establishment of Management Information System at CSIR. As part of the plan, in 2002, the CSIR MIS national coordinator was sent to ISNAR for training on:

- a) Concepts of information management in the context of research management.
- b) In-depth study of a management information system, INFORM-R Light.
- c) Trainer training: how to pass skills on to others.
- d) Setting up a strategy for the country in MIS training and implementation.

He participated in the training workshop (see figure 4.20) and returned with an action plan for MIS implementation and institutionalization at CSIR.



Figure 4.20: MIS training workshop in The Hague (including the Ghanaian MIS National Coordinator), 2002.

As part of the action plan, ISNAR MIS staff provided technical backstopping to the national coordinator by email. The account of the implementation and institutionalization of MIS at CSIR is narrated in this case study research.

The research was conducted at CSIR headquarters in Accra and research institutes in Accra and Kumasi (see map of Ghana in figure 4.21). The results of the research are presented below.



Figure 4.21: Map of Ghana

Source: University of Texas library collection:
<http://www.lib.utexas.edu/maps/africa.html>

Results of the Interviews

A. Extent of Institutionalization of MIS at CSIR

CSIR staff used the MIS to provide information on progress of projects and research activities to the Director-General. INFORM - R Light was used for data collection but not necessarily for planning monitoring and evaluation. In the past the MIS practitioners conducted workshops and used the opportunity to collect data but lately forms were sent to the staff and they rarely returned them for data entry. The Director-General was not using the MIS as such. He was not well sensitized. He sometimes asked questions and the information could obviously be retrieved from the INFORM - R Light but he made no effort to consult or demand for it. He participated briefly in the recent MIS workshop but did not provide adequate institutional support.

Table 4.4: Integrating MIS in Research Management in CSIR Ghana

• January	• Start financial year
• February	• Approval of proposals
• March	• Release of funds; quarterly reports
• April	• Project implementation starts
• May	• Half yearly reports
• June	• 3 rd Quarterly reports
• July	• Submission of proposals
• August	• Submission of proposals
• September	• Annual reports
• October	
• November	
• December	

Table 4.4 illustrates the approach used by CSIR Ghana for institutionalizing MIS in their annual research management cycle.

B. Results based on the independent variables in the Causal Model

1. Leadership and Organizational Culture

Leadership

Most top managers interviewed at CSIR did not state their roles in the institutionalization of MIS, except one who said he was a facilitator and trainer. He said, after the MIS training programme in December 2001 at Ede in The Netherlands, he drew up an action plan to organize sensitization workshops for the top management of CSIR, as well as some selected research scientists and information practitioners. But he was told that there were no funds available to support the programme. I was not able to interview the Director-General because of his busy schedule or probably lack of interest in MIS. Few middle managers provided answer to the question as well. One of them said if top management institutionalizes MIS he would have a role to play. CSIR had no champion for MIS. The national coordinator was the facilitator and a user of the system. He served as a resource

person for training workshops and used the system for monitoring the progress of research projects. Researchers rated themselves as users of the system but acknowledged that they did not use the system very much except occasionally providing bio-data and research data to the MIS practitioners.

In terms of involvement in institutionalization, top managers interviewed said they have never had hands-on practice with INFORM-R Light. One institute Director said he will be willing to commit resources to institutionalize MIS in his organization if he is well sensitized and shown the direct benefit of an MIS. Another top manager said “There is an officer who has been made solely responsible for the monitoring and evaluation at the AgSSIP secretariat who is responsible for institutionalizing MIS in all the AgSSIP participating institutions”. Middle managers did not tell about their involvement except one from a research institute in Kumasi who said he was an information scientist and has a lot to offer given the necessary support, personnel and equipment.

Organizational Culture

In-house reviews, timely reporting of research activities and good accounting department were the main strengths of CSIR information management culture. Research information was being shared during annual review meetings where researchers present their results and proposals. Those that did not provide reports are being sanctioned. According to informants, even though these factors worked towards successful implementation of MIS, the practitioners charged with the responsibility of seeing to the implementation of the INFORM-R Light were never given the necessary support. A major weakness of CSIR in this area was lack of commitment of managers. The managers were not involved at the initial stage of the introduction of MIS in CSIR.

Organizational Culture: Incentives

According to most respondents, timely reporting on research activities and improvement in the quality of decisions made by managers were major incentives that promoted the use

of MIS. These factors motivated them to participate in institutionalizing MIS at CSIR. Few respondents mentioned time reporting as an incentive. This point work in favour of successful institutionalization of MIS, but it has not been proactive enough at CSIR said some respondents.

Organizational Culture: Disincentives

Lack of commitment on the part of management and the high rate of attrition of staff were the major disincentives mentioned by respondents. Trained MIS staffs left the organization for greener pastures and this called for constant retraining of new staffs to be conversant with the MIS package. There was no proper recognition of MIS staff at CSIR. This factor demoralized potential MIS practitioners.

Organizational Culture: Transparency

Respondents said the level of transparency in sharing information at CSIR was high. In house reviews, seminars and annual reports ensure a good degree of transparency of information sharing. This actually was the reason behind the establishment of MIS in the organization. CSIR scientists usually collaborate and cooperate with one another.

2. Organizational Capacity

Information Management Capacity (Knowledge and Skills)

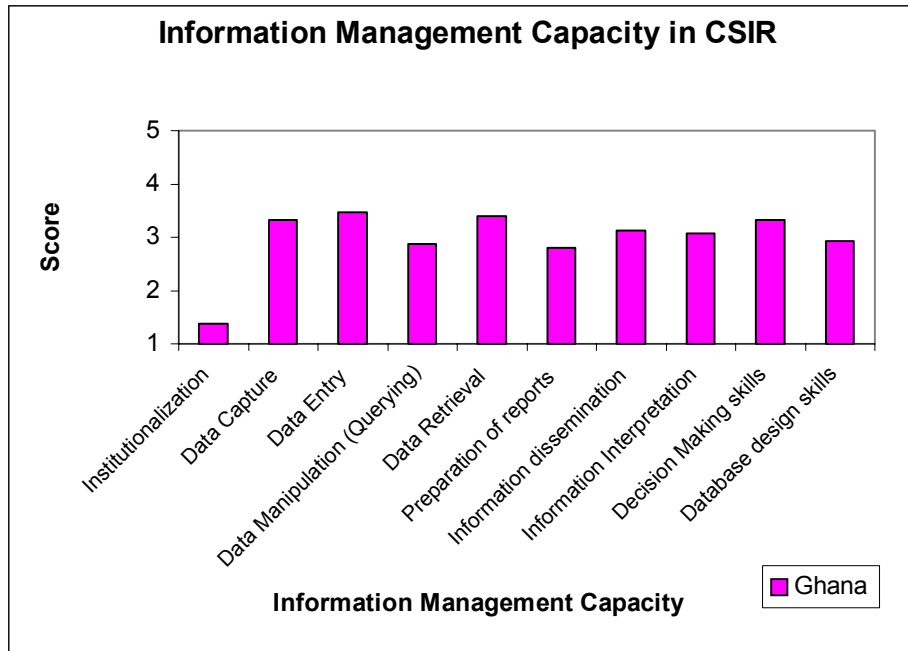


Figure 4.22: Information Management Capacity in CSIR Ghana.

Score 1 = Inadequate, 2 = Poor, 3 = Moderate, 4 = Good, 5 = Highly adequate.

Information management capacity of CSIR staff was moderate and appeared to be better than the level of institutionalization of MIS in their research management. The result so far showed that they were doing well in all areas but this did not help in improving institutionalization of MIS.

In terms of extra training on MIS, top managers interviewed said they never had MIS training since 1997 so fresh training is required. Computers and accessories are also required to put the skills acquired into practice. Middle managers said they would like to have training on database design and maintenance, data manipulation (querying), data retrieval and preparation of reports. Furthermore, researchers said they would like a review of the whole programme and retraining of scientists. Querying and Web-based MIS would be useful for such future training. Finally, MIS practitioners said they would like to have extra training on Visual Basic Programming.

ICT Infrastructure:

In general the level of computer hardware, software and network facilities for MIS in CSIR was a little bit more than moderate according to informants and respondents. The Animal Research and Soil Research Institutes said their levels were inadequate. Communication and information flow within and between CSIR was enabled through availability of ICT infrastructure. It also facilitated data entry and information processing in INFORM-R Light. But according to one respondent “The institute has ICT infrastructure, but it is yet to institutionalize MIS even though a similar system has been developed using a Microsoft ACCESS software package to monitor the question and answer service”. The question and answer service package was introduced by CTA in Wageningen to enable researchers in developing countries to provide practical answers to practical problems and questions raised by local farmers.

In terms of non-availability of ICT infrastructure, most institutes have computers but few LAN. Some institutes also have Internet connection, UPS and standby generator. Electricity may sometimes pose problems to research institutes in Ghana. Lack of electricity may result in a standstill in electronic information management activities and lack of Internet connection may result in communication problems between headquarters and stations.

In conclusion, CSIR has a moderate level of ICT infrastructure, which could be very useful for promoting institutionalization of MIS. I believe the major problems are lack of top management involvement, connectivity and electricity.

Adoption:

Almost all respondents said they were at the awareness or interest stage in terms of adoption. The informant at the headquarters also confirmed they were at the interest

stage, but the informant at the Forestry Research Institute of Ghana said they were at the evaluation stage.

Adaptation:

On the average, INFORM-R Light was not adapted to suit the research and management structure of CSIR. Most respondents did not answer this question because they felt that they were at the awareness stage of adoption. But the informants from the headquarters and the Forestry Research Institute of Ghana indicated the system was fairly adapted. For example, the experiment level was replaced with project level and data collection forms were simplified. The main problems were no staff with database skills and lack of top management support. In principle the top management staffs were interested in having a MIS put in place to monitor the R&D activities at CSIR but they have not accorded the adaptation of INFORM-R Light the priority it deserves. Furthermore the staffs do not have the basic skills to be able to operate the system at the institute level.

Resistance to Change and Solutions:

In the case of CSIR, because of less involvement of top management in the design and implementation of the MIS, researchers lost interest in providing data for input into the system. Transparency issue and researchers' lack of interest in research administration were also mentioned as sources of resistance. These problems have not yet been solved at CSIR. But most researchers I met during the interviews said they were willing to institutionalize MIS if they receive adequate awareness and training on MIS.

3. External Operating Environment:

Government Support:

Respondents and informants said the trend of government support was somehow positive. But at the time of this research, government support was said to be political and

based on promises, which never materialized. There was no proper plan by government to fund and sustain MIS at CSIR.

Respondents and informants advised the government of Ghana to: release funds on time, provide information policy guidelines, ensure clear link between ministry of agriculture and NARS especially CSIR, because the link at the time of this research was reported not to be clear. Government should also develop stronger linkages between ministry of agriculture and ministry of environment and science. Finally, government should identify key actors (champions) to promote the institutionalization of MIS.

Donor Support:

CSIR respondents and informants said the trend of donor support was somehow positive. Donors were praised for funding MIS training and the purchase of ICT hardware and software, and for forging links with ISNAR to deliver MIS activities. CSIR management used these funds to train few practitioners at the headquarters but most researchers and managers have not been trained. According to one respondent, “This is one package that needs sometime for the research scientists to be very conversant with and this calls for institutionalization of training programme. Unfortunately, the institutes are not well resourced to be organizing such training programs. In this respect, support is needed by management to organize train - the - trainer programs”.

On the negative side, respondents said donors contributed to drastic ends to projects and their projects very often lack continuity. One respondent recounted that when donor projects start at CSIR they sometimes have to write follow-up activities to show impact. They requested for donors funds and the answer was “we don’t have”. They could not attach duration to projects because they were often requesting the money from donors and the no-objection authorization to use the money. Respondents perceived this as not encouraging them to conduct research and provide data for the MIS. They advised donors to change by tying their funds to how far MIS has been institutionalized in CSIR. This is

because the establishment and use of MIS was a trigger for moving the AgSSIP from phase 1 to 2.

Critical Success and Failure Factors:

In the questionnaire and interview respondents were requested to choose what they thought were the critical success and failure factors for institutionalization of MIS. We counted their choices and plotted bar charts. The number of respondents and informants from CSIR were 15. Factors that had less than seven counts were not considered as critical success or failure factors. The result (in fig. 4.23) so far revealed that the critical success factors promoting institutionalization of MIS in CSIR were donor support, ICT infrastructure and MIS training. The earlier results on donors and ICT infrastructure support this finding. Donors, especially the World Bank, supported NARP and AgSSIP programs at CSIR.

Critical Success Factors:

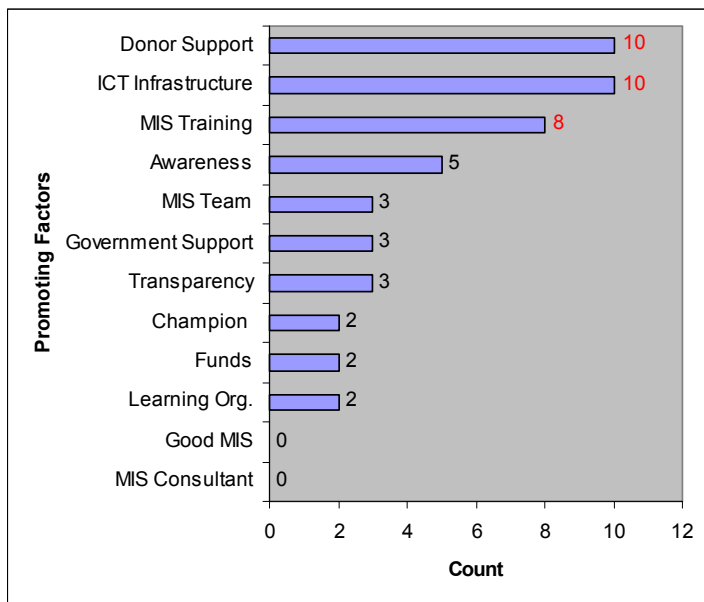


Figure 4.23: Critical Success Factors for Institutionalization of MIS in CSIR.

Y-axis = Critical Success Factors promoting institutionalization of MIS

X-axis = Count: Number of respondents out of fifteen who scored the CSF.

Critical Failure Factors:

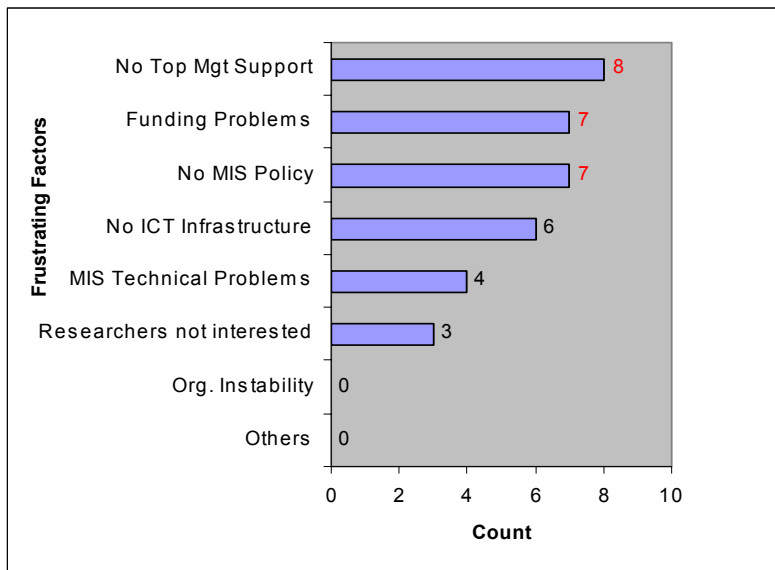


Figure 4.24: Critical Failure Factors frustrating institutionalization of MIS in CSIR.

Y-axis = Critical Failure Factors frustrating institutionalization of MIS

X-axis = Count: Number of respondents out of fifteen who scored the CFF.

The critical failure factors frustrating institutionalization of MIS at CSIR were absence of top management support, lack of policy for MIS and lack of funds.

4.7. SWOT Analysis for the Four NAROs

The objective of this SWOT analysis is to enable the case study NAROs to understand and appreciate the details of the internal factors (strengths and weaknesses) and external factors (opportunities and threats) that might affect institutionalization of MIS. The SWOT an analysis is in a nutshell the summary of the results in chapter four. Our advice to NAROs is that the strengths must be enhanced or improved, weaknesses must be minimised or if possible eliminated, opportunities must be capitalised on and threats must be avoided as much as possible. The SWOT analysis for each case study NARO is presented separately a table (below).

Table 4.5: SWOT Analysis for ZARI Zambia.

Strengths	Weaknesses	Opportunities	Threats
Champion: The Director of ZARI is the champion of MIS. This has promoted institutionalization	Funds: Lack of funds for backstopping. It should be included in the overall budget.	Donors: Donors appear to be interested in funding projects in Zambia. ZARI should generate MIS proposals for donors, government and clients	Rate of Attrition: Outside companies paying better salaries and attracting ZARI staff. Rewarding MIS specialists should discourage this threat.
A number of trained MIS Practitioners are available but more staff should be trained and allocated to stations and programs	Disincentives: Not recognizing Practitioner's effort. Terms of reference should be made clear for MIS Practitioners and incentives such as promotion and higher degree training should be provided.	Availability of INFORM-R and INFORM-R Light Should be capitalized on.	Government Support
Transparency: MIS should be continuously used for quarterly, midterm and annual reviews.	Original concept of MIS for M&E not expanded to deal with management Information need on finance, personnel and inventory. This idea should be expanded and M&E specialist should be included at Biometrics Unit.		
	Reporting to the general public is weak because of delay in submission of interim and other		

Strengths	Weaknesses	Opportunities	Threats
	reports. For this reason we recommend that allocation of research funds to Researchers should be tied to report submission.		
	Lack of clear policy guidelines: The DG should include MIS in ZARI vision statement and support the development of MIS policy and strategy.		

Table 4.6: SWOT Analysis for NARO Uganda.

Strengths	Weaknesses	Opportunities	Threats
Availability of PM&E Unit is a major strength of NARO. It should be maintained and well staffed	Researchers not interested in MIS. Continuous MIS awareness seminars and change in culture is advocated.	Donors appear to be interested in funding projects in Uganda. NARO should generate proposals for donors, government and clients to fund MIS activities.	Rate of Attrition: Outside companies paying better salaries and attracting NARO staff. Rewarding MIS specialist by promotion of higher degree training should discourage this threat.
Availability of MIS Specialist at NARO is also a big plus.	Data accumulated but not analyzed. Top management should employ a Statistician	East African Network (ASARECA) should be capitalized on.	Organizational instability (restructuring exercise). Government and donors should assist NAROs to bring

Strengths	Weaknesses	Opportunities	Threats
			this exercise to closure.
A number of trained MIS Practitioners are available but more staff should be trained and allocated to stations and programs	Funds: Lack of funds for backstopping. It should be included in the overall budget.	Availability of INFORM-R and INFORM-R Light should be capitalized on.	The DG should ensure clear link between Ministry of Agric and Finance in order to avoid unnecessary delay in release of funds to NARO.
NARO is very aware of its information needs. This is actually promoting institutionalization of MIS	Training for top managers and institutes manager is highly recommended to bring this group on board.		
	The DG should encourage more Transparency of information sharing with NARO.		
	Disincentives: Not recognizing Practitioner's effort. Terms of reference should be made clear for MIS Practitioners and incentives such as promotion and higher degree training should be provided.		
	Reporting to the general public is weak because of delay in submission of interim and other reports. For this reason we recommend that		

Strengths	Weaknesses	Opportunities	Threats
	allocation of research funds to Researchers should be tied to report submission.		
	Lack of clear policy guidelines: The DG should include MIS in NARO's vision statement and support the development of MIS policy and strategy.		

Table 4.7: SWOT Analysis for DRD Tanzania.

Strengths	Weaknesses	Opportunities	Threats
MIS team	Funds: Lack of funds for backstopping. It should be included in the overall budget.	Donors appear to be interested in funding projects in Tanzania. DRD should generate proposals for donors, government and clients to fund MIS activities.	Government support: It is strongly recommended that government should release funds on time and ensure clear link between Ministry of Agriculture and Ministry of Finance.
PM&E Unit available is a major strength for DRD but we strongly recommend that MIS should be used for M&E information management.	Connectivity: LAN is recommended	East African Network (ASARECA). Collaboration strongly recommended.	
Availability of a Champion is strength and it should be	Transparency: The DG should encourage team work	Availability of INFORM-R and INFORM-R Light should be	

Strengths	Weaknesses	Opportunities	Threats
maintained.		capitalized on.	
A number of trained MIS Practitioners are available but more staff should be trained and allocated to stations and programs	Top management support. The DG should be the champion for MIS		
Organizational Culture of mid term reviews should be maintained and MIS should be used for information management.	Reporting to the general public is weak because of delay in submission of interim and other reports. For this reason we recommend that allocation of research funds to Researchers should be tied to report submission.		
Incentives for MIS staff should be maintained.	Lack of clear policy guidelines: The DG should include MIS in DRD's vision statement and support the development of MIS policy and strategy.		
Availability of ICT Infrastructure is strength but LAN is needed to link with institutes and stations in the zones and regions.			

Table 4.8: SWOT Analysis for CSIR Ghana.

Strengths	Weaknesses	Opportunities	Threats
Availability of ICT Infrastructure is strength but LAN is needed to link with institutes and stations	Top management support. It is strongly recommended that the DG become the champion for MIS.	Donors appear to be interested in funding projects in Ghana. CSIR should generate proposals for donors, government and clients to fund MIS activities	Rate of Attrition: Outside companies paying better salaries and attracting NARO staff. Rewarding MIS specialist by promotion of higher degree training should discourage this threat.
Information management Capacity was observed to be strength in CSIR so it should be used in promoting MIS institutionalization.	Electricity: The use of Solar energy is strongly recommended	Availability of INFORM-R and INFORM-R Light should be capitalized on.	Government support: It is strongly recommended that government should release funds on time and ensure clear link between Ministry of Agriculture and Ministry of Finance.
Culture (In house reviews)	Connectivity: LAN is recommended		
	Funds: Lack of funds for backstopping. It should be included in the overall budget.		
	Reporting to the general public is weak because of delay in submission of interim and other reports.		

Strengths	Weaknesses	Opportunities	Threats
	For this reason we recommend that allocation of research funds to Researchers should be tied to report submission.		
	Lack of clear policy guidelines: The DG should include MIS in CSIR's vision statement and support the development of MIS policy and strategy.		

4.8. Conclusion

The results so far were representative of the actual situation on the ground in the four NAROs at the time of this research. In the next chapter we will analyze and present the results of the four NAROs quantitatively at organizational and individual levels.

Chapter 5. Country and Individual Levels Comparative Analysis

Introduction

This chapter presents the results of the country and individual levels analyses of institutionalization of MIS. The statistical analyses are based on interviews and questionnaires from NAROs staff, and are thus based on their perceptions. We use the qualitative results in chapter four, observations made during fieldwork and review of NAROs annual reports and websites to triangulate and corroborate the quantitative results in this chapter.

We used two-levels of analyses in order to link a sociological study to current concerns in individual psychology of NAROs staff. Geert Hofstede (1995) wrote that a major part of social science research is based on information collected from or about individuals. Different social disciplines analyse such data each at their own level of aggregation: the individual, the group, the tribe, and the country. Hofstede noted that this division of labour has developed into over-specialization because students of one discipline ignore developments in other disciplines. In conclusion he stated that jumping to a different level of analysis could shed new light on existing issues.

In this study statistical analyses e.g. Means, Frequency, Correlation and Linear regression at country and individual levels of analyses were carried out in order to gain insight into the extent of institutionalization of MIS, and into factors promoting and frustrating institutionalization. Country level analysis enabled us to compare the best country with the worst. Individual level analysis enabled us to gain insight into individual perceptions of NAROs staff with respect to institutionalization of MIS.

5.1. Country Level Analysis

5.1.1. Extent of Institutionalization of MIS in NAROs

The extent of institutionalization of MIS in NAROs was a key question in the interviews. To evaluate the extent of institutionalization of MIS, respondents and informants were asked to score what they thought to be the level of institutionalization in their organization. The score ranged from one to five: one meaning not institutionalized and five meaning highly institutionalized. To analyze the extent of institutionalization, scores from 49 respondents/Informants on the use of MIS for data collection and decision-making for various research management processes across research structures (Experiments, Projects, Programs and Organization) were entered into eight tables in the MS ACCESS database. The tables were appended into one data matrix consisting of 392 records. Finally, the institutionalization means across countries were computed in SPSS statistical software.

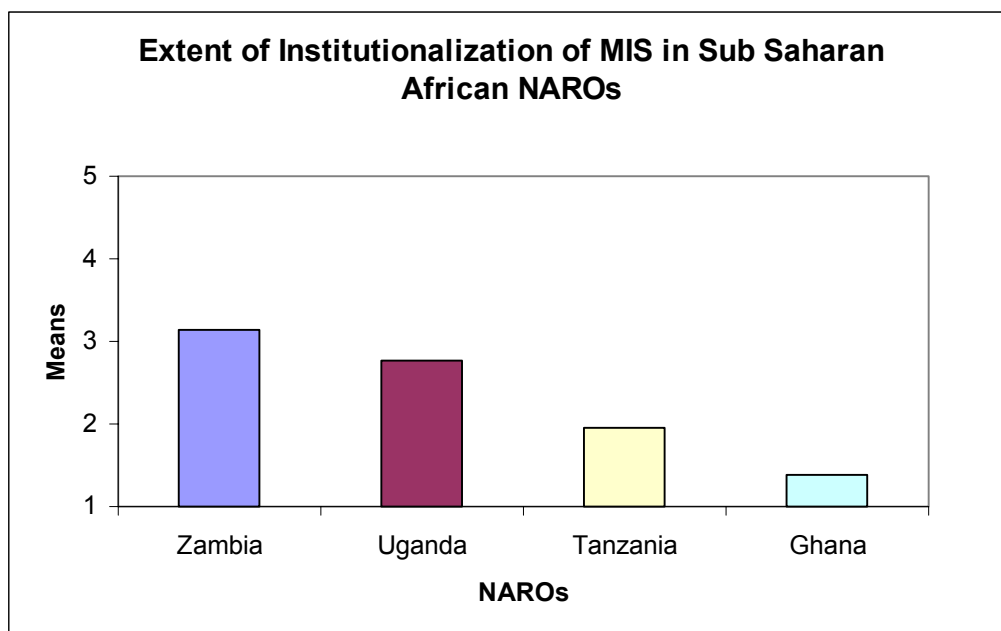


Figure 5.1: The answer to question 2a and 2b: means of the two sub-questions.

Where 1 = Not institutionalized, 2 = Inadequately institutionalized, 3 = Partially institutionalized, 4 = Highly institutionalized, 5 = Fully institutionalized. (See questionnaire in annex 4).

The results in figure 5.1 show that Zambia (ZARI) and Uganda (NARO) partially institutionalized the MIS in their research management processes. Both organizations are so far the best compared to the other two NAROs. Tanzania (DRD) inadequately institutionalized the MIS and Ghana (CSIR) did not institutionalize the MIS. The difference between institutionalization means for Zambia and Ghana is significant at 0.05 levels.

5.1.2. Use of MIS for Data Collection

Data collection is one of the most important steps in the processes of institutionalizing MIS in NAROs. To determine the extent to which NAROs used INFORM-R or INFORM-R Light for data collection; we made use of the data matrix described in section 5.1.1. The data collection responses were separated into a new table and the average responses for data collection across countries were computed and a histogram was plotted. Figure 5.2 reveal that Zambia use the MIS highly for data collection in the areas of planning and monitoring followed closely by its use in evaluation, priority setting and budgeting but poorly in financial accounting. Uganda use it highly in collecting data for budgeting, and data collection for the other areas are also at a moderately high level except again for financial accounting. Data collection in Tanzania and Ghana is on the average mild compared to Zambia and Uganda.

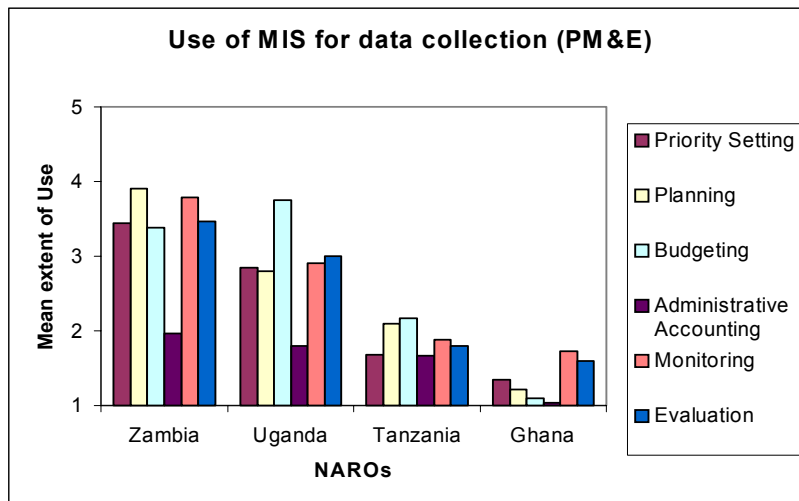


Figure 2 Use of MIS for data collection at PM&E level.

In terms of data collection for reporting purposes, figure 5.3 show again that Uganda and Zambia were performing better than Tanzania and Ghana. All case study countries appear to have problem with data collection for reporting to the general public. This probably explains one of the reasons why there are few international peer reviewed publications from Sub Saharan African NAROs.

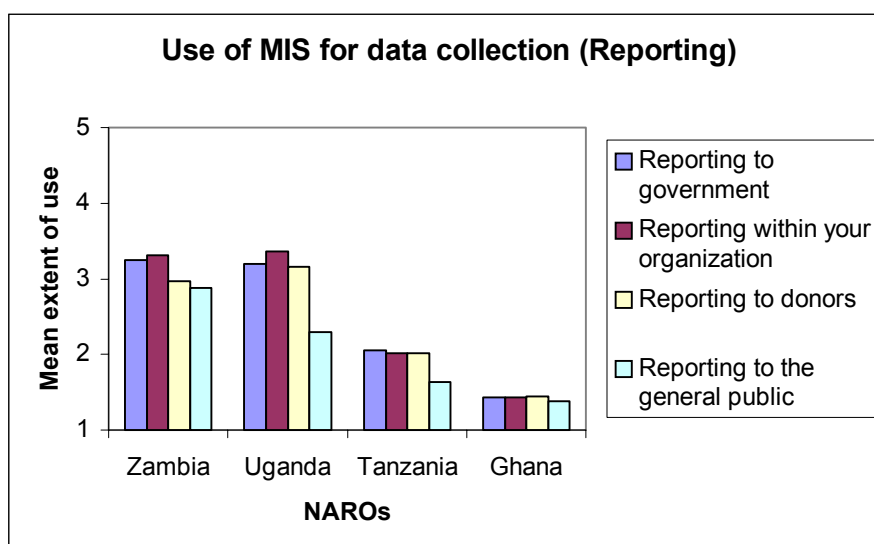


Figure 5.3: Use of MIS for data collection at reporting level.

5.1.3. Use of MIS for Decision-Making

The main advantage of having an MIS in an agricultural research organization is for managers and researchers to use aggregate reports from the MIS to make decisions. As mentioned earlier in chapter four, it is important to note that NAROs made use of information from INFORM-R/INFORM-R Light and other information systems in making decisions. To explore the extent to which NAROs use information from INFORM-R/INFORM-R Light for their decision-making, we made use of the same data matrix described in section 5.1.1. The responses for decision-making were separated from the main table and the mean responses across countries were computed and a histogram was plotted.

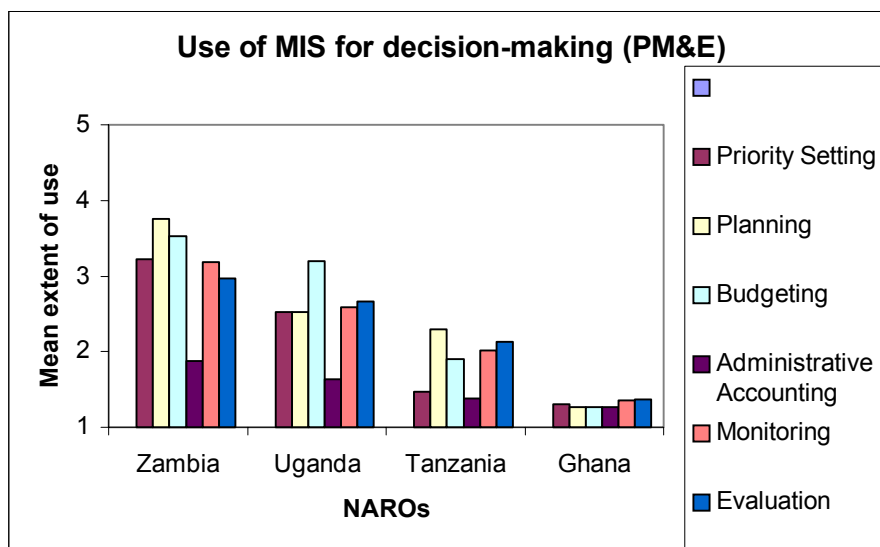


Figure 5.4: Use of MIS for decision-making at PM&E level.

The results in figure 5.4 show that ZARI Zambia use the MIS highly for making decisions during annual research planning and budgeting meetings. The use of the system for collecting data for research monitoring purpose is higher compared to using it for making decisions for the same purpose. The Uganda result for use of MIS in making decisions is consistent with the use MIS for data collection. They use the system highly for decision-

making in the area of budgeting and moderately in the planning, monitoring and evaluation. Furthermore, the results show that Tanzania and Ghana use MIS the least in terms of decision making although Tanzania was slightly higher than Ghana. The same trend described above was observed in the results on using the MIS for making decisions on reporting activities (figure 5.5).

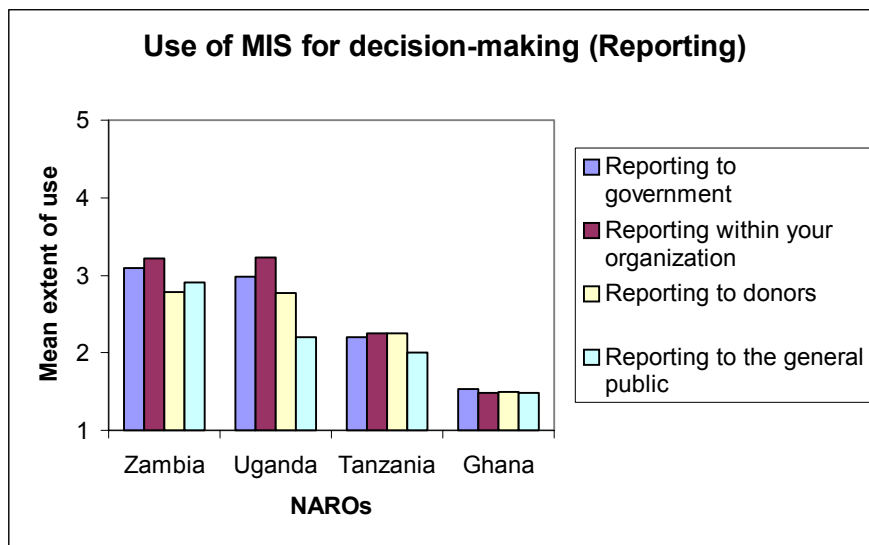


Figure 5.5: Use of MIS for decision-making at reporting level.

5.1.4. Use of MIS in Management Processes (PM&E).

Priority setting, planning, budgeting, financial accounting, monitoring and evaluation are major activities in managing agricultural research organizations. For an MIS to be fully institutionalized in an organization, it has to be fully integrated into these management processes. To determine the extent of institutionalization of MIS in the management processes across countries, we made use of the same data matrix described in section 5.1.1 to compute institutionalization means across management processes and countries. In other words, we combined the results of data collection and decision-making to produce the histograms in figures 5.6 and 5.7.

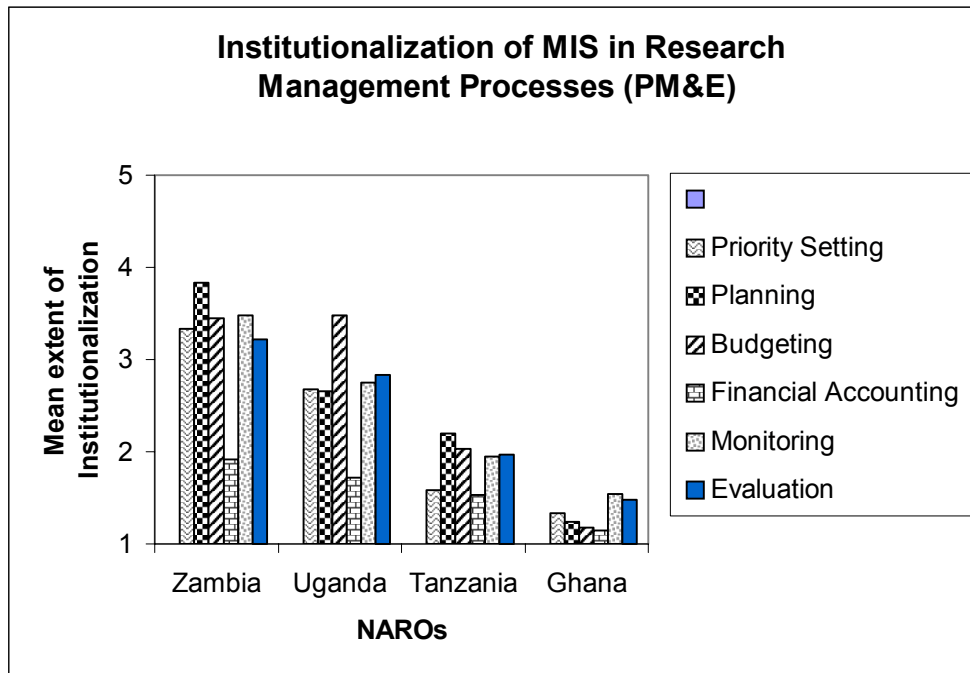


Figure 5.6: Institutionalization of MIS in Research Management Processes (PM&E). The answer to question 2a and 2b.

The results in figure 5.6 show that Zambia and Uganda NAROs use the MIS moderately for priority setting, planning, monitoring and evaluation of research activities and staff. But the use of the system for financial accounting was low. In comparison, Tanzania and Ghana institutionalized the MIS little in their research management processes. These results confirms the information in the country reports (see chapter 4), which indicated that Zambia and Uganda NAROs use MIS to a greater extent than Tanzania and Ghana. It is worth mentioning that institutionalization of MIS in ³financial accounting is low in all four NAROs. These NAROs have financial accounting software but they made less effort to link it to their MIS in order to show expenditure of research funds. The implication was that research managers were not up to-date with the expenditure of research funds and financial managers were not up to-date with ongoing research activities and progress reports. In the words of one respondent, “Cheques for research purposes were signed out

³ Financial Accounting was formerly referred to as administrative accounting in the questionnaire.

by managers but they had no mechanism to control and account on how the money was used”.

5.1.5. Use of MIS for Reporting

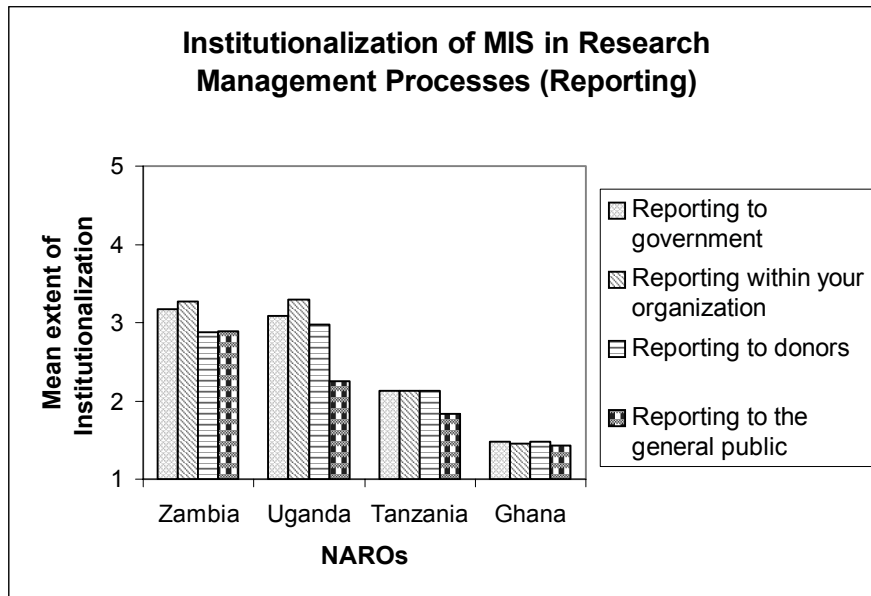


Figure 5.7: Use of MIS for Reporting. The answer to question 2a and 2b

For NAROs staffs to show accountability and transparency, they need to communicate their research findings, new technologies and budget/expenditure internally to their managers and peers and externally to their stakeholders and beneficiaries. Reporting is therefore an important research management activity in NAROs. To determine the degree of institutionalization of MIS for reporting, we computed the means for reporting as described in section 5.1.4. The results in figure 5.7 reveal that Zambia and Uganda NAROs use the MIS moderately for reporting: within their organizations, to their governments and donors. Tanzania and Ghana used it less for reporting at all levels. In comparison to Zambia, the results show that Uganda, Tanzania and Ghana use the MIS less for reporting to the general public.

5.2. Critical Success and Critical Failure Factors

5.2.1. Correlations: Institutionalization and Independent Variables

Based on the causal model in figure 2.2, we collected data from 49 respondents/informants from four countries. To better understand the correlations between institutionalization of MIS and independent variables at country level; we computed the mean values for seven factors and for institutionalization, and based on that computed correlations (table 5.1) in SPSS software.

Table 5.1: Correlations at country level of analysis of institutionalization and seven factors. (N=4)

Factor	Correlation Coefficient	P-value
Leadership Involvement	0.969(*)	0.031
Adoption Median	0.960(*)	0.040
Adaptation	0.767	0.233
Government Support	0.665	0.335
Information Management	0.344	0.656
Donors Support	-0.287	0.713
Computer Infrastructure	-0.851	0.149

* Correlation is significant at 0.05 levels (2-tailed).

The p-value (probability value) is compared with the significance level and, if it is smaller, the result is significant. Small p-values suggest that the null hypothesis is unlikely to be true.

The results in table 5.1 show that leadership involvement is highly and significantly correlated to institutionalization. This suggests that increase in involvement of NAROs

leadership would very likely to lead to increase in institutionalization of MIS. A similar result is observed in the variable adoption median. We calculated the median value for adoption because the data type is categorical. Donor support and ICT infrastructure are negatively correlated to institutionalization. To have a detailed understanding of these correlations at the country level we made scatter-plots.

5.2.2. Leadership

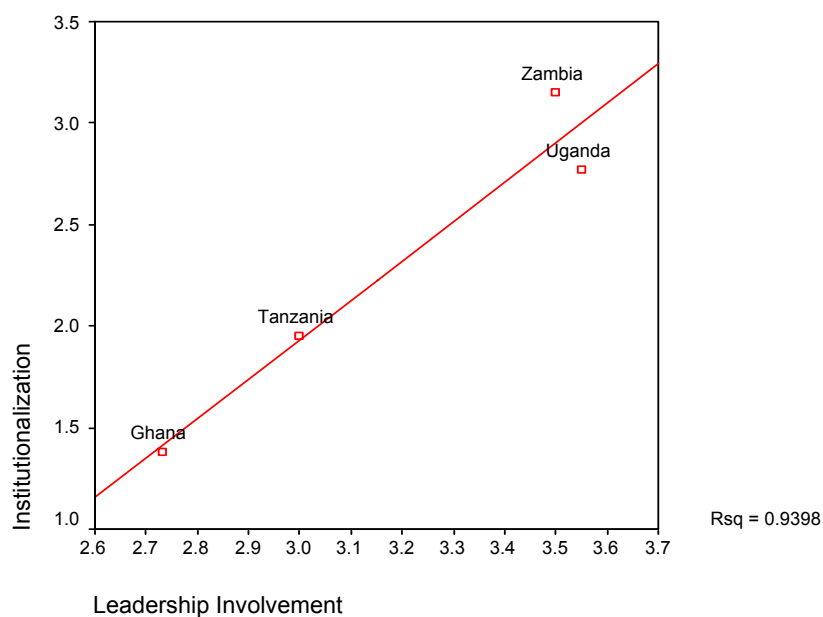


Figure 5.8. Scatter-plot of the relationship between Institutionalization of MIS and the involvement of NAROs leaders.

The results in figure 5.8 show that institutionalization of MIS in the four NAROs is strongly and positively correlates to leadership involvement.

5.2.3. Information Management Capacity

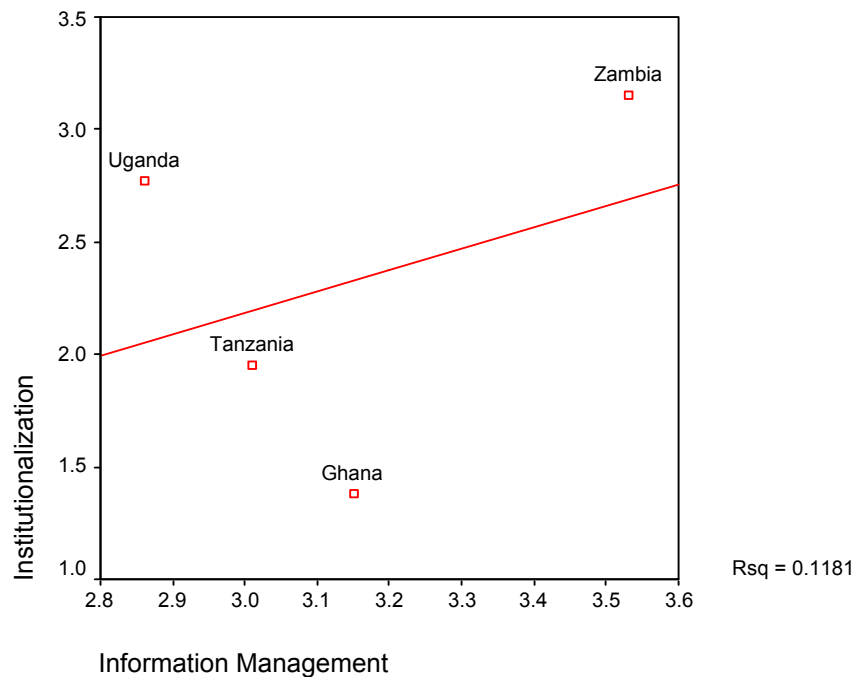


Figure 5.9: Scatter-plot of the relationship between Institutionalization of MIS and information management capacity of NAROs.

In general all case study NAROs appear to have moderate information management capacity (skills and knowledge). But the correlation with institutionalization is low and insignificant. Moderate information management capacity did not really help in increasing institutionalization of MIS in the four NAROs.

5.2.4. ICT Infrastructure

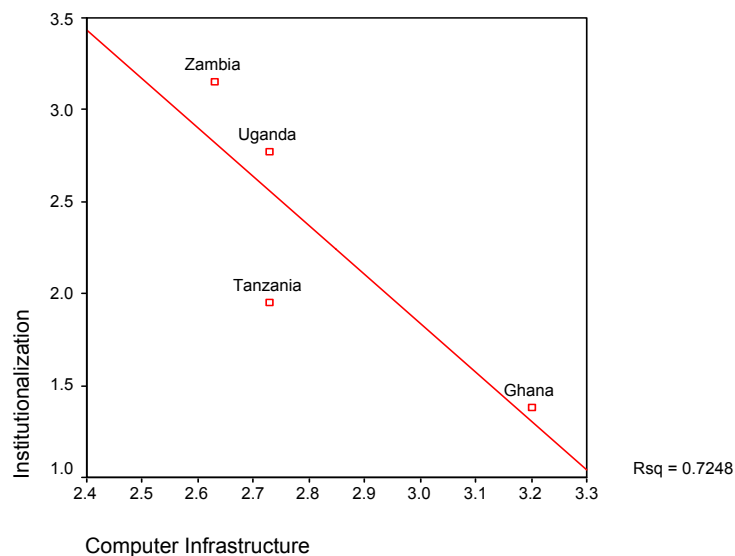


Figure 5.10. Scatter-plot of the relationship between Institutionalization of MIS and the level of ICT infrastructure in NAROs.

For MIS to be institutionalize in organizations such as NAROs, it is essential to have the right infrastructure in place and functioning. During the interviews, respondents were requested to score the level of ICT infrastructure in their organizations (1 meaning low and 5 meaning high). The average level of ICT infrastructure is moderate in the four NAROs. The means were used to draw a scatter-plot. The results in figure 5.10 show a negative correlation between the level of ICT infrastructure and institutionalization at country level.

To find out whether or not there are positive correlations between the level of ICT infrastructure and institutionalization at stations/institutes and NARO headquarters, we computed means for ICT Infrastructure and Institutionalization at these levels and analyzed correlations in SPSS. The results reveal that institutionalization of MIS at headquarters positively and significantly correlates with institutionalization at institutes/stations. ICT infrastructure at station/institute level correlates positively with institutionalization at NARO headquarters (see table 5.2, and figure 5.11).

Table 5.2: Correlations between ICT infrastructure at station/institutes and institutionalization of MIS at NAROs headquarters.

	INST	ICT2	INSTHQ	ICT2HQ
INST	1	-.207	.730(*)	-.435
	.	.623	.040	.282
ICT2	-.207	1	.071	-.267
	.623	.	.868	.523
INSTHQ	.730(*)	.071	1	-.904(**)
	.040	.868	.	.002
ICT2HQ	-.435	-.267	-.904(**)	1
	.282	.523	.002	.

Legend:

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

inst: Institutionalization of MIS at Stations or Institutes

ict2: ICT infrastructure at Stations or Institutes

insthq: Institutionalization of MIS at headquarters

ict2hq: ICT infrastructure at headquarters

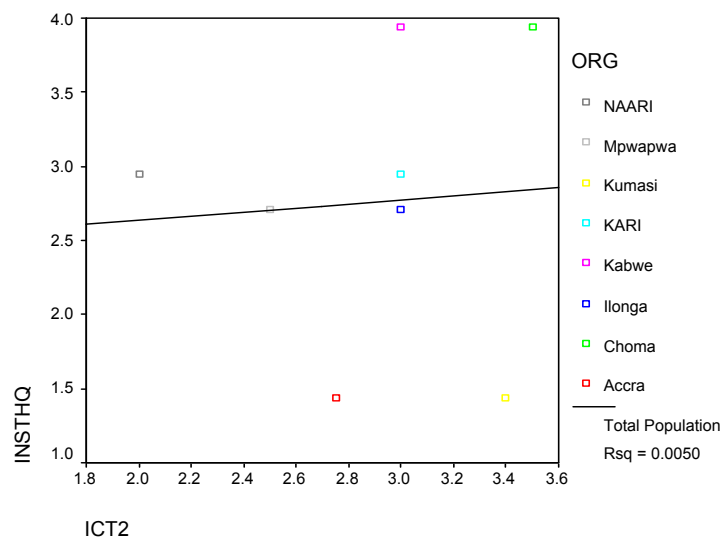


Figure 5.11: Correlations between ICT infrastructure at station/institutes and institutionalization of MIS at NAROs headquarters.

This result is not surprising because in some countries, research stations/institutes are better equipped with computers than headquarters. Especially stations or institutes that

have donor-funded projects tend to be better equipped with computers and networking facilities. These facilities may enable such stations/institutes to manage information much faster than the headquarters. A good example is Ilonga research station in Tanzania. At the time of this research I observed that this station had better ICT infrastructure compared to the headquarters in Dar es Salaam. In principle NAROs headquarters are supposed to be better equipped with ICT infrastructure than the stations or institutes.

In the second part of the interview question, respondents were requested to state how the availability or non-availability of ICT infrastructure affected institutionalization of MIS. The qualitative results in chapter four suggest that availability of ICT infrastructure is a critical success factor for institutionalization of MIS, and non-availability of ICT infrastructure especially connectivity (networking facilities) is a frustrating factor.

Because connectivity problems faced by the case NAROs affected information flow within their organizations, we decided to explore the relationship between connectivity/flow of information (management and scientific information) and institutionalization of MIS. We made use of the data generated from questions 2a and 2b to compute the mean level of use of INFORM-R and INFORM-R Light for research management at experiments, projects, programs and organizational levels. The results indicate low levels of use in the four decision-making levels. The connectivity problems described by these NAROs are probably some of the reasons for low information flow. From the qualitative results in chapter four, we also learned about lack of flow of financial and infrastructure information, which also occurred due to gap in connectivity. Figure 5.12 illustrates connectivity scheme and information flow in the case study NAROs.

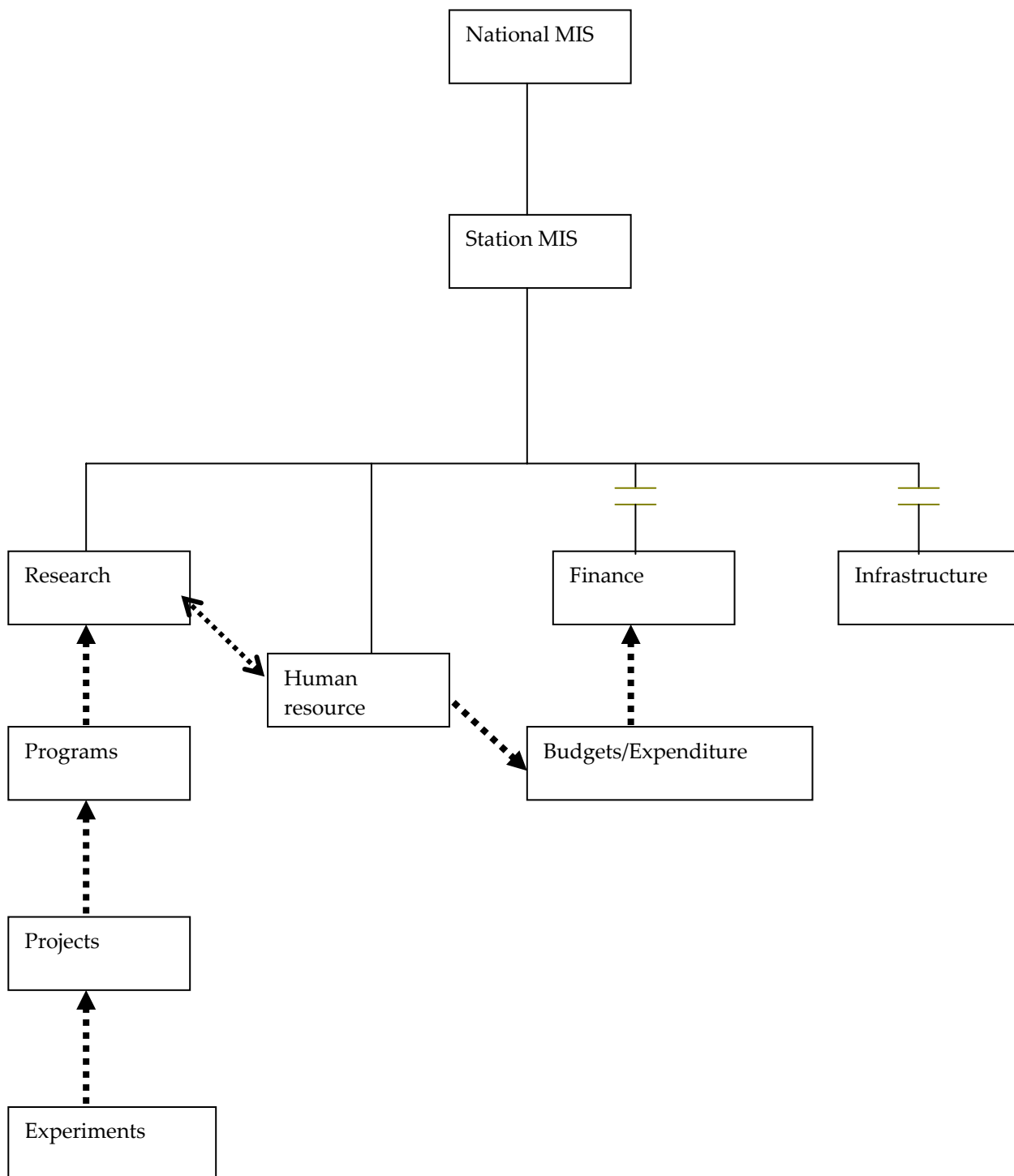


Figure 5.12: Connectivity Scheme: Information flow in SSA NAROs

Legend:

Straight lines indicate hierarchical connections, and lines with bridges indicate a gap in connectivity.
Dotted arrows indicate flow of management information.

Below are some of the statements made by respondents regarding lack of connectivity and its effects on institutionalization of MIS:

“Computer hardware and software was not a very critical issue at the time of this research but lack of connectivity (local Area Network and Internet) remain a source of worry in the case study NAROs”.

“Lack of connectivity affected institutionalization of MIS in ZARI Zambia. Some stations like Mt Makulu (headquarters) and Mochipapa have Internet connection but the others are not yet connected. Even those stations that have Internet connections still face problems because the Internet connections at the time of this research were unsustainable due to poor funding and lack of phone lines. This has affected data collection from remote research stations”.

“Lack of connectivity impeded the distribution of INFORM-R Light to NARO Uganda staff to get familiarised with the system. Local Area Network connection would facilitate the transfer of data and reduce on the time taken to merge data from institutes into the national database. In DRD Tanzania, lack of Internet connection made it very difficult to get information from other institutions”.

“Electricity may sometimes pose problems to research institutes in Ghana. Lack of electricity resulted in standstill in electronic information management activities and lack of Internet connection resulted in communication problems between headquarters and stations”.

5.2.5. Adoption of MIS Software

During the field research I inquired from respondents and informants about the stages of adoption of INFORM-R and INFORM-R Light in their organization. Rogers (2005) in his

book “*Diffusion of innovations*” provided definitions of adoption stages. We slightly modified these stages to suit our institutionalization model (see chapter 2).

Responses from respondents and informants were used in computing minimum, median and maximum levels of adoption for the four NAROs. The results in Table 5.3 reveal that there are two groups of NAROs. Zambia and Uganda NAROs adopted the system and are implementing and using it, while Tanzania and Ghana are aware and interested in the MIS. The table also reveal that some informants or respondents in Tanzania and Ghana adopted MIS and were implementing it in their institutes or stations but not using it routinely as compared to Zambia and Uganda. The variation in the level of adoption of MIS in Sub Saharan African NAROs is correct because during the fieldwork I observed that the system was more actively adopted at the headquarters than in research stations.

Table 5.3: Adoption stages of MIS Software in Sub Saharan African NAROs.

NARO	Minimum	Median	Maximum
Zambia	Trial	Implementation	Use
Uganda	Interest	Implementation	Use
Tanzania	Awareness	Interest	Implementation
Ghana	Awareness	Awareness	Implementation

Legend:

1 = Awareness, 2 = Interest, 3 = Evaluation, 4 = Trial,
5 = adoption / Implementation, 6 = Use.

In order to understand the relationship between adoption of MIS software and institutionalization, we computed correlation using the data described in section 5.2.1.

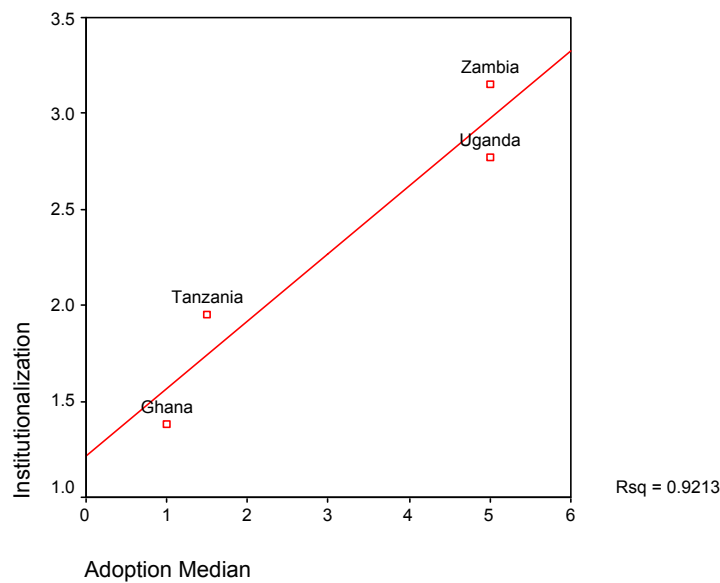


Figure 5.13: Scatter-plot of the relationship between Institutionalization of MIS and adoption of INFORM-R / INFORM-R Light in NAROs.

The results in figure 5.13 show that adoption of MIS software (INFORM-R / INFORM-R Light) positively correlates with institutionalization of MIS in the four NAROs. Again Zambia and Uganda score high and Tanzania and Ghana score low. Rsq (is the coefficient of determination, which is simply the square of the correlation coefficient) is the amount of variation in institutionalization that is accounted for by (the predictor) adoption. Large value of Rsq represents a large correlation between the predicted and observed values of institutionalization. The amount of variation in institutionalization (0.9213) is >0.6 . This represents a large correlation between institutionalization and adoption.

5.2.6. Adaptation of MIS Software

The adaptation of MIS software took place in NAROs during the implementation stage. As stated in the problem statements in chapter 1, it may be possible that some managers and researchers did not perceive INFORM-R and INFORM-R Light to be adequate for their organization. For this reason, in the questionnaire we requested respondents and

informants to choose what they thought were the main problems to implementation. We counted their choices and plotted bar charts.

The results in figure 5.14 reveal that INFORM-R and INFORM-R Light software are not the main problems to implementation but funding and lack of top management support are indeed the main problems.

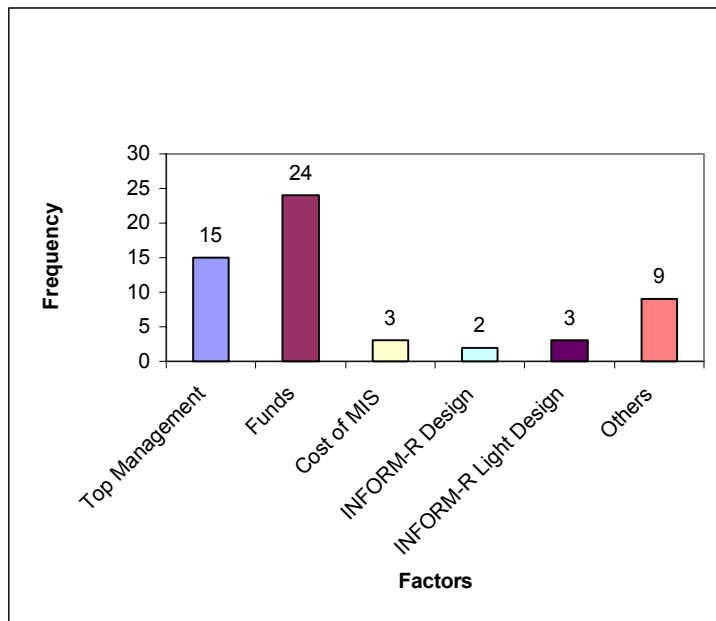


Figure 5.14. The main problems to implementation and use of MIS in Sub Saharan African NAROs

Although INFORM-R and INFORM-R Light are not the main problems to implementation and use of MIS in NAROs yet few respondents did mention the design of the systems as a problem. For this reason we were interested in understanding the relationship between adaptation of these MIS software and institutionalization of MIS in NAROs. To answer this question we computed correlation between adaptation and institutionalization using the data described in section 5.2.1.

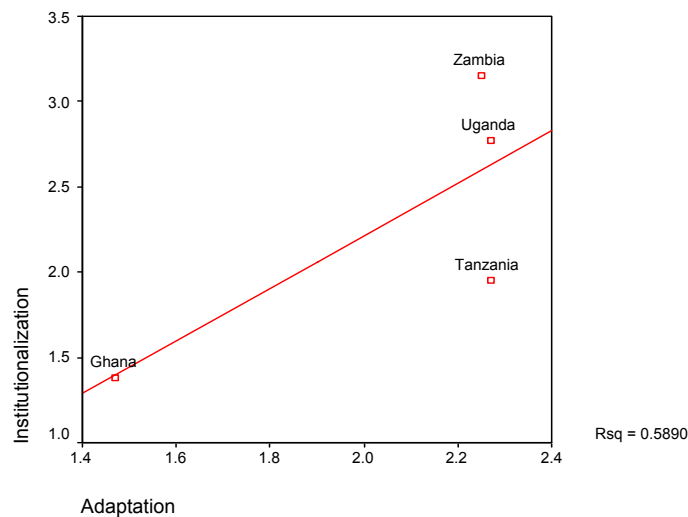


Figure 5.15. Scatter-plot of the relationship between Institutionalization of MIS and adaptation of INFORM-R / INFORM-R Light in NAROs.

The results in figure 5.15 reveal that adaptation of INFORM-R / INFORM-R Light is positively correlated to institutionalization in the four NAROs but not significant. Zambia, Uganda and Tanzania scored higher than Ghana. In Ghana, the result shows that small adaptation was done at CSIR headquarters and Forestry research institute Kumasi, and this was observed together with a low level of institutionalization. In general what the data is telling us is that the more you adapt the system to suit your organization structure and work processes the higher the chance that it will be used.

5.2.7. Government Support

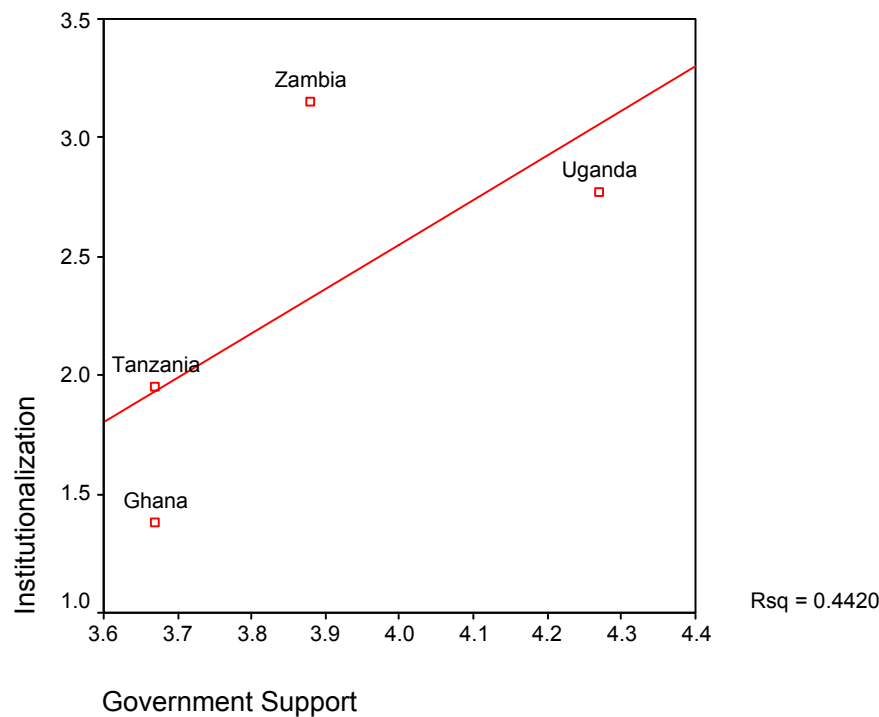


Figure 5.16: Scatter-plot of the relationship between Institutionalization of MIS and the trend of government support to NAROs.

Government support is positively correlated with institutionalization of MIS in the four NAROs but R_{sq} is not significant. Uganda NARO has high government support for MIS compare to the other NAROs. In contrast Zambia has slightly less government support than Uganda but the extent of institutionalization is slightly higher in Zambia. This indicates that there may be some other factors within government support that are responsible for this result, for instance organizational instability. At the time of this research, respondents from NARO Uganda referred to government led (slow) restructuring process as the source of NARO's instability and delay in MIS institutionalization. Tanzania and Ghana have low government support compare to Zambia and Uganda. This partly explains why their level of institutionalization of MIS is also low.

5.2.8. Donor Support

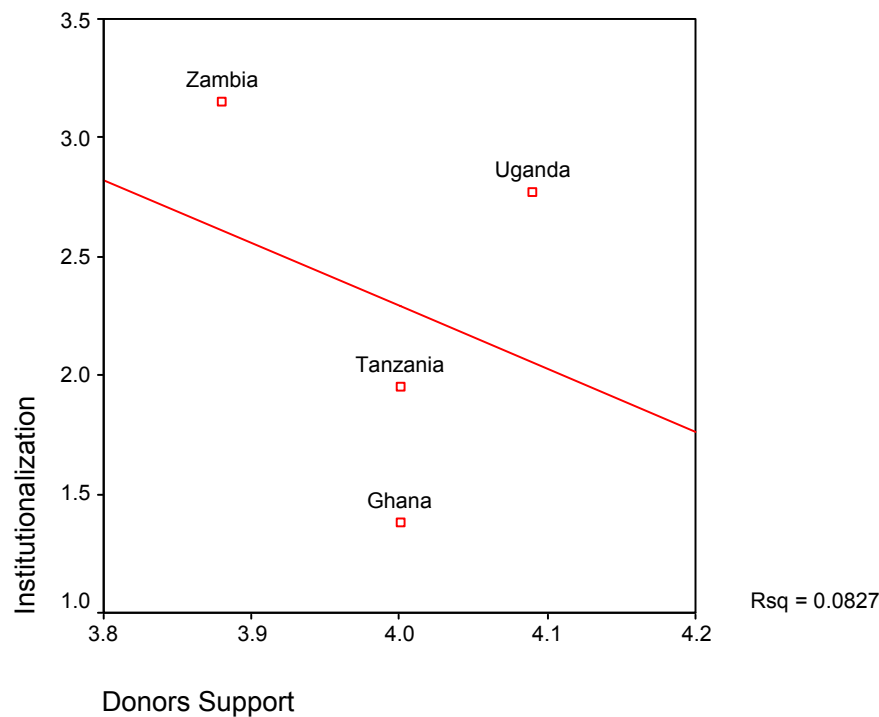


Figure 5.17: Scatter-plot of the relationship between Institutionalization of MIS and donor support to NAROs.

The results in figure 5.17 show that donor support negatively correlates with institutionalization. Donor support is higher in Uganda than the other three NAROs. This same trend is also observed in government support. This indicates that government support and donor support might be related (The relationship between government and donor support will be elaborated in chapter 6). Zambia NARO in comparison has the lowest donor support but yet the level of institutionalization of MIS is higher than the other NAROs. This suggests that other factors combine to promote institutionalization in Zambia. Ghana with the lowest level of institutionalization appear to be highly supported by donors at the time of this study. But the donor support did not have effect on institutionalization of MIS. In hindsight, it may be possible that the Ghanaians have not yet used the acquired donors funds for MIS activities. Tanzania had a similar level of

donor support like Ghana but did not improve very much in institutionalization compared with Zambia.

5.2.9. Management of change

Change management in the context of an MIS was one of the challenging areas during my interview with respondents and informants. In this section of the thesis, we reiterate the questions and analyze their responses.

What has to change for MIS institutionalization?

When asked what has to change in order for MIS to be institutionalized, respondents and informants from the four case study countries provided these responses. The count column indicates the number of respondents that provided comments on each of the change factors.

Table 5.4: What has to change for MIS institutionalization?

Change Factors	Count/49	Comments
Government	23	Adequate and timely release of funds by government. Implementation and Institutionalization would require government support for success. Support should come from the ministerial level e.g. the Permanent Secretary of the Minister of agriculture.
Culture	21	Change in organizational culture towards Information management and sharing: If people do not appreciate the importance of sharing information, it will be difficult for them to provide the necessary data, which is lifeblood of the system. NAROs should cultivate

Change Factors	Count/49	Comments
		culture emphasizing on MIS and IT.
Donors	19	More donor support is needed.
Web based MIS	19	<p>A web-based or network system will reduce movement and allow remote access. NAROs have lots of research information but the challenge is how to make this information available to the end users and the world at large.</p> <p>Respondents from a research station in CSIR Ghana mentioned that they were struggling to put together personal money to build a website but they believe the government should have done it for them.</p> <p>They also recommended that database designers should be employed by the organization.</p>
Budgeting	17	Budgeting for MIS at institute level would improve on purchase of consumables and motivate the few MIS practitioners.
Institutionalization Process	17	MIS activities should be made part of the whole research activities process.
Implementation Process	16	MIS should be implemented in all research institutes.
MIS Policy	14	MIS policy is needed to guide and oblige staff to avail data input. MIS policy is needed such that governance and institutionalization of MIS has an operational dimension deeply embedded in the organizational policy dimensions. MIS should be taken as a programme to remain operational in all institutes.

Change Factors	Count/49	Comments
		MIS policy must be made more transparent. MIS policy should be implemented and staff should be well informed on MIS.
Decentralization	14	Zonal empowerment. The existing MIS coordinators must be empowered through further (more advanced) training.
Adaptation	14	MIS should be adapted to suit the organisations research management processes.
Powers to stations/institutes	10	The institutes must be in control but the headquarters should be informed.
New Champion	10	A new champion from management level is needed.
Awareness	1	Increase awareness of benefits of MIS.
Incentives	1	MIS practitioner's efforts must be recognized with some incentives such as higher degree training, promotion etc. Management should introduce these incentives.

Are you willing to make the changes?

Most respondents and informants said they are willing to make changes in order to institutionalize MIS in their organizations. But it would require strong support from top management. According to one respondent "Give me a rod and I will lift the earth, sometimes management has to be dragged into MIS". Another respondent said "Definitely things have to change at the corporate level, and this can only come about when concrete efforts are made to educate the top management about the relevance of MIS". The MIS national coordinators can do this through presentations at the meetings of top management. Making change is a concerted effort and not an individual task in an organization; however, individuals have to make themselves available for training and funding for MIS should be focused and not diverted to other activities.

Are you able to make the changes?

When asked whether they are able to make changes, about 32% of respondents and informant interviewed said they are able to implement changes in order to institutionalize MIS in their organizations. About 25% said they are not able. The remaining 43% are neutral. The 32% who said they are able to make changes are staff from the top and middle management level. The remaining 68% are researchers, MIS National Coordinators and Practitioners. This implies that managers especially those at the top echelon are the people able to inspire researchers to institutionalize MIS in Sub Saharan African NAROs.

Who should make the changes?

When asked who should make the changes, they suggested that top management (which includes: Director Generals, Research, finance and human resources Directors, and Permanent Secretary at the ministry of agriculture, policy makers) and donors should spearhead the change making process. Researchers should participate fully in the process as well.

What would it take to make the changes?

When asked what would it take to make the suggested changes, respondents and informants suggested the following:

- Organise a joint meeting, seminar or workshop and iron out all suggestions concerning MIS institutionalization and make recommendations, management decisions and directives.
- More sensitization and commitment to implementing the new changes.
- Make everybody aware of the system through training and supporting it fully.
- Constant prompting by the National MIS coordinators and sensitization through publishing about organizational MIS in the national media.

- Funding and incentives to MIS practitioners: Commitment of resources, dedicated staff and equipment. The MIS is to the advantage of the organization so management need to commit money for its operation.
- Monitoring of research activities can be done efficiently if management commits small funds for the practitioners to visit the research stations or institutes.
- Top management should support, teamwork and be committed to making decisions based on information. Managers need to realise the need and usefulness of an MIS.
- Governments should support and provide policy guidelines.
- NARO staff should change their attitudes by making sure that all reports on projects, staff and finance are reported in MIS format.

5.3. Individual Level Analysis

5.3.1. Correlations: Institutionalization and Independent variables

Based on the causal model in figure 2.2, we collected data from 49 respondents/informants. The data was organized in a data matrix and correlations were computed in SPSS to determine the relationships between institutionalization of MIS and the independent variables.

Table 5.5: Correlations at the individual level of analysis (N=49)

Factor	Correlation Coefficient	P-value
Adoption	0.629(**)	0.000001
Leadership involvement	0.527(**)	0.0001
Adaptation	0.373(**)	0.008
Government Support	0.344(*)	0.015
Donor Support	0.162	0.266
Information Management Capacity	0.137	0.349
Level of ICT Infrastructure	-0.359(*)	0.011

** Correlation is significant at the 0.01 levels (2-tailed).

* Correlation is significant at the 0.05 levels (2-tailed).

The p-value (probability value) is compared with the significance level and, if it is smaller, the result is significant. Small p-values suggest that the null hypothesis is unlikely to be true.

The results in table 5.5 show that institutionalization correlates positively and significantly with adoption, leadership involvement, adaptation and government support of MIS. On the other hand, institutionalization correlates negatively but significantly with the level of ICT infrastructure. This negative correlation at individual level may be because some respondents and informants scored low for institutionalization because they thought that the level of ICT infrastructure in their organization was moderate enough for MIS activities but these computers were not being used effectively to institutionalize MIS. According to the former MIS National Coordinator (now a middle manager) in Uganda: "Computers to institutionalize MIS are not the main problem. The main problem is changing the culture of NARO staffs towards using computers to manage information". As stated earlier on, the qualitative analyses in chapter four reveal that availability of ICT

infrastructure correlates positively with institutionalization of MIS. That result also suggests that some respondents and informants thought that the available ICT Infrastructure was promoting institutionalization of MIS. ZARI Zambia with a slightly low level of ICT infrastructure performed better than CSIR Ghana in terms of institutionalization of MIS.

There is less correlation between institutionalization and donor support, and information management capacity. This may suggest that increase in donor support or information management capacity although valuable for the continuity of MIS activities in NAROs may not necessarily result in big increases in institutionalization of MIS in all the case study countries. Nearly all respondents and informants scored high on these variables but some NAROs did not perform in terms of institutionalization. Regarding information management capacity, the best countries (Zambia and Uganda) claimed that ISNAR's MIS and other ICT trainings provided them with good information management skills and knowledge. They however, stressed that they are deficient in database design skills and querying of databases. Respondents from Ghana claimed that they are generally good with information management even though they lack skills and knowledge of INFORM-R and INFORM-R Light.

Respondents also scored high on donor support. This suggests that they are positive about the trend of donors' financial support to MIS activities in their organizations, although some respondents had some negative criticisms about donors. The positive perception about donors support did not result in increase in MIS institutionalization in the four NAROs.

5.3.2. Regression Model

We used linear regression method to develop a model about the perception of respondents and informants (from the four case study countries) on MIS institutionalization and the independent variables. The regression model in table 5.6 suggests that two variables contribute to institutionalization of MIS in NAROs.

Table 5.6: Coefficients of the regression model for 49 respondents and informants from four countries in Sub Saharan Africa.

Parameter	B: Regression Coefficient	Sig.
Leadership	0.309 (**)	0.001
Government Support	0.204 (*)	0.055

Dependent Variable: Institutionalization

** Correlation is significant at the 0.01 levels (2-tailed).

* Correlation is significant at the 0.05 levels (2-tailed).

Firstly, the model suggest that institutionalization of MIS may increase by 0.309 unit for each unit increase in leadership involvement. The contribution of this variable to the model is significant at 0.001 levels and it is therefore rated as the largest contributor to institutionalization of MIS compared to the other variables. Secondly, the model also suggest that institutionalization of MIS may increase by 0.204 unit for each unit increase in government support. This variable is significant at 0.055 levels and it is therefore the second largest contributor to institutionalization of MIS.

The other variables such as adoption, adaptation etc were removed from the model by SPSS software because they either did not contribute to the model or their contributions has already been explained by the two main variables. Statistically speaking, the analysis above may be correct but in the real world it may not be possible to accurately quantify

the level of leadership involvement or government support. In the real world, however it is possible to observe whether or not greater involvement of NARO leaders or greater government support can result in increase in institutionalization of MIS.

Because the perception of managers and researchers may differ in terms of leadership involvement, we separated the data for these two groups and computed two new regression analyses in SPSS.

Table 5.7: Coefficients of the regression model of institutionalization of MIS for 23 Managers from four countries in Sub Saharan Africa.

Parameter	B: Regression Coefficient	Sig.
Leadership: Managers	0.427 (*)	0.026
Government Support	0.280	0.274

Dependent Variable: Institutionalization

Table 5.8: Coefficients of the regression model of institutionalization of MIS for 26 Researchers from four countries in Sub Saharan Africa.

Parameter	B: Regression Coefficient	Sig.
Leadership: Researchers	0.457 (**)	0.005
Government Support	0.265	0.114

Dependent Variable: Institutionalization

The model in Table 5.7 and 5.8 suggest that leadership involvement as perceived by managers and researchers would indeed contribute significantly to increase in institutionalization of MIS in Sub Saharan African NAROs. These result in essence confirm

the result in table 5.6 and also confirm that the perceptions of managers and researchers are similar in terms of leadership involvement.

5.3.3. Critical Success Factors

In the questionnaire, we requested respondents and informants to select from the options provided, what they thought were the key factors promoting institutionalization of MIS in their organizations. Their responses were counted and grouped under the two main factors obtained from the regression model (see annex 1 for Frequency: Count method, and open-ended questions). The results in table 5.9 suggest that most respondents and informants perceive leadership involvement as the first critical success factors.

Table 5.9: Critical Success Factors promoting institutionalization of MIS in Sub Saharan African NAROs.

CSF	Count (Out of 49 respondents)
Leadership	
• MIS Training	30
• Awareness	23
• Consultant	14
• Champion	13
• Transparency	11
Government	
• ICT Infrastructure	26
• Govt Support	13
• Donor Funds	12

Under leadership involvement, factors such as: MIS Training, NAROs awareness of its information needs, MIS consultant support, Champion, and Transparency were mentioned as key promoting factors. Under government: factors such as ICT

infrastructure, government support, donor funding were perceived as promoting factors. The numbers in the table represents the number of respondents and informants who made the selections during the interview.

5.3.4. Critical Failure Factors

Table 5.10: Critical Failure Factors frustrating institutionalization of MIS in Sub Saharan African NAROs.

CFF	Count (Out of 49 respondents)
Leadership	
• Lack of MIS policy/strategy	22
• Lack of Top management support	21
• Researchers not interested in research administration	9
Government	
• Lack of Funds	26
• Lack of ICT infrastructure	17
• Technical problems	9
• Organizational instability	8

Regarding critical failure factors, respondents and informants rated the two factors as follows: Under leadership, factors such as lack of MIS policy, lack of top management support, researchers not interested in research administration and organizational instability were mentioned as the key frustrating factors (table 5.10). Under government: lack of funds, lack of government support for ICT infrastructure, technical problems and organizational instability were mentioned as the key-frustrating factors.

5.4. MIS in Improving Research Management

The process of using MIS for managing agricultural research has been theoretically explained in chapter one of this thesis. In chapter four, we also observed how the four case study NAROs used MIS to improve research management in their organizations (see tables 4.1, 4.2, 4.3 and 4.4). In this section of the thesis, we try to understand the outputs generated by MIS that improved research management and NAROs' internal/external performance.

In the interview I asked respondents to choose from several options, how MIS supported information and communication flow in and outside of their organizations. The responses per option for 38 respondents were counted for internal performance and 22 respondents for external performance.

In terms of internal performance, the results in figure 5.18 reveal that NAROs use MIS mainly for generating annual and donor reports and for decision-making. In terms of external performance, the system is used mainly as a backbone for website and journal publications.

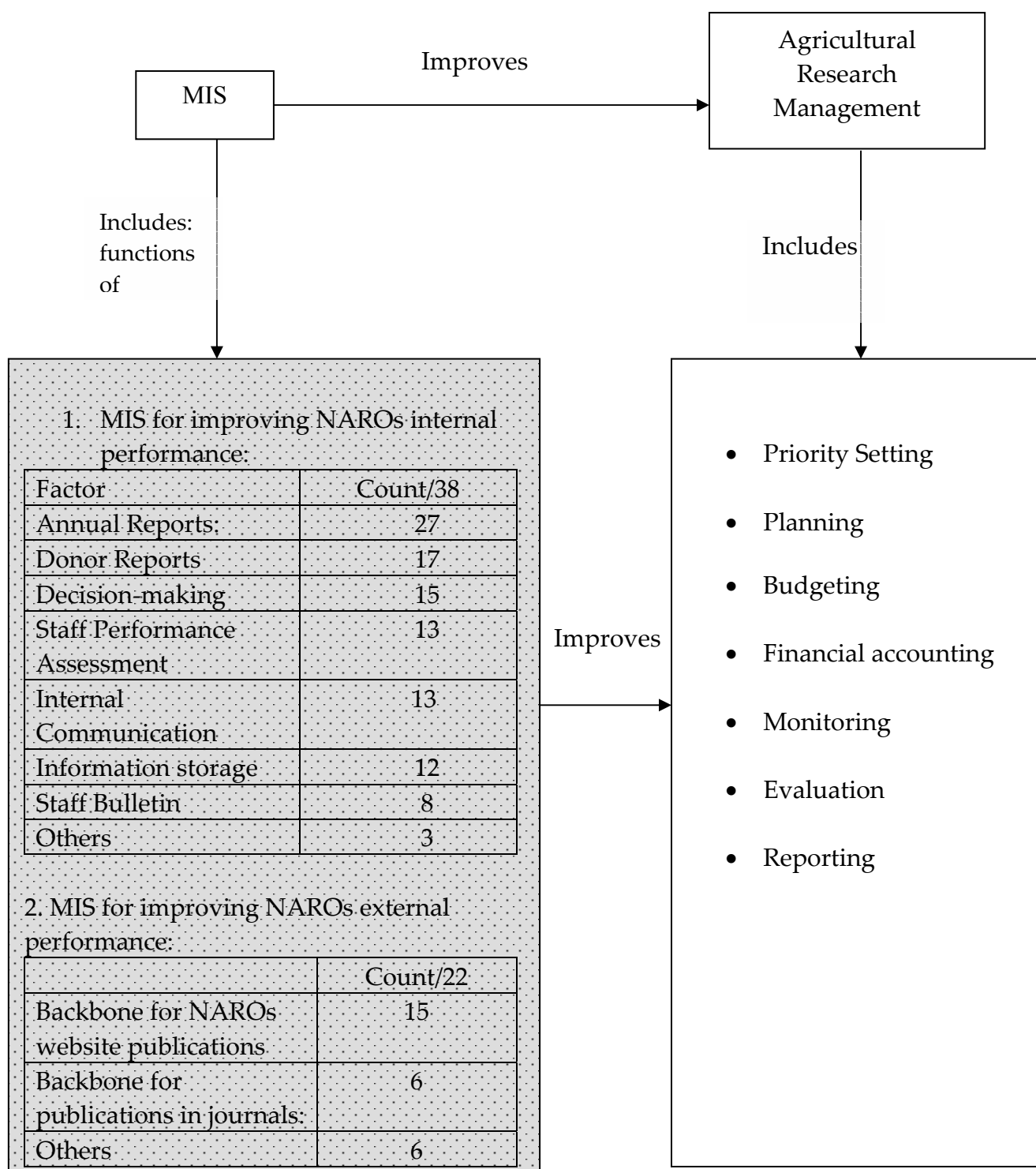


Figure 5.18. Diagram showing how MIS improved NAROs research management performance.

The following are some of the comments made by respondents reflecting the effects of MIS to research management:

Internal Performance:

- “MIS has helped in providing annual and donor reports”.
- “MIS encourages compilation of regular quarterly reports of the institute and eventually the production of annual reports”.
- “INFORM-R Light was used for internal communication to know who is doing what”.
- “The MIS has been the basis for organizational reporting in terms of achievements. It sets the target; it is a monitoring tool on what researchers are doing”.
- “Managers at headquarters have full picture of what’s going on at the research stations”.
- “Staff performance assessment is done every year and this enables top management to make decisions on staff welfare”.

External Performance:

- “Some of the information captured by INFORM-R Light is in the DRD website”.
- “Website publications are important to provide up to date information to end-users”.
- “Annual and journal reports like rural extension were generated from INFORM-R”.

5.5. Conclusion

In chapter five, we successfully presented the statistical analysis of the quantitative data obtained from the four case study NAROs. In this next chapter, we will attempt to discuss qualitatively the combined results of chapters four and five.

PART 4 DISCUSSION AND CONCLUSIONS

Chapter 6. Discussion of Findings

6.1. Introduction

We started this research by stating the real world problem, which is inadequate use of MIS for data collection and decision-making in Sub Saharan African NAROs and how to improve MIS institutionalization. The goal of the research was to get insight into factors affecting positively and negatively institutionalization of MIS in National Agricultural Research Organizations (NAROs) in Sub Saharan Africa.

This problem statement and goal led us to formulate these three generic research questions:

- To what extent is MIS institutionalized in Sub Saharan African NAROs?
- What key factors promoted (critical success factors) and frustrated (critical failure factors) institutionalization of MIS in Sub Saharan African NAROs?
- How does institutionalization of MIS improves NAROs research management performance?

In this chapter, we attempt to analyse qualitatively MIS adoption, implementation, adaptation, and institutionalization trajectory in time. In the second part of this chapter, we will analyse the critical success factors promoting institutionalization and the critical failure factors frustrating institutionalization and the interaction between some of these factors. We will also compare our main results with the findings by other authors and generalize and elaborate on how they contribute to institutionalization of MIS and improvement of research management in NAROs.

6.2. MIS adoption, Implementation and Institutionalization Trajectory

6.2.1. Adoption Stage

Kishore and Mclean (1998) stated that the first condition for an innovation to be institutionalized is that the entire community of potential adopters must adopt it widely and the second is that it must be adapted and put into full use. The findings by the above-mentioned authors, the results in chapter four, 5.2.3, and 5.2.4, of this thesis point to the fact that the MIS Software was adopted more at NAROs headquarters than in the remote research institutes and stations. This observation is not surprising because NAROs headquarters in Sub Saharan Africa have more resources compared to the stations. The headquarters are responsible for the administrative functions and implementations of policies. The Director General and the top management in the Secretariat decide on which technology to adopt and the extent to which it should be diffused to the research stations and institutes. This observation also corresponds to Hofstede's (1991) family model of business in Sub Saharan Africa, where the leader is the master with lots of power. Rogers (2003) in his adoption of innovations theory in organizations also alluded to authority innovations decisions, whereby choices to adopt or reject an innovation are made by relatively few people who possess power, high status or technical expertise.

With respect to INFORM-R and INFORM-R Light, we categorise the period between 1995 and 2000 as the adoption stage. This was the period when the MIS software packages were developed by ISNAR in collaboration with NAROs in developing countries. Demonstrations, awareness seminars and distance learning courses were provided by ISNAR to introduce MIS concept and the software packages to NAROs. Most top managers and MIS national coordinators from the case study NAROs participated in the demonstrations and awareness seminars. They also participated in the 2000 MIS sensitization workshop organized by ISNAR in The Hague. The awareness and experience

gained by the top managers motivated them to support the in-country training and implementation workshops. Unfortunately, top managers from CSIR Ghana did not participate in the sensitization workshop as stated earlier in chapter four. Only one Librarian and a middle manager from CSIR participated in the ISNAR / CTA sensitization workshops. This was probably the reason why an institute Director in CSIR commented that if he had been well sensitized on the direct benefit of a MIS, he would have committed recourses to its adoption and institutionalization. This supports our earlier observation that top managers in some NAROs were aware of the existence of MIS but not of its importance.

The adoption levels of MIS in Sub Saharan African NAROs varied from high-level adoption at the headquarters to medium or low level at institutes/stations. The results in figure 5.13 reveal that adoption of INFORM-R and INFORM-R Light positively correlates with institutionalization of MIS in the four case studies. This is a very important finding but it is worth realizing that for MIS to be fully institutionalized it has to be widely adopted in the remote research stations and institutes.

6.2.2. Implementation stage

Rogers (2003) regards implementation as one step in the innovation decision process, which occurs when an individual (or decisional unit) puts an innovation to use. Implementation in this thesis is defined as the stage of managing organizational change towards institutionalizing MIS. With respect to INFORM-R and INFORM-R Light, we categorize the period between 2000 and 2001 as the implementation stage. This is because the in-country training and implementation workshops took place during this period. The case study NAROs had enough funds from the World Bank for this purpose but only three NAROs (Zambia, Uganda and Tanzania) actively organized and implemented the training workshops. Computer hardware and software were purchased, INFORM-R and INFORM-R Light were installed and data were collected from Scientists. Again, top leadership

involvement and support was crucial for successful implementation of these workshops. In Zambia, the top management actively participated and provided moral support. This was probably the reason why the national coordinators and station MIS practitioners and researchers were very motivated to implement MIS in ZARI. In Ghana, even though there were funds from the World Bank, MIS implementation took off slowly because of lack of top management involvement and support.

6.2.3. Adaptation Stage

We categorize the period between 2001 and 2002 as the adaptation stage. During and after the implementation stage INFORM-R and INFORM-R Light were adapted to suit NAROs' research structures. The results in this research reveal that adaptation correlated positively with institutionalization. Other authors such as Douthwaite (2002), and Sechrest (1999) reported that adaptation of a stripper-harvester for local use in the Philippines led to its adoption by Philippine farmers. Broadman (1992) also reported that the ability of staffs in the ministry of finance in Indonesia to develop and modify microcomputers promoted its institutionalization. The findings by these authors and our result supports and confirm our argument that adaptation of MIS software to suit local conditions can promote institutionalization.

6.2.4. Institutionalization stage

Hobbs (1994) De Man (1996, 2000, 2003), Kramer (2000), Kishore and Mclean (1998) characterized institutionalization as the stage when an innovation is generally accepted, integrated and routinely used in an organization. Regarding INFORM-R and INFORM-R Light, we categorize the period between 2002 and 2004 as the institutionalization stage. This is because in Zambia and Uganda NAROs, it was the period when the system was being accepted and routinely used for improving research management.

The extent of institutionalization of MIS is observed to be partial in Zambia and Uganda NAROs; in contrast, institutionalization is inadequate in Tanzania and none in Ghana. This result is consistent with our earlier observation in the problem statement in chapter one, which stated that Zambia and Uganda NAROs were progressing better in institutionalization of MIS than Tanzania and Ghana. The results also reveal that countries that used INFORM-R or INFORM-R light highly for data collection also used it highly for decision-making in the research management processes. The use of the systems for data collection and decision making at all levels of research management is relatively higher in Zambia and Uganda than in Tanzania and Ghana. This implies that the more a NARO uses MIS for the data collection and decision-making, the greater the chance of institutionalization. This statement may be true for the four case study countries but to generalize this finding to other NAROs in the world, it will be important to conduct a survey that will involve many NAROs in Africa, Asia and Latin America.

6.3. Critical Success Factors

Leadership involvement

Leadership involvement is the most important critical success factor that strongly correlated with institutionalization of MIS in Sub Saharan African NAROs. Other authors such as Ackof (1960), Thong (1996) Broadman (1992), Mustafa (2000), Peterson et. al. (1997), Van der Weide et. al. (2003) also concluded that top management or leadership support, management commitment, and progressive government officers (saints) were the critical factors for successful implementation of information systems.

Hofstede's (2005) classification of Sub Saharan African countries organizational model as a family model with the leader being the master whose power is based on tradition also corresponds with our finding that leadership involvement strongly correlates with institutionalization of MIS in Sub Saharan African NAROs. Hofstede pointed out that in

countries with large power distance, dependence on more powerful people is a basic need, which can be a real motivator. Assuming this statement to be correct then we could strongly state that in order to institutionalize MIS in Sub Saharan African NAROs, it would be useful to rely on the support of the Director General who is the most powerful person in the organization. African managers and researchers are more likely to institutionalize MIS if the Director General or the Minister of Agriculture (depending on the organizational structure) gives his or her full support and blessing.

The expert validation interview I had with the Director of Management of LEI in the Netherlands also revealed that researchers were reluctant to institutionalize MIS when it was initially introduced to the organization. But they began to participate fully when management showed commitment to enforce MIS in the organization. The Director confirmed that LEI's MIS is now being fully used (100%) in planning, budgeting, monitoring and evaluation. This observation also confirms that leadership involvement matters in institutionalization of MIS in Northern and Southern parts of the world.

Government Support

Government support is an important factor in NAROs because it can help to reduce uncertainty of funds for carrying out MIS activities in NAROs. Government financial support of MIS activities in NAROs is promoted through donor support. This is a kind of financial arrangements with the governments of these countries and Western donors. Detailed discussion on government support for NAROs is in section 6.5 of this thesis.

Donor support

Donors especially the World Bank have been supporting agricultural research in Sub Saharan Africa since the late 1980s (Roseboom, 2002). Donors also supported ISNAR to provide technical support to these NAROs. This actually enabled the collaboration between ISNAR and NAROs on MIS development and training. The results however,

show that increase in donor support may not necessarily lead to increase MIS institutionalization but may lead to increase in government support (correlation between donor and government support in table AT3 (in annex) confirmed this statement). Donor funds to NAROs are usually channelled through government ministries in Sub Saharan Africa. When donors approve loans or grants to NAROs, it is the Ministries of Agriculture and Finance that decides on the time and amount of money to be actually disbursed to NAROs.

Untimely or no release of these funds has negative effects on implementation of research projects and institutionalization of MIS in NAROs. A major question will be what will happen if there is no more donor support for agricultural research in Sub Saharan Africa? Could governments and NAROs sustain MIS on their own effort? These questions will be very useful for future research on institutionalization of MIS. Detailed discussion on donor support is in section 6.5 of this thesis.

Information Management Capacity

Contrary to Jaiyesimi (1992) who suggested that Computer awareness in West Africa is low, our results show that information management capacity of respondents and informants from the four case study NAROs is moderate. But correlation with institutionalization is observed to be low. This implies that NAROs staffs may not be using the knowledge they gained after MIS training to promote institutionalization.

Broadman (1992) suggested that training in the use of information strongly determined the ability of staffs in government ministries in Indonesia and Kenya to use Micro Computers to improve decision-making. Because Kenya is a country in East Africa, this finding should apply to countries such as Tanzania and Uganda as well. Since this is not the case we may be inclined to argue that some NAROs staffs (managers and researchers) received MIS training but prefer to delegate work to secretaries. In that context Beulens (1992) is

perhaps right when he suggested that IT users e.g. managers must participate and use applications in the correct manner.

ICT infrastructure

For MIS to be institutionalized in organizations such as NAROs, it is important to have the right infrastructure in place and functioning (Beulens 1992, 1996, 2003). According to the qualitative analysis in chapter four ICT infrastructures is rated as a critical success factor that promoted institutionalization of MIS in NAROs. This is probably because between 2000 and 2002, most case study NAROs received donor funding with which they acquired computers for MIS activities. Respondents probably scored ICT Infrastructure high in order to justify the recent purchase. The quantitative analyses however, show a negative statistical correlation. This may be because of low use of the computers for MIS activities. Musa et. al. (2005) reported that ICT Infrastructure was used as status symbol in Africa. It is one thing to have a powerful computer in the office and another thing to make full use of the power of a computer to improve work processes and maximize profit.

Another ICT Infrastructure problem facing Sub Saharan African NAROs is lack of connectivity. Jaiyesimi (1992) reported that poor telecommunications and unreliable electricity supplies was a major problem in West Africa. This point also holds true for most NAROs in Sub Saharan Africa except countries in Southern part of Africa that are relatively stable with electricity.

Three NAROs Uganda, Tanzania and Ghana said ICT infrastructure promoted MIS institutionalization (see chapter four). ZARI Zambia however did not see it as a major promoting factor. Few years prior this research, the World Bank supported MIS activities financially in Uganda, Tanzania and Ghana NAROs. This meant that these NAROs were provided funds with which they purchased computer hardware and software. In Zambia however, lack of ICT infrastructure is rather seen as a critical failure factor because of two

reasons: the NARO is currently under funded and the major issue in the area of ICT infrastructure is connectivity. That is through connecting the existing computers in form of a local and wide area network and linking them to the Internet.

Connectivity in the broad sense is very important because it facilitates exchange and sharing of data. It can enable data collection; processing and information dissemination to be performed at a faster rate compared to the status quo where data exchange in NAROs is done using CD-ROM and diskettes. It is worth mentioning that recent messages from the ZARI (Zambia) MIS National Coordinator (July 2005) stated that IICD (The International Institute for Communication Development) a Dutch NGO is currently supporting ZARI to setup LAN and purchase computer hardware. Connectivity is also seen as an important factor for institutionalizing MIS in the other three NAROs.

Organizational Structure:

As described in chapter four of this thesis, NAROs in Sub Saharan Africa have tall organizational structure or family model (as stated by Hofstede 2005). Their organizational structures also have numerous levels of authority and management, and long chain of command. For instance top management, middle managers at headquarters, stations/institute managers, program and project leaders. This requires an efficient and effective MIS and PM&E unit to generate management information for rapid decision-making and to improve information and communication flow.

Three out of the four case study NAROs included PM&E/MIS functions in their organizational structure and the results of this research show that NAROs that included both MIS and PM&E functions in their organizational structure and had top management support performed better than NAROs that did not. ZARI Zambia, NARO Uganda and DRD Tanzania included PM&E/MIS unit in their structure while CSIR Ghana had an MIS specialist who was neither in the organizational structure nor directly involved with MIS

implementation and institutionalization. This result would be useful to NAROs top management and others involved in designing NAROs structures to realize and appreciate the importance of MIS and PM&E functions in their organizational structures.

6.4. Critical Failure Factors

Regarding critical failure factors, our research reveal that three major factors frustrated MIS institutionalization in NAROs. These factors were funding problems, and lack of policy/strategy for MIS and resistance to change.

Funding:

Funding has been a major problem in executing and sustaining projects in developing countries. It is no surprise that it refocused in Sub Saharan African NAROs as a major critical failure factor. As stated in the introduction section of this thesis, funding for agricultural research declined in Sub Saharan African NAROs in the late 1980s (Byerlee 1998). Foreign donors provided funding support to Sub Saharan African NAROs in the 1990s (Roseboom 2002). In this new millennium however, these NAROs do not attract much funds from the donor community. Even those who managed to attract funds do so on highly restrictive conditions. They have to pay the money back with some interest. Access to the borrowed money is becoming very difficult. To have access they need to apply and obtain a letter of no objection from donors (Setsofia 2003, personal communication).

The funding problem has indeed frustrated MIS institutionalization in NAROs for example NARO Uganda, where there had been lots of progress in the past but recently the organization is very unstable because of never-ending reorganization to attract donor funds. Reorganization in NAROs is very often in response to external pressures from funding agencies, governmental units and organized constituent groups (Busch et al 1994).

Donor agencies for instance may encourage structural change in order to achieve certain policy objectives. NAROs that agree to change could attract funds for running its activities. Reorganization could help to improve the quality of work, to monitor scarce resources more closely, and to ensure clear reporting relationships. But structural change alone is not always the best solution to problems facing an organization (Busch et al 1994). Busch (1994) in his ISNAR briefing paper stated that in order for a NARO to achieve success from re-organization, a multifaceted approach that involves a combination of structural, human resource, and political perspectives is important.

Lack of MIS policy/Strategy:

Lack of policy guidelines and strategy for MIS is another critical failure factor. In principle NAROs accepted MIS as a tool for information management and decision-making but no NARO can proudly provide you with a policy document or a position paper to support its institutionalization. Researchers in one of the case study countries reiterated that, even when the policy paper is available the content is rarely taken seriously. Managers especially in Ghana on the other hand complained that they have not been well sensitised or shown the direct impact of MIS on agricultural research management. Managers in the other three case study countries are willing to introduce MIS policy but this is yet to be seen.

Resistance to change

User resistance to change has been the main factor noted by many authors (Ackof 1960; Davis 1974; Lucas 1975; Markus 1983; Van der Weide et al 2003) as a reason responsible for information systems implementation failure. In our study in Sub Saharan Africa we also observed user resistance as a failure factor alongside with lack of continuous funding (which was the key frustrating factor). Researchers at ZARI Zambia said they resisted MIS because they perceived it to be time consuming in terms of filling in forms and quarterly updating of information.

NARO Uganda researchers perceived MIS as an administrative burden because management did not include it in their terms of reference. Secrecy in sharing information generated from activities not funded by NARO was also another reason for resistance. DRD staff resisted using MIS because of lack of awareness of the benefits of MIS. Researchers at CSIR Ghana lost interest in MIS because of lack of top management involvement in institutionalization. In general NAROs resistance to change in using MIS did not promote institutionalization.

6.5. Interactions Between the Factors

Correlation between Donor, Government Support and Incentives

The results in table 5.1 show that donor support is negatively correlated to institutionalization of MIS. This suggests that increase in donor financial support although useful will not necessarily result in increase in institutionalization of MIS in all NAROs. NAROs that can utilize donor funds prudently would achieve positive results in institutionalizing MIS but NAROs that either don't use the funds or divert it to other activities and spend time hunting for funds would achieve negative results. The result in Table AT3 (see Annex), also suggests that there is a relationship between donor support and government support. This is also confirmed by the high level and relatedness of donor support and government support in Uganda. Donors especially the Worldbank, DGIS, SIDA, DFID and others funded most research programmes (including the MIS activities) in NAROs. These donor-funded programmes carry different acronyms depending on the country concern. In Zambia it was called the ASSIP, Uganda: ARTP, Tanzania: TARP and Ghana: AgSSIP (see list of acronyms).

These donor funds were provided as short term (3-5 years) loans to Sub Saharan African governments to improve agricultural research. The ministries of agriculture and finance of these countries were responsible for releasing the funds to the NAROs to carry out

research programs including MIS activities. During the interview, respondents were asked to narrate the positive and negative aspects of donor support to the MIS project, the trend of government support, and the available incentives and disincentives that affected institutionalization of MIS in their organizations. Our analysis of results so far indicate the following:

Donor Support

On the positive side, most respondents said donors funded training and the purchase of computer hardware and software. They also commended donors for forging links with ISNAR, which enabled MIS development and implementation in NAROs. Since donors are the source of project funds in NAROs, respondents requested that they should coordinate among themselves and insist on getting meaningful reports that require some kind of analysis that requires an MIS capacity. On the negative side, most respondents criticized donors for starting projects and not providing extra funds for continuity. Other criticisms are: donors contributed to drastic ends to programs in Sub Saharan African NAROs and donors have interest in special projects. That suggests that they only support projects that are beneficial to them and other projects initiated by the NAROs are either rejected or under funded.

Donors have their specific interest, which may be different from the institutions' interest, and when they go, their projects can't be sustained. When their projects come to an end, everything also comes to an end. Beye (2002) also made a similar observation about donors being interested in special projects and recommended that they should form partnership with NAROs and fund long-term projects.

Government Support

Governments in Sub Saharan African NAROs are involved in training personnel, paying salaries and in some cases providing equipments (Byerlee 1998). They also provided donor

funds to NAROs to carry out daily research activities and this enabled the establishment of basic ICT infrastructure; e.g. computers for initiating MIS activities. Overall government support is regarded as positive. However, governments, respondents argued, can do better than the current situation. Currently, they are not able to do much in terms of continuity of donor projects. If government support continues to exist then MIS will succeed but if there is no support, it won't succeed. The government of Zambia had a bilateral understanding with ISNAR to support the MIS programme (INFORM-R) in the soils and crop research branch. The government so far supports MIS politically but financially and technically the support is at low level. Government Budget deficits in these countries may have contributed to low financial support to NAROs. Funds from donors were not also directed to the MIS projects hence poor performance of the MIS activities. In Uganda, NARO is said to be instable because of long and never ending government led restructuring. Research activities became stagnant and research managers were not able to allocate resources and personnel to run the MIS project.

In Ghana, respondents reported that there is inadequate government support. Most of the supports are based on promises that never materialized. Funds are often not released on time. The government have other priorities and have no proper plan to fund and sustain MIS, although the government recently initiated a nationwide ICT policy, which according to respondents is a positive sign for the MIS project.

Incentives

The quality of decisions made by managers is a major incentive that promoted the use of MIS in NAROs. Each year each NARO staff member is assessed according to performance and this enabled top management to make decisions on promotion, rewards, and training opportunities etc. Broadman (1992) also observed that higher status, satisfaction in using advanced technology and easing of workload were major incentives for institutionalizing microcomputers in the Indonesia Ministry of Finance. Other incentives that promoted the

use of MIS in the case study NAROs are timely reporting on research activities, MIS training opportunities and time reporting.

Disincentives

In terms of disincentives, a majority of respondents said inconsistent staffing is a major disincentive that affected MIS institutionalization. The high turn over rate of staff in some of the institutes called for constant retraining of staff to be conversant with the MIS software package. Lack of enough practitioners/staff dedicated solely to maintenance of the MIS software and career prospect of MIS practitioners is the second disincentive. In some NAROs, researchers were converted to MIS practitioners but career prospects were not being balanced. Thus MIS Practitioners felt cheated to do more work than their research and yet no promotion avenues and no training opportunities especially at higher degree levels. Poor reward systems for staff greatly affected MIS institutionalization and this resulted to some staff leaving the organizations. MIS practitioners have often other duties in addition to the MIS activities.

MIS is a new discipline in NAROs so managers when assessing staff do not rate MIS practitioners' outputs like other research outputs such as publications of plant breeding research findings in local or international journals. On the other hand IT professionals in private companies receive ten times the salary of NARO MIS practitioners. This made it difficult to retain staff even after heavy investment in MIS training. Israel (1989) stated that inadequate rewards within organizations could reduce or eliminate feedback from their staffs.

Culture and Transparency

Information management Culture

Strong reporting tradition is a major strength in terms of information management culture in the four case study countries. This strong reporting tradition appear to be promoting

institutionalization of MIS in these NAROs. Our result on culture is strongly supported by findings from authors such as De Man (2003) who suggested that culture and participation are key factors for institutionalization of GIS technology. Hofstede (2001) also stated that national culture plays a prominent role in adoption of technology, Broadman (1992) stated that organizational culture (value, believes and traditions) influences peoples' behaviour and it is therefore a powerful motivating force for change and institutionalization. ZARI (Zambia), which is high in terms of institutionalization, said transparency in management is their major strength, while CSIR (Ghana) said in-house reviews, timely reporting of research activities and a good accounting department are their major strengths. The main weaknesses of information management culture for the four NAROs are data accumulated but never acted upon, secrecy and lack of commitment of researchers and managers.

Transparency

In general the level of transparency in sharing research management information is moderate to high. ZARI Zambia and CSIR Ghana appear to be more transparent compared to DRD Tanzania and NARO Uganda. Transparency in information sharing appear to be promoting institutionalization of MIS in these NAROs. Our findings on transparency of information sharing in NAROs could be compared to the benefits of transparency suggested by Hofstede (2004). Hofstede also wrote that transparency could enhance trust and reduce transaction costs between organizations. It can help to ensure quality control of products and the processes from which they are generated. In crisis situations in public organizations, transparency or better communication among public bodies can help tackle problems and avoid panic by the public.

In our NAROs case study the key factors promoting transparency are: presentations at annual research meetings, and progress and annual reports. Factors frustrating transparency are researchers delaying progress and annual reports, annual research

planning meetings not regularly held and the difficulty in participating in such meetings because of the distance between headquarters and stations.

It may be possible that another factor frustrating transparency in NAROs is that some NAROs managers did not want a transparent information system such as an MIS because it would make clear how funds are being spent and thus limit their room for manoeuvre. We did not collect much information on this factor from respondents and informants during the interviews. This may probably because the question on transparency is open ended and respondents did not feel comfortable to say things related to corruption. Although it must be mentioned that respondents from Uganda did allude to secrecy in sharing financial information and research results especially when donors fund specific projects, which are separate from NARO - Uganda priority projects. Future research should be done to address this question in NAROs.

6.6. Management of Change

As a way to manage change in NAROs in order to institutionalize MIS, respondents and informants provided useful solutions that have been presented in section 5.2.9 of this thesis. To supplement the solutions to manage change we borrow ideas from authors such as Davis (1974), Lewin (1952), Van der Weide et al (2003), Bradley et al (2005), Borup (2004), Humphrey (1987), Checkland (1990). Davis (1974) advocated user participation and communication as a means to curb user resistance. Respondents who requested that they be empowered by provision of training in MIS and connecting headquarters to remote stations in order to facilitate communication. Lewin (1952) advocated unfreezing (disrupting the existing organizational behaviour by providing information to show gaps), moving (learning of new behaviours, attitudes to put change in place through human process, technology and strategy) and refreezing (reinforcing stability through introduction of new norms, policies and structure), as phases required for implementing

change in organizations. Lewins model is popular and useful for our flow chart model of planning and managing MIS project described in chapter 7 of this thesis.

Van der Weide et al (2003), Bradley et al (2005), Borup (2004), Humphrey (1987), advocated methods for successful management of projects, which are relevant to managing change with respect to institutionalization of MIS in NAROs. According to Van der Weide et al (2003) for projects to be successful, team members must communicate and negotiate. Communication and raising awareness of the existence and importance of MIS in NAROs is very crucial to curb resistance of managers and researchers. Negotiation will be useful especially when NAROs are allocating resources such as funds and ICT infrastructure.

Bradley et al. (2005) wrote about PRINCE (Projects in Controlled Environment) methodology, which has proven to be quite successful in managing projects in the United Kingdom. Ideas from some aspects of the process of PRINCE2 (latest version) will be incorporated in our design of planning and managing MIS projects in NAROs (see chapter 7). Aspects such as the main four processes of PRINCE2 will be useful: starting a project, initiating a project, controlling a project and closing a project. Borup (2004) also stated that before implementing PRINCE2 organizations must identify their project management maturity level. Humphrey (1987) developed five steps for software capability maturity model (see chapter 2). This model could be useful for NAROs to check their project management maturity level before introducing new projects such as an MIS in their organizations. For example it could be used to check whether a NARO has existing procedures and standards to institutionalize MIS, whether NARO projects are currently being managed and tracked, whether there are indicators for monitoring and evaluation and ensuring quality of projects outcome and finally whether there are feedback mechanisms for ensuring continuous institutionalization of MIS.

6.7. Conclusion

Developed vs. Developing countries

Looking closely at the results of the critical success factors in this study; it appears that these factors cut across Sub Saharan Africa and the Western part of the world in terms of information systems institutionalization. Factors such as leadership involvement, culture, transparency etc appear to be important. The basic processes and factors are the same but the levels of the average (CSF) factors appear to be different. This is probably because of cultural differences between Sub Saharan Africa and the West. Hofstede (2001) reported that national culture plays a prominent role in the adoption of communication technologies. He suggested that cultural dimensions of individualism/collectivism and uncertainty avoidance could be used to predict the ease and speed of technology adoption. He defined uncertainty avoidance as the degree to which novel phenomena or ambiguity are perceived as threats by nations". When a new communication technology is introduced in a country, uncertainty avoidance predicts the speed of its adoption. The higher a country scores on uncertainty avoidance, the slower it will be in adopting a new technology. High individualism can predict the penetration of established technologies such as TV, Radio and Internet.

Some developing countries feel threatened by new technologies that they are yet to understand its functions. This results in a behavioral pattern of avoiding risks and keeping away from any sources of uncertainty. As a result their score of uncertainty avoidance is high and this leads to low adoption of new technology. When people in developing countries begin to leave as individuals and not in groups, then technologies such as radio, TV, Internet and Management Information Systems will be highly in demand.

Chapter 7. General Conclusions and Recommendations

7.1. General Conclusions

In this section of the thesis, we use the model in figure 7.1 derived from the empirical research to summarize our main results (the results in chapter four, five and the discussion in chapter six) and draw concluding remarks on the detailed research questions. This model originated from the causal model in figure 2.2 and could be used as a base for developing an impact model for institutionalization of MIS in Sub Saharan African NAROs. The model enables us to show the picture of how much support each of the hypothesized causal links relates to institutionalization of MIS. It is important however to note that the statistical analyses in this thesis were based on interviews and questionnaires from NAROs staff, and are thus based on their perceptions.

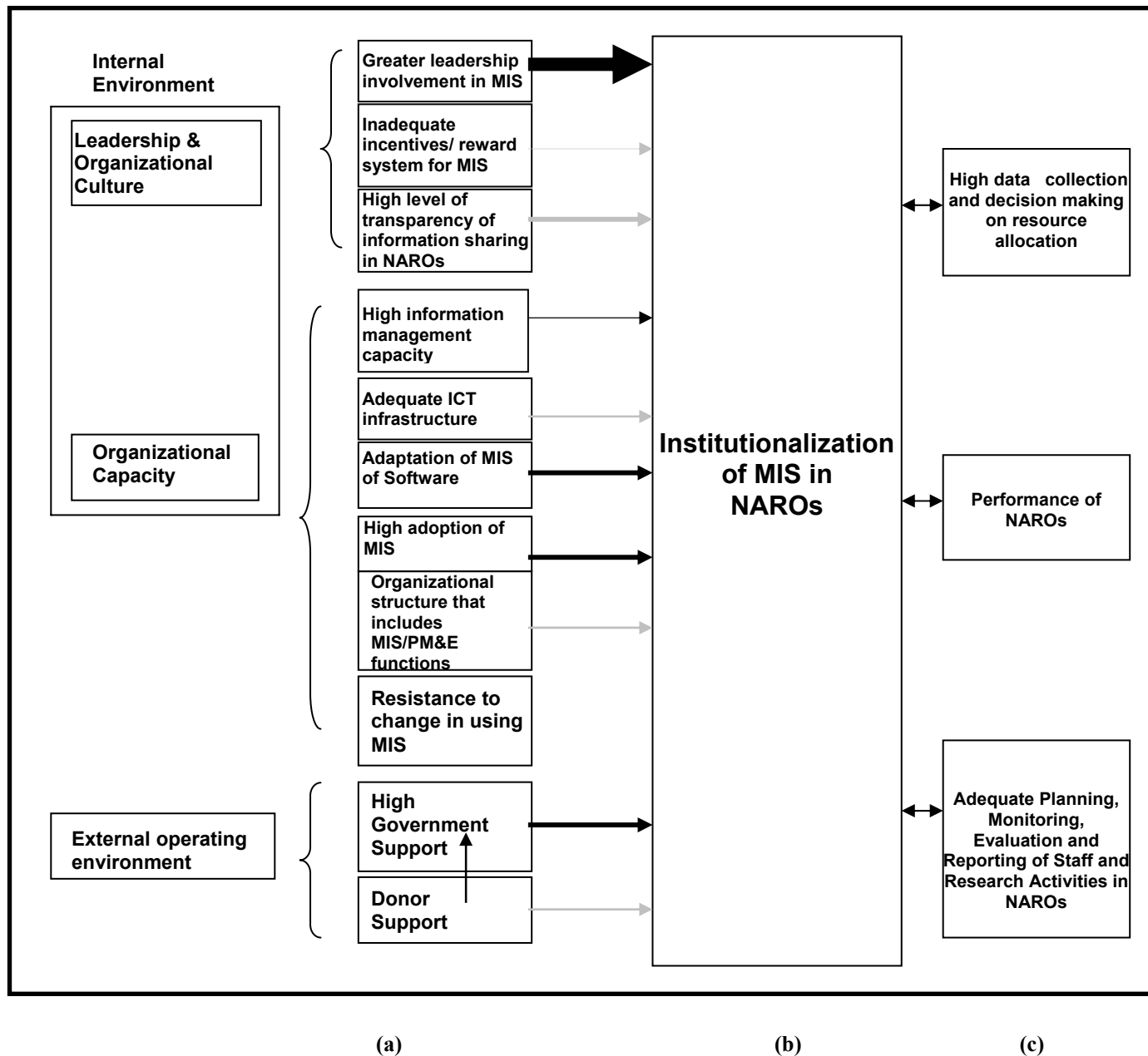


Figure 7.1: Impact Model of Institutionalization of MIS derived from Empirical Research in Sub Saharan African NAROs.

Legend:

The model is divided into three parts:

- (a) Independent variables
- (b) Dependent variable: institutionalization of MIS in Sub Saharan NAROs, and
- (c) Impacts of institutionalization of MIS in NAROs.

The arrows show factors that correlate with institutionalization of MIS in NAROs. The width of the arrows symbolises the strength of the relationship. Factors without an arrow indicate no correlation and factors with faint arrows indicate correlations qualitatively inferred with institutionalization.

Leadership Involvement:

Based on the results of the country and individual level correlations and regression analysis, we can conclude that leadership involvement is the most important critical success factor that promoted institutionalization of MIS in Sub Saharan African NAROs. This implies that the more NAROs' leaders especially the Director General get involved in institutionalization of MIS, the greater the chance of success. On the contrary, less involvement of NAROs leaders in institutionalization would result in stagnation and failure.

Organizational Culture

In terms of organizational culture, strong reporting culture e.g. in- house reviews, timely reporting on research activities, and transparency in information sharing are the factors promoting institutionalization of MIS in the case study NAROs.

Incentives:

Improvement in decisions made by managers, timely reporting on research activities, training opportunities and time reporting are incentives that promoted the use of MIS in NAROs.

Disincentives:

Inconsistent staffing, high turn over rate, lack of career prospect for MIS practitioners and poor reward system are disincentives frustrating institutionalization of MIS in NAROs.

Transparency:

In terms of transparency in information sharing: presentations at annual research meetings, progress and annual reporting are key factors promoting institutionalization. Transparency in information sharing in NAROs, appear to be promoting institutionalization of MIS in Sub Sahara African NAROs.

Organizational Capacity:

Information Management Capacity

In general all case study NAROs appear to have high information management capacity (skills and knowledge). But the correlation with institutionalization is low and insignificant. We therefore conclude that information management capacity of NARO staffs minimally promoted institutionalization of MIS in the case study NAROs. This implies that NAROs just having computer knowledge and skills alone would not promote institutionalization of MIS. The knowledge and skills should fit to a well-organized management process. It is useful to receive training on MIS but it is more important to put the knowledge and skills gained into practice. Computer knowledge and skills quickly deteriorate if not put to use.

ICT Infrastructure

Based on the qualitative analysis we can conclude that availability of ICT infrastructure promoted institutionalization of MIS in the case study NAROs. The quantitative analysis however did not show correlation between the level of ICT infrastructure and MIS institutionalization at the organizational level. This is probably because of low use of computers and the MIS software packages and lack of connectivity in these NAROs. We therefore conclude that high use of ICT infrastructure and availability of connectivity (LAN, Internet and Intranet) are prerequisites for institutionalization of MIS in Sub Saharan African NAROs.

Adoption

Adoption of MIS software significantly correlates with institutionalization of MIS in these NAROs. MIS was however, highly adopted at NAROs headquarters and less adopted in the research institutes and stations. We therefore conclude that high level of adoption of MIS software in both the headquarters and research institutes/stations would result in full institutionalization of MIS in Sub Saharan African NAROs.

Adaptation

Adaptation of MIS software correlates positively to institutionalization of MIS. The four case study NAROs made some slightly successful adaptation to INFORM-R and INFORM-R Light and this was observed to promote institutionalization. We therefore conclude that the more a NARO adapts the MIS software to suit its organization structure and work processes the higher the chance that it will be institutionalized.

Organizational Structure

ZARI Zambia, NARO Uganda and DRD Tanzania included PM&E/MIS units in their organizational structure. This enabled these organizations to perform better than CSIR Ghana that did not include PM&E/MIS unit and function in their structure. We therefore conclude that NAROs that include PM&E/MIS functions in their organizational structure will have high possibility of institutionalizing MIS. This is because MIS is the source of timely information for decision-making on PM&E. It is therefore important to locate both functions in one department.

Resistance to Change

Resistance to change is one of the major barriers to institutionalizing MIS in Sub Saharan African NAROs. This study revealed that managers and researchers resist using MIS for research management. Researchers at ZARI Zambia resist the use of MIS because it was perceived to be time consuming in terms of filling in forms and quarterly updating of information.

Researchers in NARO Uganda perceived MIS as an administrative burden because management did not include it in their terms of reference. Secrecy in sharing information generated from activities not funded by NARO was also another reason for resistance. DRD staff resisted using MIS because of lack of awareness of the benefits of MIS.

Researchers at CSIR Ghana lost interest in MIS because of lack of top management involvement in institutionalization.

In general NAROs resistance to change in using MIS did not promote institutionalization. Raising awareness about the existence/importance of MIS in NAROs, providing training and incentives to staffs and MIS practitioners and National Coordinators are solutions to resistance.

External Operating Environment:

Government Support

Government financial Support correlated positively to institutionalization of MIS. We can therefore conclude that government support is a critical success factor promoting institutionalization of MIS in Sub Saharan Africa. Government support is important because it ensures certainty of funds for running MIS activities. Western donors provide funds for Sub Saharan African governments to support agricultural research. This implies that without donors, government financial support to NAROs will dwindle at least in the near future.

Donor Support

The qualitative analyses show that donor support correlates positively to institutionalization. The quantitative analyses however show that donor support correlates negatively to institutionalization but positively to government support. The later result confirms the statement that donors are the source of government financial support for agricultural research including MIS in Sub Saharan Africa. Based on these findings we can conclude, that donor financial support if channelled through Sub Saharan African governments would strengthen the financial positions of these governments and promote institutionalization of MIS. Governments however, must release funds to NAROs in a timely fashion so as to promote research and institutionalization of MIS.

Critical Failure Factors

Regarding critical failure factors, we can conclude that **lack of funds, and lack of MIS policy/strategy** frustrates institutionalization of MIS in the case study NAROs.

Lack of Funds

Lack of funds for executing MIS activities was mentioned by the four case study NAROs as the major critical failure factor that frustrate institutionalization. We therefore conclude that NAROs without adequate and continuous funding for MIS activities cannot institutionalize MIS.

Lack of MIS Policy and Strategy

Lack of MIS policy and strategy frustrated institutionalization of MIS in nearly all the case study NAROs. This is probably because NAROs introduced MIS into their organization without including it in their organizational vision/mission statements and developing appropriate policy guidelines and strategy. We therefore conclude that NAROs without MIS policy guidelines and strategy cannot institutionalize MIS.

Extents of MIS institutionalization

In terms of the extent of institutionalization of MIS, we can conclude that MIS is still not fully institutionalized in Sub Saharan African NAROs. The results so far show that Zambia and Uganda NAROs score high while Tanzania and Ghana NAROs score low. Zambia and Uganda NAROs also score high in terms of using MIS for data collection and decision-making in the research management processing. We therefore conclude that NAROs that use MIS highly for data collection and processing into information for management decision-making would stand a better chance of institutionalizing the system in their organizations.

MIS in Improving NAROs Performance

MIS enabled NAROs to organize their data and generate information for timely decision-making on their annual research management cycle. Annual reports generated from the MIS improve NAROs internal performance, in terms of NAROs being able to show accountability, relevance and sense of continuity to their stakeholders and beneficiaries. Website publications generated from the MIS improve NAROs external performance, in terms of NAROs being able to show their achievements to the world. We therefore conclude that NAROs that use MIS for their research management cycle and for generating annual reports and website publications would be able to improve their research management performance.

7.2. Recommendations

In view of the conclusions above, we use this section of the thesis to recommend better ways of institutionalizing MIS in Sub Saharan Africa NAROs and other NAROs wishing to improve research management. The recommendations are targeted towards NAROs leaders, MIS coordinators, researchers, governments (ministries of agriculture and finance), and the donor community. However consultants, other researchers and NGOs going to do field work in Sub Saharan Africa may use these recommendations as management guidelines.

Recommendations for NAROs Leaders:

This case study revealed that leadership involvement is significantly correlated to institutionalization of MIS in Sub Saharan Africa. We therefore strongly recommend that top management i.e. Director General or Minister of Agriculture (depending on the organizational structure of a NARO) become the continuous champion for MIS and use his or power to promote full and continuous institutionalization. In this context the champion should:

- Include MIS in NARO's vision, structure and support MIS policy and strategy development in NARO. Most NAROs have no MIS policy because it is not in their vision statement. Their staffs are also reluctant to institutionalize MIS because they have no clear policy guideline and strategy to do so. For this reason we strongly recommend that NARO Directors General should ensure that MIS is included in their vision statement and MIS policy/strategy should be in place before any attempt at institutionalization. The policy should be widely advertised within and outside the organization such that NARO staff could claim ownership.
- The champion should continuously allocate special funds and support planning for institutionalization.
- Support and spearhead efforts to acquire and allocate funds from partners, donors, governments, or clients. Funding is identified as a major critical failure factor for MIS institutionalization. It is therefore important that the champion encourage all efforts and avenues for raising funds for instance development of proposal for partners, donors, governments and clients. S/he should have a clear idea of the available funds in-house by controlling budget, expenditure and research performance.
- Participate in the stages of adoption, implementation, adaptation and institutionalization of MIS and encourage teamwork. The absence and lack of continuous involvement of the top manager usually sends a wrong signal to staff. They become demoralize and begin to withdraw from the process. If the head of the organization is not able and willing to participate in institutionalization of MIS then it is advisable not to initiate MIS into the organization because it will fail.

- Support and finance the procurement of ICT infrastructure (especially LAN infrastructure) and connectivity of NARO headquarters and remote research stations/institutes.
- Support MIS training (especially training of institute/station managers and program leaders) and ensure that institutes, stations and programs have MIS practitioners.
- Reward MIS Coordinators and Practitioners by promotion or higher degree training so as to avoid high rate of turnover of trained MIS practitioners. Include MIS activities in their terms of reference and evaluate them on it during staff performance assessment.
- Ensure clear links between NARO and ministries of agriculture and finance so as to enable funds and technical support from these ministries to reach NARO in a timely fashion.

Research Managers at Headquarters and Stations/Institutes

In order to speed up adoption and adaptation of MIS, research managers should decentralize MIS activities to remote research stations/institutes and involve researchers and support staffs in the institutionalization process.

Research managers should make good use of available ICT infrastructure in-house. It is also important to purchase LAN and Internet infrastructure and connect remote research institutes/stations with the headquarters. A web-based MIS will reduce movement of MIS practitioners and allow managers and researchers in remote institutes/stations to have access to the content of the MIS software.

Research managers should use the information generated from MIS for making decisions and for producing annual reports, website publications and publications in local and international journals. MIS is a good tool to work with because it can assist managers in resource allocation, planning, monitoring and evaluation of research activities.

Recommendations for Researchers

In terms of information management culture, we recommend that researchers should learn to appreciate the importance of sharing information and participate actively in providing the necessary data, which is lifeblood of MIS. Researchers should be inspired by the noble work they do and realize the importance of filling in MIS forms promptly and write and publish research reports in a timely fashion. MIS is a good tool to work with because it can enable annual and publication reports to be generated in time. It can enable researchers to find out potential collaborators and competitors in their research area.

Recommendations for MIS National Coordinators and Practitioners

MIS National Coordinators and Practitioners must work closely with top management and research managers to adapt MIS software package to suit NAROs research management processes (planning, budgeting, monitoring, evaluation and reporting) and research structures (divisions, programs, projects and experiments). This would motivate top management to acknowledge their efforts and reward them appropriately.

Recommendations for Governments (Ministries of Agriculture and Finance)

Ministries of agriculture and finance in NAROs should coordinate and work out institutional arrangements to ensure timely release of funds to NAROs. Ministers of both ministries should also increase their matching funds to donor funds because investment in research can lead to increased agricultural productivity.

Ministries of agriculture should provide NAROs with MIS policy guidelines and assist NAROs with funds to develop and implement MIS strategy. The MIS strategy should guide and promote institutionalization of MIS in NAROs. It is important that the ministries support MIS because reports generated from it could be useful for governments to monitor and evaluate NAROs performance and accountability.

Recommendations for Donors

The importance of technical and financial support rendered by donors to Sub Saharan African NAROs cannot be overemphasized. Donors have been the backbone to agricultural research in Sub Saharan Africa in the last two decades. NAROs also indicated their appreciation for donor support. It is important that donors support MIS institutionalization because they can use the reports generated from it to monitor and evaluate NAROs performance and accountability.

We therefore recommend that donors should contribute to and ensure resource availability by supporting NAROs with long-term (5–10 years) funding to institutionalize MIS in order to improve research management and research. As a check and balance measure donors could tie funding to how far MIS has been institutionalized.

NAROs appreciated the fact that donors insisted on getting reports generated from MIS. But several donors demand different reporting format. This made it difficult to use one MIS software package. We therefore recommend that donors should support joint participatory planning, monitoring and control of research projects with NAROs at the early stages of project design. This would enable NAROs and donors to jointly identify indicators and formats for reporting. We also recommend that donors agree on a common reporting format, as this would ensure that one MIS software package is used for managing the jointly planned projects.

Interest in special projects is of course good for some donors because of the adage: “you put your money where your mouth is”. Different donors fund projects in developing countries for different reasons. But whatever the reasons might be it is important to jointly develop projects with the indigenes so as to ensure that they are in line with their national visions, policies and strategic plans.

7.3. Future Research Opportunities

- We could not perform regression analysis with four (countries) NAROs because the sample size was small. Future research should use survey strategy and broaden the sample size. We recommend at least 10 NAROs to be randomly selected from Africa, Asia, Latin America, Caribbean and the Pacific (NAROs that participated in the implementation of INFORM-R or INFORM-R Light should be included in the survey research). This would enable us to have a large sample size with which to perform regression analysis and generalize our findings to NAROs in developing countries. It would also be useful to include French, Spanish and Portuguese speaking countries, as this would enable us to compare management practices in these countries.
- Funding was a major critical failure factor for institutionalization of MIS in NAROs. This research confirmed that donors are the primary source of funds for institutionalization of MIS in NAROs. Nowadays, there is a feeling of donor fatigue in supporting Sub Saharan African NAROs. We did not search whether or not there are other sources of funds available to NAROs to support institutionalization of MIS. Future research should focus on: what are the alternative funding mechanisms to support institutionalization of MIS in Sub Saharan African NAROs? What are the roles of the private sector and NGOs in sustaining MIS in NAROs?
- The case study research revealed that institutionalization of MIS in financial accounting was poor in all case study NAROs. Finance and research activities data are usually not linked in most NAROs. Respondents mentioned that Research Managers and Researchers were not able to track expenditure of research funds and Finance Managers were not able to track past and ongoing research and their performance. This gap in information flow affected institutionalisation of MIS. Future research should seek to understand institutional coordination mechanisms required to link financial

information to research activities information in Sub Saharan African NAROs. This research would promote transparency of financial information in Sub Saharan African NAROs.

- Future research could consider using and extending the questionnaire in the annex of this thesis to monitor the trend of leadership involvement, adoption, adaptation, government/donor support, funding, MIS policy development, organizational stability and how they affect institutionalization of MIS in Sub Saharan African NAROs. This may enable us to predict institutionalization of MIS and perhaps other innovations in Sub Saharan Africa.

7.4. Expert Validation of Recommendations

The above-mentioned recommendations were sent to MIS Experts and leaders from the case study NAROs for validation. Their comments are presented below.

Mr. Richard Vernon

Mr. Vernon from the United Kingdom has many years experience as an agricultural research manager in the tropics. He had a degree in MIS and was one of the founding fathers of INFORM-R at ISNAR. His comments are the following:

“The concept of including ‘recommendations’ that could be used by NAROs to improve research management introduces an applied research element that will add value to this work.

Many recommendations are made. All or nearly all are of merit. Many are known from other work but this research has put them on a surer foundation and teased out a better understanding of the underlying issues. This is valuable work. It could provide the basis

for meetings of agricultural research managers to explore its recommendations leading to significant prospects of improving research management.

Two recommendations for future research are made and both are sensible. The need to link finance with research activities is widespread and important. A number of attempts have been made but the limited success calls for further exploration of the issues and the identification and testing of practices and systems to bring this about. The use of a 'management questionnaire' to identify best practices has been used in industry in the North and the deployment of something similar amongst Southern NAROs could prove valuable and is well worth exploring."

ZARI - Zambia

Mr. Albert Chalabesa is the Deputy Director of the Zambian Agricultural Research Institute. His comments are as follows:

"The recommendations have been well received by ZARI in the sense that they cater for all sectors including NAROs, governments and donors. Since the introduction of MIS ZARI management has taken a strong stance to ensure that its implementation is successful. MIS is extensively used in the decision-making processes of ZARI. ZARI is in the process of coming up with an information policy and strategy to develop guidelines on how information within ZARI is to be used as well as on how it is to be managed. ZARI is also working closely with donors in acquisition of ICT infrastructure for MIS as evidenced by the recent agreement signed with the International Institute for Communication and Development (IICD). ICT equipment such as computers, VSATs and local area networks (LAN) including the development of a website will be acquired through this partnership.

ZARI has significantly contributed to the development of the Ministry of Agriculture and Cooperatives MIS strategy due to its vast experience acquired in recent years. Therefore, ZARI accepts the recommendations, as they are important in further strengthening the

institutionalization of MIS. The head of ZARI (Deputy Director) has strived to be a champion of MIS and continues to ensure that it is included in the organisation's vision. These recommendations have come at an opportune time, as they have to be shared with all partners and stakeholders including government and donors."

NARO - Uganda

Mr. Dickson Baguma NARO MIS Expert validated the recommendations because the recent restructuring in NARO Uganda resulted in change of top management. The new Director General was not available to provide comments.

"For MIS to thrive well it requires the top most person to be the Champion. This person should be a good manager who listens and appreciates what his/her subordinates suggest and are doing. Champions can also come from lower management level provided that the top manager is in favour. If they are not in favour, no matter what the lower level champions propose, it cannot work. In a nutshell, we agree with your recommendations more than 100%. If NARO managers read such recommendations coming from such a comprehensive study, I hope it will help to improve research management."

DRD - Tanzania

The Director General of DRD became the Director of Research and was not available to provide comments. DRD MIS Experts Mr. John Banzi and Mr. Richard Kasuga provided the following comments:

"The recommendations were read with great satisfaction and we believe the work to be excellent. Management Information System is a new field in the Agricultural Research System. Very few works to date can be picked up from that discipline especially in Sub-Saharan Africa. Therefore, the recommendations on better ways of institutionalizing MIS are quite valid and the department has started to implement some of them e.g.

- Allocation of funds for MIS activities for the year 2005/06
- Supporting and spearheading efforts to acquire funds from partners, donors, governments or clients
- Supporting MIS training
- Supporting and financing the procurement of ICT infrastructure.

This thesis would surely be one of the valuable reference materials for ICT in Sub-Sahara Africa.”

CSIR - Ghana

CSIR head of human resources and the MIS National Coordinator Mr. Kwasi Setsofia read the recommendations and provided the following comments:

“CSIR Ghana accepts the recommendation for a champion for MIS. We would examine the possibility of appointing the Director for the Institute for Scientific and Technological Information to play that role in view of the rather heavy schedule of the Director-General. We agree that there is the need to have a policy on the institutionalization of MIS in our NARS. It may however be difficult to include MIS in our vision because of its brevity.

Our Crops Research Institute now has Internet facilities and construction work is on going to get the two of our institutes and the Headquarters connected by the end of June 2005. CSIR has an MIS division at the headquarters headed by someone with a MBA in MIS. The Agriculture, Forestry and Fisheries Sector have had for more than ten years an MIS Section which has been involved in the implementation of INFORM, INFORM Light and INFORM-R. We therefore have the capacity at the headquarters to institutionalize MIS. We however, agree that we need to set up such sections at the institutes to speed up the process of institutionalization of MIS at the institutes.”

7.5. Planning and Managing MIS Project

The flow chart model for planning and managing MIS project is based on the discussion, conclusions and recommendations from this thesis. By definition a project is supposed to deliver the right output within a finite overall budget and time allocation. MIS institutionalization however advocates for continuity after implementation. It is therefore important for the MIS champion to decide on the right time to end the project and plan for continuous sensitization and motivation. NAROs wishing to introduce MIS in their organization may use the flow chart (figure 7.2) for planning and managing a MIS project as a guideline. This flow chart was designed with INFORM-R and INFORM-R Light in mind but may be useful for institutionalizing other MIS software.

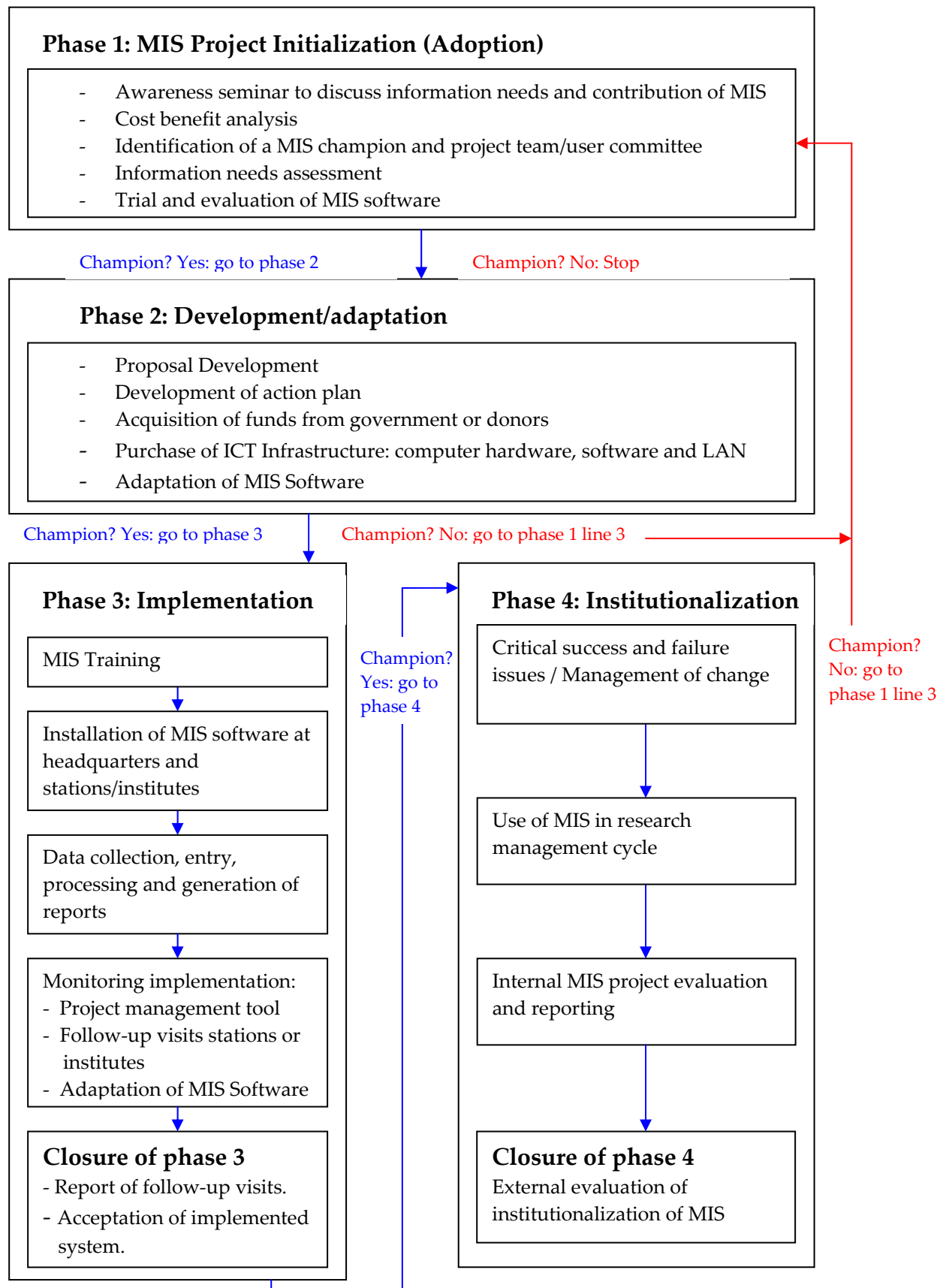


Figure 7.2. Flow chart for planning and managing an MIS project.

Phase 1: MIS Project Initialization /Adoption

Awareness seminar:

INFORM-R, INFORM-R Light or any other MIS related software should be demonstrated to NAROs top management, institute/station directors, program leaders and researchers in a seminar. The purpose of this seminar should be to raise awareness about NAROs information needs, the contribution an MIS has to offer and issues related to institutionalizing an MIS.

A qualified **MIS specialist** who may be a staff of the organization or an outside consultant should act as facilitator in the seminar. The MIS specialist should state clearly what the system has to offer in relation to research management information, provide outline estimated costs in both financial and staff time, ICT infrastructure requirements and the need for top management involvement in making the right decisions at the adoption phase and all other phases of introducing the system to the organization.

Identification of a MIS champion:

At the end of the seminar, the Director General should be inspired and committed to work as the champion for MIS. S/he should have good knowledge on what an MIS can do to improve research management in the organization before proceeding to the development phase. S/he should weigh and understand what the system demands in terms of financial cost, staff time, ICT infrastructures etc. Once the decision has been made to continue with the introduction of MIS in the organization, top management should ensure that MIS policy and strategy is developed and shared among staff and adequate fund is committed to the MIS project. The policy/strategy would specify the key points that would guide the development, implementation and institutionalization of the system in the organization. It may be useful for the champion and a MIS specialist to visit NAROs with institutionalized MIS so as to learn from best practices.

Identification of a project team /user committee:

The MIS project team comprising of Director General (champion), PM&E Director, institute/station directors and MIS national coordinator and station/institute MIS practitioners should be setup. This team will be responsible for issues related to project management, proposal development, funding, ICT infrastructure and maintenance, donor relations, budgeting/expenditure of funds, MIS training, sensitization and government support issues. The user committee should also be setup. The committee should consist of the PM&E unit, program leaders and selected senior and junior researchers. The user committee should represent users interest and ensure that users' needs are well addressed. The project team and user committee together form the MIS institutionalization team.

Information needs assessment:

The MIS project team and user committee should jointly review the current status of research information management in the NARO. The review should be based on looking at the organizational structure and assessing the work processes and information flows for example the existing research management cycle, key research planning meetings, research reports. Review the current status of data on human resources, training, communications/publications, and ICT infrastructure. Collect and review all available databases either in digital or paper format. A report of the review should be written, synthesized and shared among NARO staff.

Trial and Evaluation of MIS Software:

The user committee should try entering some data on human resources and research activities in the MIS software and judge whether the system is user friendly. The MIS specialist should use the content of the review report to assess whether INFORM-R /INFORM-R Light is suitable for the organization or some adaptation is needed.

N/B: If a champion is available then the organization can proceed to phase 2: development and adaptation, else it is advisable to stop the project because it will not succeed.

Phase 2: Development/adaptation phase

Proposal Development:

Once the decision has been made to adapt the system, the MIS specialist supported by the project team should develop a proposal. The proposal should include objective of the project, activity plan, division of task between MIS project team and user committee, ICT infrastructure and budget.

Develop an action plan:

The project team should agree on methods to adapt the MIS software, the implementation procedure and its integration into research management cycle (institutionalization).

Acquisition of funds from government or donors:

The proposal should be approved by the champion and sent to the government (ministries of agriculture and finance) and potential donors for funding.

Purchase of ICT Infrastructure: computer hardware, software and LAN:

If adequate funds have been obtained for the MIS project then ICT infrastructure should be purchased. In terms of software for INFORM-R or INFORM-R Light, Windows 2000 professional, Windows XP, Windows 2003 or later version, Microsoft ACCESS 2000 or later version is recommended. Regarding hardware: a personal computer with 300 megahertz or higher processor (Intel Pentium/Celeron family, or AMD K6/Athlon/Duron family, or compatible processor recommended), 128 megabytes (MB) of RAM or higher,

Super VGA (800 x 600) or higher-resolution video adapter and monitor, CD-ROM or DVD drive, Keyboard and Mouse or compatible pointing device. Regarding network facilities: Local Area Network, VSAT (small aperture terminal used to connect communications satellite), and Internet.

Due to rapid changes in information technology, it is advisable to try to cope with the modern changes by upgrading ICT hardware and software. Of course the upgrading and maintenance should be based on the MIS policy and strategy developed at the initial phase. This policy and strategy should be revisited and if necessary revised as time pass by. As a matter of strategy, it may be advisable to change hardware and software every five years. This would save costs of trying to buy every new gadget and yet still remain modern.

Adaptation of MIS Software:

During phase two of the project the MIS specialist supported by the MIS team (especially the PM&E unit) should attempt to adapt the MIS software to suit organization and research structures. The adaptation should continue also in the implementation and institutionalization stages.

N/B: If a champion is available then the organization can proceed to phase 3: implementation, else it is crucial to identify a champion before proceeding.

Phase 3: Implementation

MIS Training:

In the implementation phase, three groups should be trained separately. The first training should start with top management, finance and human resources managers, institutes/stations directors and program leaders. They should be trained on data manipulation (Querying), retrieval, preparation of reports, information interpretation and

dissemination, and decision-making skills. The second group of trainees should be the researchers, national, institutes/stations and programs MIS coordinators and data entry staff. They should be trained on data capture, entry, retrieval, querying, preparation of reports, information interpretation and dissemination and database design skills. The duration of the training may be two to three weeks. Finally, a Database Administrator should be trained on database maintenance, LAN, Internet protocols and Computer hardware and software installation.

Installation of MIS software and hardware:

After training, the MIS software and hardware should be installed in all research stations/institutes and NARO headquarters. A NARO with available network system could install the MIS software on a server and replicate to the MIS practitioners. Those wishing to use the web-based version could even install and share on the intranet and Internet. This could make data entry (by researchers and MIS Practitioners), retrieval and exchange possible and faster for all staff.

Data Collection:

MIS practitioners and data entry staff at headquarters and stations working under supervision of the MIS coordinators should collect all available data on research priorities, researchers and their research activities, budgets and expenditure, publications and enter into the system. The data should be quickly processed, reports generated and distributed to all staff. If a NARO has existing data sets then they should be converted and appended into the MIS database.

Monitoring implementation:

Project management tool

A project management database should be developed in MS Excel or MS ACCESS or any other software e.g. Microsoft Project. The database should record all MIS project tasks and

activities, their start dates, estimated duration and end dates, budget and expenditure. Another module in the database should record the bugs and user comments. This tool will provide useful indicators for progress of the project and guide the champion and MIS project team on decisions to be made. It is important to note that a project management database is not the same as the MIS software package.

Follow-up visits and technical backstopping:

Follow-up visits (usually two to three quarterly visits) should be performed by the MIS national coordinator and selected members of the MIS institutionalization team. The goal of the visits should be to monitor implementation and resolve social issues. The MIS specialist should provide technical support at headquarters and stations/institutes and resolve technical issues emanating from the software or hardware.

Adaptation of MIS software:

Based on the follow-up visit and technical backstopping the MIS National Coordinator should adapt the MIS software to suit NAROs structures. The adapted software should be redistributed to all institutes/stations.

Closure of phase 3:

Report of follow-up visits and technical backstopping should be prepared and shared among staff. The institutionalization team led by the champion should analyze the report and find out whether NARO staffs have accepted the MIS and whether it satisfies NAROs' needs. If so then a decision should be made to continue to the institutionalization stage, else the project could be stopped. This phase should mark the end of the implementation phase.

N/B: If a champion is available then the organization can proceed to phase 4: institutionalization, else it is crucial to identify a champion before proceeding.

Phase 4: Institutionalization

Critical success and failure issues / Management of change:

In the institutionalization phase, the champion / top management involvement and continuous support will be highly crucial to achieve success. Top management should encourage teamwork, and strong commitment to decision making based on information.

The project team led by the champion should sensitize and motivate all staff to change their practices and attitudes toward information management and ensure that all reports e.g. experiments, projects; programs, staff and finance are collected and entered in the MIS format. Ensure that data are collected promptly at every stage of the research management cycle. Ensure that the data are processed and reports generated and used for making decisions in every stage of the research management cycle.

Top management should encourage and motivate government (Ministry of Agriculture and Finance) to release adequate funds on time for execution of the MIS activities. Portray a good image of the NARO to the government and donors by providing annual reports and other reports in a timely fashion. Show to the government and donors that the NARO is accountable, relevant, stable, and can perform.

Continuous sensitisation and commitment to implementing the new changes related to the MIS should be encouraged. For instance management should make staff aware of the system through training and publishing about organizational MIS in the national media.

Use of MIS in research management cycle:

See integrating MIS in research management cycle in *Annex 1* of the thesis.

Internal MIS project evaluation and reporting:

The PM&E unit of the organization should perform an internal evaluation of the institutionalization phase. A user satisfaction survey may serve this purpose at regular intervals.

Closure of phase 4:

An external evaluator should evaluate the MIS institutionalization project. A report should be written, shared and discussed among NARO staff. Finally the National Coordinator (MIS specialist) supported by the champion should compare the internal and external evaluation reports and make synthesis. A seminar should be held to present the synthesis and lesson learned and the champion should formally close the project. The end of the project should be celebrated but of course it does not stop the use of MIS in the organization and certainly does not prevent the champion from continuously sensitizing NARO staff on MIS. In fact a follow-up plan should be made for continued sensitization and maintenance of MIS in the organization.

ANNEX

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Annex 1. Integrating MIS in Research Management

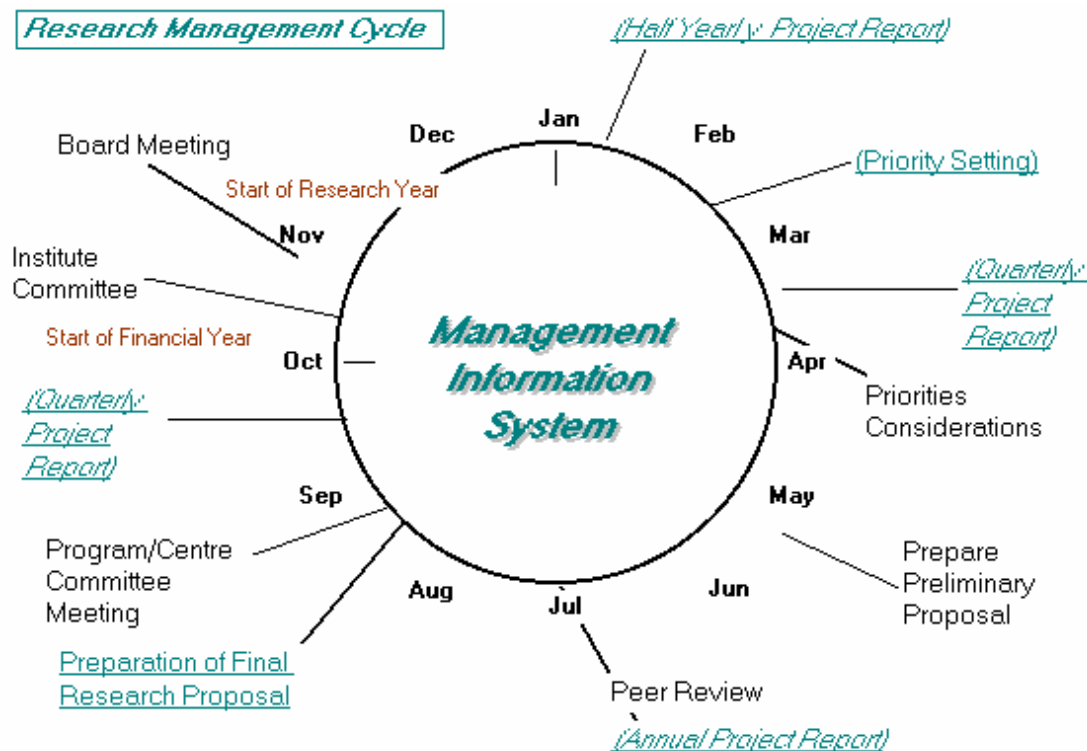


Figure A1: Research Management vs. MIS Cycle.

The diagram in figure A1 is meant to picture how MIS could be used to improve research management. This research management vs. MIS cycle, starts in **January** and ends in **December**. In **January**, half yearly reports are produced by MIS National Coordinators and MIS Practitioners and disseminated to all staff and stakeholders. Between **February** and **March**, using the half yearly report research priorities are set in a joint meeting of Programme Committee, Executive Committee, Board of Trustees (BOT), Stakeholders and Researchers. In **March**, Program leaders and institute Directors monitor experiments and projects performed by researchers. MIS National Coordinators and MIS Practitioners must collect and enter all data generated from the priority-setting meeting and monitoring exercise in INFORM – R Light. After that quarterly reports are produced from INFORM-R light and disseminated to all staff and stakeholders. In **April**, Programme Committee,

Executive Committee, BOT, Stakeholders and Researchers meet again to consider priorities. The adjusted priorities data should be updated in INFORM-R Light. In **May**, Researchers prepare preliminary proposals based on prioritized area of research. Proposal forms in INFORM-R Light should be used for this purpose and the data generated should be entered in the system.

Between **June and July** peer review meetings are held and researchers present their preliminary proposals and annual reports. These proposals and reports are peer reviewed (ex-ante and ex-post evaluation respectively) and accepted or rejected. Again INFORM-R Light should be used to capture data generated from the peer review meeting. In **August** researchers prepare final research proposals to be approved by the program committee during annual planning meeting in **September**. In the same month annual reports are generated from INFORM-R Light and published in hard copy and on organizational web sites.

The annual research-planning meeting is referred to as program/centre committee meeting. During this meeting, researchers present their final research proposals for approval by the Program Committee (consisting of the Director General and stations/institutes Directors). Institute/Station MIS Practitioners should provide INFORM-R Light proposal forms to researchers to enter research proposal data. The national MIS Coordinator should merge the data into the national INFORM-R Light database. Before the end of **September**, proposals that meet NARO's objectives and national priorities are approved. Approved proposals become projects and are given identity number by the MIS national Coordinator in consultation with the Program Committee. MIS Practitioners should then enter projects data into INFORM-R Light and generate quarterly reports and disseminate to staff and stakeholders in **October**.

It is important to note that research and financial periods may not be the same in all countries. It is therefore recommended that NAROs restructure this cycle to suit their organizations research management cycle. The financial year in this cycle starts in **October**. Researchers should prepare budgets using INFORM-R Light budget forms. The institute committee discusses the budgets and in **November**, the Board of Trustees meets with program committee to approve budgets. In the same month approved funds should be released to researchers to start implementing research experiments, studies or projects. The cycle ends in December and starts again in January with monitoring of research projects and experiments, capturing of research activities data and entry in INFORM-R Light and generation of half yearly reports.

Annex 2. Data Analysis Steps

Closed-ended Questions:

1. Open SPSS,
2. Click on file, open database, new query: a dialogue box appears
3. Select MS ACCESS database, click on next to select the data source: This may be a query in your ACCESS database. Follow the next steps to import the data into SPSS
4. Once the data is in SPSS ensure that the primary key, data and variables are correct
5. In SPSS menu bar click on Analyze, compare means, means,
6. Select independent and dependent variables, click on option and select the type of statistics and click continue and OK
7. You can also use other types of analysis
8. To plot a graph: In SPSS menu bar click on graph and follow the steps to choose the type of graph. You may also choose to copy the means, past in EXCEL and plot the graph.

Open-ended questions:

1. Copy query data from your ACCESS database into notepad
2. save as txt
3. open in excel (delimited, comma)
4. make column in I (1 thru number of answers)
5. select in next column N+1 cells
6. choose function--> frequency
7. enter the data array
8. and bins-array (column I: 1-N)
9. close with shift-Ctrl-Enter
10. rank the counts
11. plot bar charts
12. analyse data qualitatively and take the remarks made during the interviews into consideration.

Annex 3: Other Results

Table AT1. Correlations Matrix (Country Level Analysis)

Factor		Institutiona lization	Adaptation	Computer Infrastructure	Donors Support	Government Support	Adoption Median	Leadership Involvement	Information Management
Institutionalization	Pearson Correlation Sig. (2-tailed) N	1 .4 .767	.767 .233 4	-.851 .149 4	-.287 .713 4	.665 .335 4	.960(*) .040 4	.969(*) .031 4	.344 .656 4
Adaptation	Pearson Correlation Sig. (2-tailed) N	.767 .233 4	1 .233 4	-.978(*) .022 4	-.037 .963 4	.481 .519 4	.642 .358 4	.774 .226 4	-.052 .948 4
Computer Infrastructure	Pearson Correlation Sig. (2-tailed) N	-.851 .149 4	-.978(*) .022 4	1 .233 4	.223 .777 4	-.441 .559 4	-.710 .290 4	-.816 .184 4	-.151 .849 4
Donors Support	Pearson Correlation Sig. (2-tailed) N	-.287 .713 4	.767 .233 4	-.851 .149 4	1 .233 4	.477 .523 4	-.100 .900 4	-.045 .955 4	-.971(*) .029 4
Government Support	Pearson Correlation Sig. (2-tailed) N	.665 .335 4	.767 .233 4	-.851 .149 4	-.287 .713 4	1 .233 4	.823 .177 4	.822 .178 4	-.345 .655 4
Adoption Median	Pearson Correlation Sig. (2-tailed) N	.960(*) .040 4	.969(*) .031 4	-.978(*) .022 4	-.037 .963 4	.477 .523 4	1 .233 4	.981(*) .019 4	.211 .789 4
Leadership Involvement	Pearson Correlation Sig. (2-tailed) N	.969(*) .031 4	.774 .226 4	-.816 .184 4	-.045 .955 4	.822 .178 4	.981(*) .019 4	1 .118 4	.882 1
Information Management	Pearson Correlation Sig. (2-tailed)	.344	-.052	-.151	-.971(*)	-.345	.211	.118	.
	Sig. (2-tailed)	.656	.948	.849	.029	.655	.789	.882	.

* Correlation is significant at the 0.05 level (2-tailed).

Table AT2: Table of means

Country	Leadership	Institutionalization	ICT Inf.	Adaptation	Adoption	Government	Donor	Information_ Management
Ghana	2	2	2	2	5	5	5	2.11
Ghana	4	2.11	2	2	1	4	4	3.33
Ghana	2	2	2	2	1	4	4	3.33
Ghana	4	1	4	1	2	2	4	5
Ghana	5	1.08	3	2	4	2	4	1
Ghana	4	1	4	2	2	4	4	3.11
Ghana	3	1	4	1	2	4	4	2.67
Ghana	2	1.2	4	1	1	4	4	3.89
Ghana	1	1	4	1	1	4	4	2.78
Ghana	2	1.2	4	1	1	4	4	4
Ghana	1	1	4	1	1	4	2	2.56
Ghana	1	1	2	1	1	4	4	4
Ghana	4	1.78	4	3	2	4	5	1.89
Ghana	3	1.5	3	1	1	2	4	4
Ghana	3	1.8	2	1	1	4	4	3.56
Tanzania	4	2.83	4	3	4	4	4	4
Tanzania	3	2.68	2	2	1	5	5	4.11
Tanzania	4	2.68	2	2	1	5	5	4.11
Tanzania	4	2.53	2	3	5	4	5	1
Tanzania	2	1	3	1	1	4	5	3.78
Tanzania	2	1	2	1	1	4	4	3.89
Tanzania	4	2.83	4	3	4	4	4	3.89
Tanzania	3	1.56	2	2	5	4	4	1.89
Tanzania	3	1.59	2	3	2	2	4	1.67
Tanzania	3	1.06	2	4	5	2	4	2.33
Tanzania	2	2.15	2	2	2	4	4	2.44
Tanzania	2	1.24	4	2	1	1	2	3.11
Tanzania	2	1.26	3	2	1	4	4	2.56
Tanzania	3	2.54	3	3	5	4	4	3
Tanzania	4	2.26	4	1	1	4	2	3.44
Uganda	4	3.15	3	3	6	4	4	2.78
Uganda	4	3.15	3	3	6	4	4	2.78
Uganda	4	3.8	3	2	5	4	4	2.78
Uganda	4	1.28	3	3	5	5	4	2.44
Uganda	3	2.71	2	3	3	5	4	3.33
Uganda	4	3.15	3	3	6	4	4	2.78
Uganda	4	2.88	2	1	6	4	4	3.44
Uganda	4	2.9	2	1	6	5	4	2.89
Uganda	1	1.65	4	1	3	4	4	2.44
Uganda	3	2.68	2	2	4	4	5	3
Uganda	4	3.15	3	3	6	4	4	2.78
Zambia	4	4.54	2	1	5	4	4	3.44
Zambia	4	3.7	2	2	6	4	4	3.33
Zambia	4	4.53	2	3	5	4	4	4.22

Country	Leadership	Institutionalization	ICT Inf.	Adaptation	Adoption	Government	Donor	Information_ Management
Zambia	3	2.99	2	3	5	4	4	3.56
Zambia	4	3.14	3	4	6	5	5	3.67
Zambia	2	2.09	4	2	4	2	2	3.11
Zambia	4	2	3	1	5	4	4	3.89
Zambia	3	2.17	3	2	6	4	4	3

Table AT3: Correlations Matrix (individual level analysis)

Factor		Leadership_ Involvement	Institutio nalization	Computer Infrastruc ture	Adaptation	Adoption	Govern ment Support	Donor Support	Information Management Capacity
Leadership involvement	Pearson Correlatio n	1	.527(**)	-.123	.400(**)	.531(**)	.067	.228	-.035
	Sig. (2- tailed)	.	.000	.399	.004	.000	.648	.115	.813
	N	49	49	49	49	49	49	49	49
Institutionali zation	Pearson Correlatio n	.527(**)	1	-.359(*)	.373(**)	.629(**)	.344(*)	.162	.137
	Sig. (2- tailed)	.000	.	.011	.008	.000	.015	.266	.349
	N	49	49	49	49	49	49	49	49
Computer Infrastructur e	Pearson Correlatio n	-.123	-.359(*)	1	-.161	-.230	-.252	-.420(**)	.079
	Sig. (2- tailed)	.399	.011	.	.269	.112	.081	.003	.588
	N	49	49	49	49	49	49	49	49
Adaptation	Pearson Correlatio n	.400(**)	.373(**)	-.161	1	.501(**)	.030	.229	-.299(*)
	Sig. (2- tailed)	.004	.008	.269	.	.000	.838	.114	.037
	N	49	49	49	49	49	49	49	49
Adoption	Pearson Correlatio n	.531(**)	.629(**)	-.230	.501(**)	1	.168	.161	-.260
	Sig. (2- tailed)	.000	.000	.112	.000	.	.248	.269	.071
	N	49	49	49	49	49	49	49	49
Government Support	Pearson Correlatio n	.067	.344(*)	-.252	.030	.168	1	.459(**)	.111
	Sig. (2- tailed)	.648	.015	.081	.838	.248	.	.001	.447
	N	49	49	49	49	49	49	49	49
Donor Support	Pearson Correlatio n	.228	.162	-.420(**)	.229	.161	.459(**)	1	-.028
	Sig. (2- tailed)	.115	.266	.003	.114	.269	.001	.	.851
	N	49	49	49	49	49	49	49	49
Information Management Capacity	Pearson Correlatio n	-.035	.137	.079	-.299(*)	-.260	.111	-.028	1
	Sig. (2- tailed)	.813	.349	.588	.037	.071	.447	.851	.

** Correlation is significant at the 0.01 level (2-tailed), * Correlation is significant at the 0.05 level (2-tailed).

Annex 4: Questionnaire

Questionnaire to evaluate the institutionalization of Management Information System (MIS): INFORM-R and INFORM-R Light in National Agricultural Research Organizations.

Please kindly answer the questions according to your current status in your organization. All replies will be treated as confidential.

PERSONAL INFORMATION

Surname

First Name

Middle Name

Gender

Male ☐ Female ☐

Job title

Organizational

Unit

Current Status	Top Manager Practitioner	Middle Manager	Researcher	MIS
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Organisation
and address

Telephone

Fax

Email

INTRODUCTION

ISNAR has collaborated with National Agricultural Research Systems (NARS) in the development and implementation of Management Information System (INFORM-R and INFORM-R Light) in the past 10 years. The 1994, 97 and 2002 external reviews, and the

training and implementation events in 2000/2002 revealed that institutionalization of the system is still the major bottleneck in NAROs. Full Institutionalization would mean routine use of the MIS for data collection, data processing into information and decision-making in NAROs management processes of priority setting, planning, budgeting, monitoring, evaluation and reporting. The goal of this case study is to get insight into the factors affecting positively and negatively institutionalization of the implementation process and the continuous and integrated use and maintenance of the MIS in NAROs. The objectives are: to identify factors that help or hinder institutionalization and to recommend a method of working for using a MIS in NAROs.

INSTITUTIONALIZATION OF MIS (INFORM-R or INFORM-R Light) (1)

1a. To what extent is MIS (INFORM-R and INFORM-R Light) institutionalized in your organization?

Not Institutionalized	Inadequately Institutionalized	Partially Institutionalized	Highly Institutionalized	Fully Institutionalized
1	2	3	4	5

1b. Please provide examples of use of MIS in your organization. How was it used, who is using it and what were the interactions?

Please provide explanatory comments:

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1c. How many years has the MIS (INFORM-R or INFORM-R Light) been used in your organization?

.....

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2(a). To what extent is INFORM-R or INFORM-R Light used in data collection for your organization's research management processes of Priority Setting, Planning, Budgeting, Monitoring, Evaluation and Reporting?

Please score using the scale 1 to 5: One means not used and five means very high use.

	Experiments level					Projects level					Programs level					Organization level				
Research Management Process	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Priority Setting																				
Planning																				
Budgeting																				
Administrative Accounting																				
Monitoring																				
Evaluation																				
Reporting within your organization																				
Reporting to government																				
Reporting to donors																				
Reporting to the general public																				

2(b) To what extent is INFORM-R or INFORM-R Light used in decision-making in your organization's research management processes of Priority Setting, Planning, Budgeting, Monitoring, Evaluation and Reporting?

Please score using the scale 1 to 5: One means not used and five means very high use.

	Experiments level					Projects level					Programs level					Organization level				
Research Management Process	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Priority Setting																				
Planning																				
Budgeting																				
Administrative Accounting																				
Monitoring																				
Evaluation																				
Reporting within your organization																				
Reporting to government																				
Reporting to donors																				
Reporting to the general public																				

2(c). What were the main problems to implementation and use?

- Top management not interested
- Weak funding of research
- MIS too costly to operate
- Design of the MIS (INFORM-R)
- Design of the MIS (INFORM-R Light)
- Others:

Please choose one or more and provide explanatory comments:

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3. Which stage of adoption of MIS (INFORM-R or INFORM-R Light) is your organization?

Awareness	Interest	Evaluation	Trial	Implementation/ Adoption	Use
1	2	3	4	5	6

4 (a) To what extent did you adapt (modify) INFORM-R or INFORM-R Light to suit your organizations' research (program, project and experiments) structures?
Please score using the scale 1 to 5: Not adapted to highly adapted (modified).

Not Adapted	Fairly Adapted	Moderate	Much Adapted	Highly Adapted
1	2	3	4	5

4(b). What adaptations (modifications) were made?

- Replacing the experiment level with project level.
- Removing the program, project levels and adding a new level like teams to the research structure.
- Adding a new level like division to the research structure.
- Removing the program level in the research structure.
- Any other modifications:

Why were they made? Please provide explanatory comments:

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4(c) How successful was the adaptation? (Please score using the scale 1 to 5: One meaning not successful to five meaning very successful).

Not Successful	Fairly successful	Moderate	Quite Successful	Very Successful

1	2	3	4	5

4(d). What were the main problems to adaptation?

- No staff with database design skills
- Lack of top management support
- Lack of computer hardware or software
- Funding problem
- Others:

Please choose one or more and provide explanatory comments:

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LEADERSHIP (2)

5. What roles did you play in the institutionalization process of the MIS (INFORM-R or INFORM-R Light) in your organization?

- Champion
- Facilitator
- Patron
- Sponsor
- Practitioner
- Policy maker
- National Coordinator
- User
- Other roles:

Please choose one or more and provide explanatory comments:

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6. How did you use the MIS (INFORM-R or INFORM-R Light) for decision-making?
Please provide explanatory comments:

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7. What is the level of your involvement in the MIS (INFORM-R or INFORM-R Light) institutionalization?
(Please score using the scale 1 to 5: One meaning not involved to five meaning highly involved).

Not Involved	Less Involved	Moderate	Very Involved	Highly Involved
1	2	3	4	5

Please choose one and provide explanatory comments:

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INFORMATION MANAGEMENT CAPACITY (3)

- 8a. How adequate are Capacity (knowledge, aptitude and skills) of staff for using MIS (INFORM-R, INFORM-R Light or any other Information System) in your organization?

	Inadequate	Poor	Moderate	Good	Highly adequate
Information Management Capacity	1	2	3	4	5
Data Capture					
Data Entry					
Data Manipulation (Querying)					
Data Retrieval					
Preparation of reports					
Information dissemination					
Information Interpretation					
Decision Making skills					
Database design skills					

- 8b. How would you rate your own capacity (knowledge and skills) in using Computerized database management information system (INFORM-R, INFORM-R Light or any other Information System)?
(Please score using the scale 1 to 5: From 1 meaning very poor skill to 5 meaning excellent skill).

	Inadequate	Poor	Moderate	Good	Highly adequate
Information Management Capacity	1	2	3	4	5
Data Capture					
Data Entry					
Data Manipulation (Querying)					
Data Retrieval					
Preparation of reports					
Information dissemination					
Information Interpretation					
Decision Making skills					
Database design skills					

8c. Do you require extra MIS (INFORM-R or INFORM-R Light) training? If so in which areas?

Please choose one or more and provide explanatory comments:

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9a. What is in your view the level of Computer Hardware, Software and networking facilities' for MIS in your organization?

None	Inadequate	Moderate	Good	Highly adequate
1	2	3	4	5

9b. How has the availability or non-availability of ICT infrastructures (Computer Hardware, Software and networking facilities) affected the institutionalization of MIS (INFORM) in your organization? Please give example.

Availability?

- Enable communication and information flow within and between the NAROs
- Increase the moral and motivation of staff
- Facilitate data and information processes
- Facilitate decision-making processes and time
- Others:

Please choose one or more and provide explanatory comments:

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Non- availability?

- Lack of Internet connection may result in Communication problem between headquarters and stations
- Delay in data capture, manipulation and feedback to scientists and managers
- Lack of electricity may result in a standstill in electronic information management activities
- Lack of PCs after MIS training may result in MIS practitioners losing their skills and moral
- Outdated computers restrict the use of advanced software and large databases

Please choose one or more and provide explanatory comments:

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ORGANIZATIONAL CULTURE (4)

10. What are the strength and weaknesses of your organizations' information management culture (values, beliefs, customs, traditions and meanings) and how do they affect MIS (INFORM) institutionalization?

Strengths?

- Transparency in management
- Strong reporting tradition
- Timely reporting of research activities
- Good accounting department
- Others:

Please choose one or more and provide explanatory comments:

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Weaknesses?

- No information sharing
- Data accumulated but never acted on
- Organization not a learning environment where it is important to learn from mistakes
- Secrecy
- Lack of commitment

Please choose one or more and provide explanatory comments:

11. What is your organizations' level of transparency in sharing research management information and how does it affect MIS institutionalization?

Please provide explanatory comments:

12a. In your opinion, what incentives or requirement (reward systems, peer recognition, prestige, remuneration, opportunity for staff promotion and intellectual freedom) for all levels (top managers, middle managers, researchers and MIS practitioners) are there in your organization that affect institutionalization of MIS (INFORM)?

- Timely reporting on activities
- Time reporting
- Scoring of staff performance assessment in MIS
- Quality of decisions made by managers
- Others:

Please choose one or more and provide explanatory comments:

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(12b) What disincentives affect MIS institutionalization?

- Career prospects of MIS practitioners: researchers converted to MIS practitioners
- Inconsistent staffing
- Others:

Please choose and provide explanatory comments:

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EXTERNAL OPERATING ENVIRONMENT (5)

13a. To what extent does donors financial or technical support positively or negatively affect institutionalization of MIS (INFORM)?

Positive?

- Funding training
- Insisting on getting meaningful reports that require some kind of analysis that requires an MIS capacity
- Coordination among donors on common reporting requirements that can be met by the local MIS
- Purchase of equipment and software
- Forging links with International organizations like ISNAR
- Exchange of Information and ideas at global level
- Others:

Please choose one or more and provide explanatory comments:

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Negative?

- Drastic end to programs
- Lack of continuity
- Interest in special projects
- Others:

Please choose one or more and provide explanatory comments:

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13b. What is the trend of donors (technical and Financial) support to the MIS (INFORM)?

Strongly negative	Somehow negative	Somehow positive	Strongly positive
1	2	4	5

14(a). How did your government support (Political and Financial/Technical) affect MIS institutionalization in your organization?

Please provide explanatory comments:

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14(b). What is the trend of your government support (Political and Financial/Technical) to the MIS (INFORM)?

Strongly negative	Somehow negative	Somehow positive	Strongly positive
1	2	4	5

14(c). What in your opinion should change about donors and your government political and Financial/Technical support to the MIS project?

Donors?

- agree on a common reporting format
- be more demanding on technical reporting
- tie funding to how far the MIS has been institutionalized.
- Others:

Please choose one or more and provide explanatory comments:

Government?

- Release funds on time
- Provide information policy guidelines
- Ensure clear link between ministry of agriculture and ministry of finance and NARS
- Identify key actors (champions)
- Others:

Please choose one or more and provide explanatory comments:

ORGANIZATIONAL STRUCTURE (6)

15. How does the MIS support information and communication flow in and outside your organization?

-In your organization?

- Provides opportunity for back-to-office reports to be stored and used for reporting:
- In Staff bulletin
- Preparing annual reports
- Donor reports
- Internal communication
- Staff performance assessments
- Backbone for information for management decision-making
- Others:

Please choose one or more and provide explanatory comments:

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- Outside your organization?

- Backbone for organizational website publications
- Publications in journals
- Others:

Please choose one or more and provide explanatory comments:

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CRITICAL SUCCESS FACTORS (7)

16. What key factors have promoted and frustrated the institutionalization of a MIS in your organization?

Promoted?

- The Organization's awareness of its' information needs
- Availability of a champion for MIS
- Availability of funds for MIS
- MIS Implementation and Institutionalization team
- Donor support
- Government support
- Good Information management and sharing culture in your organization
- Technically good MIS

- A learning organization
- Availability of external MIS Consultant support
- MIS Training
- Availability of Computers and ICT infrastructure
- Others:

Please choose one or more and provide explanatory comments:

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Frustrated?

- Lack of top management support
- Researchers not interested in research administration
- Funding problems
- Organizational instability
- Lack of organizational policy for MIS
- MIS with technical problems
- Lack of Computers and ICT infrastructure
- Others:

Please choose one or more and provide explanatory comments:

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MANAGEMENT OF CHANGE (8)

17a. What were the main reasons for Researchers and Management resisting to use a MIS (INFORM-R or INFORM-R Light) in your organization?

- Bad experience with MIS in the past
- Power struggle among MIS implementers
- Transparency issues
- MIS too costly for the organization
- MIS is time consuming

- Researchers not interested in research administration
- Others:

Please choose one or more and provide explanatory comments:

17b. How did you solve the problem of resistance to change to use the MIS (INFORM-R or INFORM-R Light) in your organization?

- Forming an MIS Implementation and Institutionalization team
- Negotiating with staff and management about how to institutionalize the MIS
- Forcing staff to use the MIS
- Leading and Managing staff on MIS institutionalization
- Acquiring funds for the MIS Implementation and Institutionalization
- Raising Awareness among staff and management about MIS
- Introducing an MIS policy in the organization
- Changes in Incentives Systems
- Others:

Please choose one or more and provide explanatory comments:

18(a). What has to change for MIS to be institutionalized in your organization?

- Better understanding of the decision-making processes
- Adaptation of the MIS to suit your organizational research management processes
- A Web-based Management Information System needed
- Change in organizational culture towards Information management and sharing
- Government Support
- Donor support

- MIS Implementation Process
- MIS Institutionalization process
- A new champion needed
- Centralization of the MIS at headquarters should change to decentralization of the system to research stations.
- Power: Research stations should be given more powers to manage the system
- Budgeting for MIS at Station and national levels
- MIS policy needed
- Changes in Incentives Systems
- Others:

Please choose one or more and provide explanatory comments:

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18(b). Are you willing to make these changes?

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18(c). Are you able to make these changes? Yes ☐ No ☐

If yes, why haven't you done it?

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If no why?

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18d. If you are not able to make these changes, could someone also make these changes?
Who?

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What will be needed for them to make these changes?

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Thank you so much for completing this questionnaire. Your participation is highly appreciated.

Return to:
Mr. Hope Webber
hope.webber@wur.nl
Tel: +31-648373048

Annex 5: Fieldwork Activity Schedule

Zambia Activity Schedule

(6 – 11, January 2004)

Period	Activity description	Remarks
(Mount Makulu)		
Wednesday Jan 7, 2004	<ul style="list-style-type: none">▪ Meeting with SCRB (<i>Mount Makulu</i>) contact person▪ Discussion about the research and expectations▪ First round of interviews with Deputy Director, Head of Biometrics and MIS coordinator respectively.▪ Documenting findings and desk study▪ Group interview with researchers and support staff (at least 4 people)	
Thursday Jan 8, 2004	<ul style="list-style-type: none">▪ Meeting with Choma contact person▪ Discussion about the research and expectations	
Choma	<ul style="list-style-type: none">▪ Second round of interviews with institute director and MIS practitioner▪ Group interview with researchers and support staff▪ Documenting findings and desk study	

Period	Activity description	Remarks
Friday (<i>Kabwe</i>) Jan 9, 2004	<ul style="list-style-type: none"> Meeting with Kabwe contact person Discussion about the research and expectations Third round of interviews with institute director and MIS practitioner Group interview with researchers and support staff Documenting findings and desk study Final meeting with Director. 	No researcher was in this institute
Saturday Jan 10, 2004	<ul style="list-style-type: none"> Documenting findings 	
(Mount Makulu)		
Sunday 11, 2004	Travel to Tanzania	

Tanzania Activity Schedule
(11 - 18, January 2004)

Period	Activity description	Remarks
Dar es Salaam		
Monday Jan 12, 2004	<ul style="list-style-type: none"> Meeting with DRD contact person Discussion about the research and expectations 	

Period	Activity description	Remarks
Tuesday Jan 13, 2004 <i>Mpwapwa</i>	<ul style="list-style-type: none"> Travel to Mpwapwa Meeting with Mpwapwa Contact Person Discussion about the research and expectations First round of interviews with institute director and MIS practitioner Group interview with researchers and support staff 	
Wednesday Jan 14, 2004 Ilonga Morogoro	<ul style="list-style-type: none"> Meeting with Ilonga Contact Person Discussion about the research and expectations Second round of interviews with institute director and MIS practitioner Group interview with researchers and support staff (at least 4 people) Documenting findings and desk study 	
Thursday <i>Dar es Salaam</i> Jan 15, 2004	<ul style="list-style-type: none"> Interview with DRD MIS national coordinator Documenting findings and desk study 	
Friday Jan 16, 2004	<ul style="list-style-type: none"> Interview with Head of PM&E and MIS 	

Period	Activity description	Remarks
<i>Dar es Salaam</i>	<p>coordinator respectively.</p> <ul style="list-style-type: none"> ▪ Group interview with researchers 	

Uganda Activity Schedule

(19 - 25, January 2004)

Period	Activity description	Remarks
Entebbe		
Tuesday Jan 20, 2004	<ul style="list-style-type: none"> ▪ Meeting with NAROSEC <i>Entebbe</i> contact person ▪ Discussion about the research and expectations ▪ First round of interviews with Director General, Head of PM&E and MIS coordinator respectively. 	
Wednesday Jan 21, 2004	<ul style="list-style-type: none"> ▪ Documenting findings and desk study ▪ Group interview with researchers and support staff (at least 4 people) 	<i>Entebbe</i>
Thursday Jan 22, 2004	<ul style="list-style-type: none"> ▪ Meeting with NARI Contact Person ▪ Discussion about the research and expectations 	
Namulonge	<ul style="list-style-type: none"> ▪ Second round of interviews with institute director and MIS practitioner ▪ Group interview with researchers and support staff (at least 4 people) 	

Period	Activity description	Remarks
	<ul style="list-style-type: none"> ▪ Documenting findings and desk study 	
Friday	<ul style="list-style-type: none"> ▪ Meeting with KARI contact person 	
Jan 23, 2004	<ul style="list-style-type: none"> ▪ Discussion about the research and expectations 	
Kawanda	<ul style="list-style-type: none"> ▪ Third round of interviews with institute director and MIS practitioner ▪ Group interview with researchers and support staff (at least 4 people) ▪ Documenting findings and desk study ▪ Final meeting with Director General. ▪ 	
Saturday	<ul style="list-style-type: none"> ▪ Documenting findings 	
Jan 24, 2004		
Entebbe		

Ghana Activity Schedule

(26 - 31, January 2004)

Period	Activity description	Remarks
ACCRA		
Tuesday	<ul style="list-style-type: none"> ▪ Meeting with CSIR contact person 	
Jan 27, 2004	<ul style="list-style-type: none"> ▪ Discussion about the research and expectations ▪ First round of interviews with Director 	

Period	Activity description	Remarks
	General, Head of PM&E and MIS coordinator respectively.	
Wednesday Jan 28, 2004 Accra	<ul style="list-style-type: none"> ▪ Documenting findings and desk study ▪ Group interview with researchers and support staff 	
Thursday, Jan 29-30 2004 Kumasi	<ul style="list-style-type: none"> ▪ Meeting with Forestry Research Institute and Crop Research Institute contact persons ▪ Discussion about the research and expectations ▪ Second round of interviews with institute directors and MIS practitioners ▪ Group interview with researchers and support staff (at least 4 people) ▪ Documenting findings and desk study 	
Friday Jan 30, 2004 Kumasi	<ul style="list-style-type: none"> ▪ Meeting with Soil Research Institute contact person ▪ Discussion about the research and expectations ▪ Third round of interviews with institute director and MIS practitioner ▪ Group interview with researchers ▪ Documenting findings and desk study 	

Period	Activity description	Remarks
Saturday Jan 31, 2004	▪ Documenting findings	

Summary

Introduction:

Agricultural research management in the public sector in Sub Saharan Africa suffers from a lack of relevant, timely and accurate information on which to base decision-making. Developments in Management information systems over the past several years have been dramatic and can offer research managers in developing countries a great deal of help in the orderly capture, processing and presentation of information for decision-making. This thesis describes case study research on institutionalization of a MIS in National Agricultural Research Organizations in Sub Saharan Africa. Full MIS institutionalization is defined as the continuous and integrated use of MIS by NAROs' staff for data collection, and data processing into information and decision-making in NAROs' research management processes. The MIS software package INFORM (Information for Agricultural Research Management) was designed and developed by ISNAR (The International Service for National Agricultural Research) in the early 1990s in collaboration with developing countries' NAROs and implemented in several countries in Africa, Asia and Latin America.

The Problem Area and Research Goal:

The institutionalization of the latest version INFORM-R and INFORM- Light in the annual research management cycle of priority setting, planning, budgeting, monitoring, evaluation and reporting of Sub Saharan African NAROs was found to be inadequate. Issues such as data collection and use, adequacy of the MIS software packages, leadership, information management capacity, organizational structure etc. were initially considered as problem factors. The goal of the study is to get insight into factors affecting positively and negatively institutionalization and the continuous and integrated use and maintenance of the MIS in NAROs in Sub Saharan Africa. The objectives are fourfold: to

evaluate the extent of institutionalization, to identify factors that promoted (critical success factors) and frustrated (critical failure factors) institutionalization, to evaluate the contribution of MIS to agricultural research management, and to recommend a method of working for institutionalizing MIS.

The Approach:

Based on the goal and objectives, we attempted to answer three questions: (1) to what extent is MIS institutionalized in Sub Saharan African NAROs? (2) What key factors promoted (critical success factors) and frustrated (critical failure factors) institutionalization of the MIS in Sub Saharan African NAROs? (3) How does institutionalization of MIS improve research management and performance of Sub Saharan African NAROs? Based on our literature review, a causal model for MIS institutionalization was developed and used to design a questionnaire and face-to-face interviews in four countries (NAROs) in Sub Saharan Africa: CSIR Ghana, DRD Tanzania, NARO Uganda and ZARI Zambia. Quantitative and qualitative data were collected from managers and researchers in these NAROs. The quantitative data were analysed with SPSS (means, frequency, correlation and regression), and the qualitative data were analysed using (a self designed) MIS institutionalization database.

Research Products:

Regarding the question on critical factors of success and failure, we conclude that leadership involvement is the most important critical success factor that strongly and significantly correlates with institutionalization of MIS in Sub Saharan African NAROs. This implies that the more NAROs' leaders (especially the Director General, Permanent Secretary or Minister of Agriculture) get involved in the institutionalization of MIS, the greater the chance of success. Other critical factors such as adoption, adaptation, government support, ICT Infrastructure, organizational structure and culture, and transparency in information sharing also contribute to the success of institutionalization.

The major critical failure factors that frustrate institutionalization are lack of funds, user resistance to change and lack of MIS policy/strategy guidelines. Based on these results an impact model for institutionalization has been designed.

Considering the results of the question on how MIS improve research management, we conclude that MIS enables NAROs to organize their data and generate information for timely decision-making on their annual research management cycle. Annual reports generated from MIS improve NAROs internal performance, in terms of NAROs being able to show accountability, relevance and sense of continuity to their stakeholders and beneficiaries. Website publications generated from MIS improve NAROs external performance, in terms of NAROs being able to show their achievements to the world. With respect to the results of the question on the extents of institutionalization, we conclude that MIS is still not fully institutionalized in Sub Saharan African NAROs. Zambia and Uganda NAROs scored high while Tanzania and Ghana NAROs scored low. We therefore strongly recommend that the Zambian and Ugandan NAROs can serve as benchmarks of good practices to other NAROs in Sub Saharan Africa wishing to introduce MIS in their organizations.

Recommendations

Based on these conclusions, we recommend that the Director General, or Permanent Secretary or Minister of Agriculture (depending on the organization structure of a NARO) be the continuous champion of MIS in order to ensure full and continuous institutionalization of MIS in Sub Saharan African NAROs. The champion should:

- include MIS in their organizational vision and support MIS policy and strategy development in NARO,
- allocate special funds for MIS institutionalization,

- support and spearhead efforts to acquire funds from partners, donors, governments, and clients,
- participate in the stages of introduction, adoption, implementation, adaptation and institutionalization of MIS and encourage teamwork,
- support and finance the procurement of ICT infrastructure (especially Local Area Network) and connectivity of NARO headquarters with remote research stations,
- support MIS training (especially training of institute/station managers and program leaders,
- reward MIS coordinators and practitioners by promotion or higher degree training,
- ensure clear link between NAROs and ministries of agriculture and finance so as to enable funds to reach NAROs in a timely fashion.

Finally, the above-mentioned recommendations for a MIS champion and other useful recommendations for research managers at stations/institutes, governments (ministries of agriculture and finance), donors, MIS coordinators, and researchers, were used to design a flow chart model for planning and managing MIS projects in NAROs.

Samenvatting

Inleiding

Landbouwkundig onderzoeksmanagement in de publieke sector in Zuidelijk Afrika heeft te kampen met een gebrek aan relevante, tijdige en nauwkeurige informatie op basis waarvan besluitvorming kan plaatsvinden. In de afgelopen jaren zijn Management Informatie Systemen sterk tot ontwikkeling gekomen hetgeen voor onderzoeksmanagers in ontwikkelingslanden de weg heeft geopend tot het verkrijgen, verwerken en presenteren van goed gestructureerde informatie ter besluitvorming. In dit proefschrift wordt een case studie beschreven over de institutionalisering van een Management Informatie Systeem (MIS) in Nationale Onderzoeksinstituten voor de Landbouw (NAROs) in Zuidelijk Afrika. Volledige institutionalisering van MIS wordt gedefinieerd als het voortdurende en geïntegreerde gebruik van MIS door het onderzoekspersoneel van NAROs ten behoeve van het verzamelen en verwerken van gegevens tot informatie en besluitvorming in het onderzoeksmanagement proces. Het MIS software pakket INFORM (Informatie voor onderzoeksmanagement in de landbouw) is ontworpen en ontwikkeld door ISNAR (The International Service for National Agricultural Research) in het begin van de jaren negentig i.s.m. NAROs in ontwikkelingslanden en is in verscheidene landen in Afrika, Azië en Latijns Amerika geïmplementeerd.

Probleembeschrijving en doel van het onderzoek

De institutionalisering van de laatste versie INFORM-R en INFORM- Light in de jaarlijkse onderzoeksmanagementcyclus van prioriteitstelling, planning, budget opmaken, monitoren, evalueren en rapporteren in de NAROs van Zuidelijk Afrika is als onvoldoende bevonden. Onderwerpen als de verzameling en het gebruik van gegevens, geschiktheid van de MIS software pakketten, leiderschap, informatiebeheer capaciteit, organisatorische structuur etc. zijn in eerste instantie geïdentificeerd als probleem

factoren. Het doel van het onderzoek is om inzicht te verkrijgen in de factoren die de institutionalisering en het voortdurende en geïntegreerde gebruik en onderhoud van MIS in onderzoeksinstituten in Zuidelijk Afrika positief en negatief beïnvloeden. De doelstellingen zijn vierledig: evaluatie van de mate van institutionalisering, identificatie van factoren die de institutionalisering stimuleerden (kritische succesfactoren) dan wel frustreerden (kritische faalfactoren), evaluatie van de bijdrage van MIS aan onderzoeksmanagement en de aanbeveling van een werkmethode voor de institutionalisering van MIS.

De Aanpak:

Gebaseerd op hoofd en subdoelstellingen, hebben we getracht drie vragen te beantwoorden: (1) In welke mate is MIS geïnstitutionaliseerd in onderzoeksinstellingen in Zuidelijk Afrika? (2) Welke sleutelfactoren vormden een stimulans (kritische succesfactoren) dan wel een frustratie (kritische faal-factoren) voor de institutionalisering van MIS in onderzoeksinstellingen in Zuidelijk Afrika? (3) Op welke wijze wordt het onderzoeksmanagement en de prestatie van nationale onderzoeksinstituten verbeterd door de institutionalisering van MIS? Uitgaande van ons literatuuronderzoek, is een oorzakelijk model ontwikkeld voor de institutionalisering van MIS en gebruikt om een vragenlijst en persoonlijke interviews op te stellen voor vier landen (NAROs) in Zuidelijk Afrika: : CSIR te Ghana, DRD te Tanzania, NARO te Uganda en ZARI te Zambia. Kwantitatieve en kwalitatieve gegevens zijn verzameld bij managers en onderzoekers in deze onderzoeksinstellingen. De kwantitatieve gegevens zijn geanalyseerd met SPSS (gemiddelden, frequentie, correlatie en regressie), en de kwalitatieve gegevens zijn geanalyseerd middels een (zelf ontworpen) MIS database voor de institutionalisering van MIS.

Onderzoeksproducten:

Wat betreft de kritische succes- en faalfactoren is de conclusie dat de betrokkenheid van leidinggevendenden de belangrijkste succesfactor is met een sterke en significante correlatie met de institutionalisering van MIS in onderzoeksinstellingen in Zuidelijk Afrika. Dit betekent dat hoe groter de betrokkenheid van leidinggevendenden als de directeur-generaal, de staatssecretaris of de Minister van Landbouw bij de institutionalisering van MIS, hoe groter de kans op succes. Andere kritische factoren zoals adoptie, aanpassing, overheidsondersteuning, ICT infrastructuur, organisatie structuur en cultuur, en transparantie van kennisdeling (of kennisuitwisseling), hebben ook bijgedragen tot het succes van institutionalisering. De belangrijkste kritische faalfactoren die de institutionalisering van MIS frustreerden waren het gebrek aan financiële bronnen, weerstand tegen verandering bij gebruikers en het gebrek aan MIS handleidingen voor beleid en strategie. Gebaseerd op deze resultaten is een impact model ontwikkeld voor institutionalisering.

Wat betreft de resultaten van de vraag hoe MIS onderzoeksmanagement heeft bevorderd, kunnen we concluderen dat MIS NAROs in staat heeft gesteld hun gegevens te organiseren en informatie te genereren voor tijdige besluitvorming in hun jaarlijkse onderzoeksmanagement cyclus. Jaarverslagen die gegenereerd zijn middels MIS hebben de interne prestatie van NAROs verbeterd doordat zij nu in staat zijn aan hun belanghebbenden en begunstigden inzicht te verschaffen over de financiële administratie, relevantie en continuïteit. Publicaties via de website die middels MIS zijn geproduceerd vormen een verbetering van de externe prestatie van NAROs, doordat wereldwijd bekendheid wordt gegeven van hun prestaties.

Wat betreft de resultaten van de vraag over de reikwijdte van institutionalisering kunnen we concluderen dat MIS nog niet volledig is geïnstitutionaliseerd in onderzoeksinstellingen in Zuidelijk Afrika. De onderzoeksinstellingen in Zambia en

Uganda scoorden hoog terwijl die van Tanzania en Ghana laag scoorden. Het wordt daarom sterk aanbevolen dat de onderzoeksinstellingen van Zambia en Uganda een voorbeeldfunctie innemen van goede praktijken ten opzichte van andere instellingen in Zuidelijk Afrika die MIS willen introduceren in hun organisatie.

Aanbevelingen

Gebaseerd op deze resultaten luidt de aanbeveling dat de Directeur Generaal of de staatssecretaris of de Minister van Landbouw (afhankelijk van de organisatie structuur van de NAROs) de trekker wordt van MIS om de volledige en voortdurende institutionalisering in onderzoeksinstellingen in Zuidelijk Afrika te verzekeren. De trekker moet zorgdragen voor:

- de inkapseling van MIS in de visiebepaling van de organisatie en ondersteuning geven aan de ontwikkeling van MIS beleid en strategiebepaling in NAROs,
- de toewijzing van specifieke fondsen voor de institutionalisering van MIS,
- de ondersteuning van pogingen fondsen te acquireren bij partners, donoren, overheden en cliënten en hierop vooruit lopen,
- zijn participatie in de verschillende stadia van introductie, adoptie, implementatie en institutionalisering van MIS en het bevorderen van teamwork,
- de ondersteuning en financiering van ICT infrastructuur (met name Local Area Network) en de bereikbaarheid van het NARO hoofdkwartier met afgelegen onderzoeksstations via het netwerk,
- de ondersteuning van MIS trainingactiviteiten (met name training van managers en programmaleiders van de instituten),
- de beloning van MIS coördinatoren en trainers met promotie of een training op hoger niveau,
- duidelijke lijnen tussen nationale onderzoeksinstituten en Ministeries van Landbouw en Financiën zodat subsidies de NAROs vlot bereiken.

Tenslotte zijn de aanbevelingen zoals hiervoor beschreven voor een MIS trekker en andere bruikbare aanbevelingen voor onderzoeksmanagers op stations/instituten, voor regeringen (Ministeries van Landbouw en Financiën), donoren, MIS coördinatoren en onderzoekers, gebruikt om een stroomlijnenkaart model te ontwerpen voor de planning en management van MIS projecten in NAROs.

Completed Training and Supervision Plan

During the period of appointment a minimum of 20 credits educational program within Mansholt Graduate School (MGS) was completed. One credit is equivalent to 40 hours of course work.

Table. Educational program completed by Hope Webber

Name of the course	Department/Institute	Year	Credits
<i>I. General part</i>			
Social Science Research Methods.	Mansholt Graduate School	2001	1
Techniques for Writing and Presenting a Scientific paper	Mansholt Graduate School	2002	1
Research Design and Conducting PhD Research.	Mansholt Graduate School	2002	2
Subtotal part I (max. 6 credits)			4
<i>II. Mansholt-specific part</i>			
Mansholt Introduction course.	Mansholt Graduate School	2002	1
Mansholt Multidisciplinary Seminar.	Mansholt Graduate School	2003	1
Other presentations at (international) conferences.	CERES Summer School: Presentation.	2002	2
	ISNAR Workshop on web-based MIS.	2003	
	Mansholt PhD day Presentation.	2004	
Subtotal part I (min. 2, max. 6 credits)			4
<i>III. Discipline-specific part</i>			
Advanced Course on development concepts: Development of Development theory.	CERES –ISS The Hague	2003	4
Philosophy and Methodology of Social Sciences.	CERES – ISS The Hague	2002	5
Management of Change.	Communication and Innovation Studies. Wageningen University.	2003	4
Governance crossing borders.	Mansholt Graduate School.	2003	3
Information Systems.	Information Technology: Wageningen University	2003	
A Practical course on methodology of fieldwork.	CERES – Utrecht/Nijmegen Universities	2003	1
Subtotal part III (min. 9 credits)			17
Total (min. 20 credits)			25

About the Author and Recent Publications

Hope Webber is currently a consultant on web-based Information Systems at the African Economic Research Consortium in Nairobi Kenya and Regional Advisor on Information Technology for the Bio-safety Clearing House (BCH) project at the United Nations Environment Program (UNEP) Geneva. He is also a MIS Consultant at FAO (specifically developing agricultural sector monitoring and evaluation system and capacity building for the ministry of agriculture in Botswana). Hope has working experience in several organizations both in developed and developing countries. He has seven years experience working as a Project Manager on Management Information System at ISNAR in The Hague. In this position, he was responsible for managing and leading the development, implementation and institutionalization of INFORM-R and INFORM-R Light and recently web based MIS (Web-MIS) for agricultural research management in developing countries. He was also responsible for managing people, fund raising, organizing cross-country workshops, producing and disseminating publications, training of policy makers, managers, researchers, ICT specialists, and Librarians from NARS in Asia, Africa, Latin America and Europe. He worked closely with directors and MIS specialists in Zambia, Tanzania, Uganda, Mozambique, and Ghana. From 1999 - 2001 he worked as part time Policy Officer with the Dutch research council: NWO-WOTRO (The Netherlands Foundation for the Advancement of Tropical Research). Hope has agricultural research background at Plant Research International (former centre for plant breeding and crop reproduction -CPRO-DLO) in Wageningen, The Netherlands, where he worked as a plant breeder.

In terms of education, Hope obtained his first M.Sc. degree in Agronomy with specialization in Tropical and Subtropical Agriculture, from the Agricultural University Plovdiv - Bulgaria. In 1997 he obtained his second M.Sc. degree in Plant Breeding and Crop Protection with an orientation in Molecular Biology from Wageningen University

and Research in the Netherlands. Additionally he took postgraduate computer courses, such as advanced databases, object oriented programming languages at the technical informatics department of Delft University in The Netherlands. He completed the Mansholt Graduate School PhD training and supervision plan (see above) and in addition did the following courses: Introduction to Management, Advanced Management, and Introduction to Marketing, Advanced Marketing, and Communication. He has knowledge of many languages for example Dutch, French, Greek, Bulgarian, and Russian. He served as elected staff council member of ISNAR and enjoys singing at the British choir in The Hague. Hope was born in Ataba, Rivers State in Nigeria.

Recent Publications:

1. Co-author of ISNAR's recent book: Knowing where your going: Information Systems for Agricultural Research – Vernon (2001)
2. Training and Implementation of Management Information System in National Agricultural Research Organization in Zambia, (2000). ISNAR country report
3. Training and Implementation of Management Information System in National Agricultural Research Organization in Uganda, (2002). ISNAR country report
4. Biotechnology in African Agricultural Research: Opportunities for Donor Organizations. Komen, J; Webber, H.; Mignouna, J. / ISNAR, 2000.
5. Institutionalization of Information Systems in National Agricultural Research Organizations, (1999). ISNAR discussion paper.
6. Webber, H., Beulens, A.J.M., Hofstede G.J., (2006). Improving Research Management: Institutionalization of Management Information Systems in National Agricultural Research Organizations in Sub Saharan Africa. (Submitted to the 7th international Chain Conference in AgriFood Chains and Networks).
7. Webber, H., Setsofia, K., Beulens, A.J.M., Hofstede G.J., (2006). Institutionalization of Management Information Systems: The case of the Council for Scientific and Industrial Research Ghana. (in progress).

8. Webber, H., Kasuga, R., Banzi, J., Beulens, A.J.M., Hofstede G.J., (2006). Institutionalization of Management Information Systems: The case of the department of research and development of the ministry of agriculture Tanzania. (in progress).
9. Webber, H., Baguma, S.D., Beulens, A.J.M., Hofstede G.J., (2006). Institutionalization of Management Information Systems: The case of NARO Uganda. (in progress).
10. Webber, H., Simumba, D., Beulens, A.J.M., Hofstede G.J., (2006). Institutionalization of Management Information Systems: The case of Zambia Agricultural Research Institute. (in progress).

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