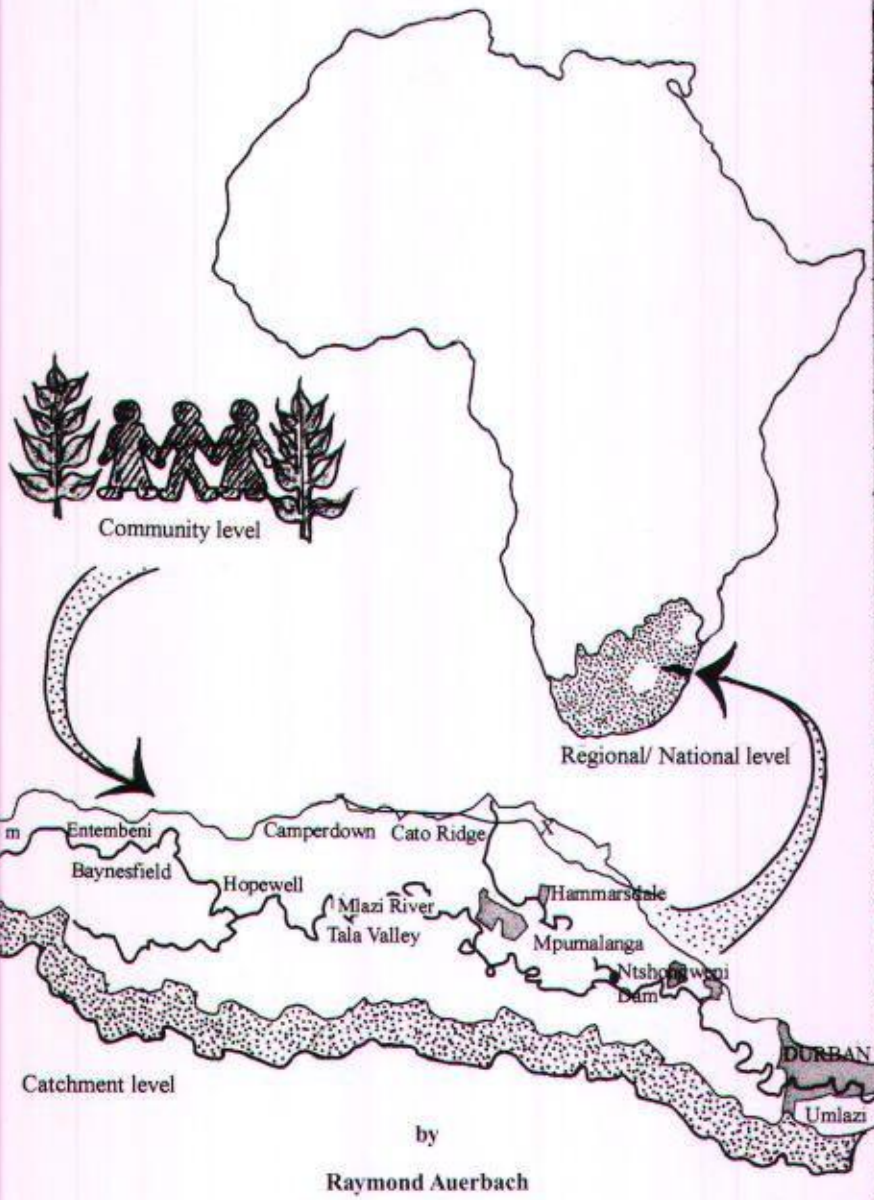
# DESIGN FOR PARTICIPATION IN ECOLOGICALLY SOUND MANAGEMENT OF SOUTH AFRICA'S MLAZI RIVER CATCHMENT




by

**Raymond Auerbach**

# PROPOSITIONS

1 Harvesting rainwater from mountains and roads and using wetlands to purify and store the water is an effective method for converting a soil erosion hazard into a productive resource (This thesis).

2 Managing conflict in KwaZulu-Natal requires independent facilitation, leading to joint problem appreciation by diverse stakeholders; collective management of natural resources requires such a platform building process together with research into local ecosystems and development options, and assistance with pilot activities (This thesis).

3 Through an environmental education process leading to the development of a catchment identity, people living within a particular catchment area can become more aware of their common dependence on the river, and thus be mobilised to care for their catchment as responsible residents and resource managers (This thesis).

4 Subcatchment committees backed by a process of participatory action research do stimulate public reflection. It is at this local subcatchment level that appropriate institutions can develop, bringing diverse groups together (This thesis).

5 Designing is a legitimate field of scientific endeavour, but unless the design process helps the intended beneficiaries to explore the benefits of innovations through an interactive process of discovery learning, the impact of designs for a desired future are likely to be small (This thesis).

6 In terms of philosophical approaches towards development, logical positivism is a dualistic approach (observer: observed) appropriate for technical, production-oriented development; constructivism brings a pluralistic approach (many varied observers) which is more suitable for social processes aimed at sustainable production; monism (one reality: consciousness itself) requires an understanding of the unity behind physical and social diversity and contributes towards ethical leadership. Consciousness alone is universal and unchanging, and transcends discursive thinking (This thesis).

7 While Farming Systems Research is a methodology which can improve understanding of the constraints under which farming families operate, relieving these constraints requires a combination of technological, social and ethical elements, combined with the political will to support progressive change (Auerbach, 1993: *A farming systems research evaluation of maize production practices in southern KwaZulu*. Natal University; van Eijk, 1998: *Farming Systems Research and Spirituality: An analysis of the foundations of professionalism in developing sustainable farming systems*. PhD thesis, Wageningen University).

8 The old Chinese saying "Give a man a fish and you feed him for a day; teach a man to fish and you feed him for many days" advocates the transition from aid to self-help education, but can lead to short-term resource exploitation. Sustainable management requires a process of learning with others about aquatic ecosystems, and requires awareness and integrative capacity as well as strength and steadiness. This can result in networking with other fishers around the global village, and can be lots of fun.

9 *Umuntu ngumuntu ngabantu* ("A person derives humanity from other people" - Zulu definition of the African concept *ubuntu* - human-ness).

Raymond Auerbach, 29th June 1999.

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**by**

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## DEDICATION

To Christina

In thanks for your clear perception, your honesty, and your commitment to finding a way to uplift those around you. In my weak moments, you always urge me to put pettiness aside, and to move in a larger, more universal world. You help me to hear the beauty of music and to see the artistry in humanity and nature.

May we live and love and laugh together for many more years.

## Mandukya Upanishad

All of this creation is Ôm.
The past, the present, the future is Ôm.
All that is beyond the three periods of time, that too is Ôm.

The word Ôm has four quarters:
The waking state with attention turned outwards to the gross physical is called Waíshwanara.
The dream state with attention turned inwards to the subtle mental world is called Taíjasa.
In deep sleep, the sleeper sees no dream, has no desire, is a mere mass of consciousness;
That state is Prájna, the inner director, controller of all.

The fourth state is Turíya, which transcends all.
Not conscious of the inner world, not conscious of the outer world, not conscious of both of these together, not a mere mass of consciousness, not simply conscious, not unconscious.
Unseen, beyond argument, beyond the grasp of the senses, beyond inference, beyond thought, beyond all empirical observation; knowable only through union with the one Self of all;
Total peace, total well-being, total unity (*adwaita*); this is the Self, and this is to be known.

(Extracts from first half of the Mandukya Upanishad, translated from the Sanskrit by Raymond Auerbach, with reference to the Commentaries on Eight Upanishads, Volume Two, Shankarāchārya, 1990).

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My family for their tolerance and support.

## LIST OF ABBREVIATIONS

| | |
|---|---|
| AFSRE | Association for Farming Systems Research and Extension (International) |
| ANC | African National Congress |
| CMR | Christelike Maatskapelike Raad (Chrsitian Social Services) |
| DMEPI | Durban Metropolitan Environmental Policy Initiative |
| D'MOSS | Durban Metropolitan Open Space System |
| FSG | Farmer Support Group, University of Natal, Pietermaritzburg |
| KDA | KwaZulu Department of Agriculture (now merged into the KZN Department) |
| KZN | KwaZulu-Natal Province, South Africa |
| ICM | Integrated Catchment Management |
| IFP | Inkatha Freedom Party |
| ITTO | International Tropical Timber Organization |
| NCMP | Ntshongweni Catchment Management Programme |
| OWLC | Durban Outer West Local Council |
| PAR | Participatory Action Research |
| PRA | Participatory Rural Appraisal |
| RTWG | Regional Technical Working Group, KZN Department of Agriculture |
| UND | University of Natal, Durban Campus |
| UNP | University of Natal, Pietermaritzburg Campus |
| WAU | Wageningen Agricultural University and Research Centre |

## NOTE ON isiZULU ORTHOGRAPHY

The Zulu language (isiZulu) uses concords both before and after nouns and verbs to indicate their grammatical function in a sentence (number, person, conjugation/ declension and relationship). In place names, a prefix often denotes the locative case (denoting where something is located, eg kwaZulu - the home of the Zulus, eZakhiweni - at the place of building, eMlazi - at the Mlazi River or the place called UMlazi). I have used capitals both in the Initial letter and the root letter to give a sense that these are proper nouns (thus KwaZulu and EZakhiweni) although opinions are divided on the correctness of this procedure. I have also used the Zulu root forms of the names of rivers (thus Mgeni and Mlazi Rivers) as Umlazi in particular could be confused with the Umlazi Township.

## EXCHANGE RATE

On 5th May 1999, one United States Dollar cost South African Rand 6.06.

US$1.00 = R6.06

## PREFACE

This thesis analyses five years of work on the Ntshongweni Catchment Management Programme, one of the programmes of the University of Natal's Farmer Support Group, which is funded by the South African Water Research Commission (contract K5/866).

The University of Natal is committed to serving the needs of all residents in the province of KwaZulu-Natal with appropriate research and outreach programmes (University of Natal, 1989). Although we cannot hope to reach everyone directly, our action research and our practical approach to experiential learning are helping to train rural resource people (for example, through our School for Rural Community Development). Some of our successful initiatives are informing national and provincial policy development, so that more effective approaches are being incorporated into the restructuring which is underway within the government agricultural research and extension services (Farmer Support Group, 1993).

The Farmer Support Group is an innovative service organisation of the University of Natal. We serve farmers with limited resources, including women and the poor. We help them to improve their lives by:

- managing natural resources in a productive and sustainable way;
- developing capacity for collective action; and
- gaining access to resources.

The Goal which the South African Water Research Commission gave to the Ntshongweni Catchment Management Programme (NCMP) is to develop a framework for community participation in catchment management in South Africa.

The Programme Objectives are to:

1. Assist local people in implementing ecologically and economically sound land use practices.
2. Help build the institutional capacity needed for informed local control of the planning and exploitation of natural resources in the catchment.
3. Help appropriate agencies to understand local people's current attitudes to the catchment and its resources, and help the agencies to develop education programmes which will improve aspects of catchment management.
4. Monitor biophysical factors such as water and vegetation, and also monitor participation of people in the management of selected areas of the catchment in order to evaluate the effectiveness of the programme, and to plan future interventions on a catchment-wide scale.

In addition to the practical activities in the catchment which the programme will undertake and support, the programme is to produce a scientific report on a framework for community participation in integrated catchment management (community participation to be considered at the individual, local, provincial and national levels of decision-making). This thesis forms the basis of the scientific report.

In 1994 I discussed the need for an integrated catchment management programme with my colleagues, local resource managers and residents. Initial talks led to a programme proposal to the Water Research Commission, and a request for seed funding to Umgeni Water (the water management agency for central KwaZulu-Natal). Seed funding led to a key informant survey and a workshop in November 1994, bringing together community leaders, resource managers and planners. Subsequently the pamphlet "Do you care about your catchment?" was distributed to decision makers in the area. This pamphlet explained the extent of the Mlazi River catchment, its main problems (as identified during the workshop) and some strategies for bringing people together to plan and manage resource use in the catchment. The approval of the Pilot Phase of the proposal (1995-96) meant that four staff members were appointed: a coordinator, a development facilitator, an agricultural facilitator and an ecologist. Funds were available in mid 1995, and two community gardens, a craftwork group and an Environmental Forum were started in the first eighteen months, and an existing research project into riverine vegetation and open space management was continued with project funding. Communication networks and community consultation processes were started.

The success of the Pilot Phase led to approval for a Consolidation Phase (1997-99). An environmental educator, a communications and publicity officer, a craftwork facilitator, a conservation consultant and an office manager were appointed, and later a second agricultural facilitator with extra funding from Mondi Forests. This inter-disciplinary team of ten (plus cooperating projects) continued working within the catchment, undertaking the following main activities for each of the six main land uses represented:

i small scale ecological agriculture and craftwork (developing a model for small scale commercial farming, applying aspects of the model to improving food security in community gardens which NCMP established with the Department of Agriculture, setting up craftwork groups to generate income for rural women while learning how to manage wetlands and other resources sustainably).

ii small holdings and conservancies (promoting ecological production and productive management of surface water through rainwater harvesting, wetland rehabilitation, water conservation and improved nutrient cycling).

iii large scale agriculture (together with the Umlaas Irrigation Board, promoting sound riverine management and wetland rehabilitation, thus promoting efficient water use).

iv commercial forestry (together with Mondi Forests and Baynesfield Estates, examining how to reduce the impacts of plantation forestry on availability if water, biodiversity decrease, and soil degradation, and developing social forestry activities which could give local communities the opportunity to develop collective resource management plans together with Mondi and Baynesfield and smaller commercial farmers).

v urban areas (together with the Durban Metropolitan Authorities, especially the Outer West Local Council, Umgeni Water and the Departments of Education and of Health, helping to develop an environmental ethic in the Mpumalanga Township through establishing conservancies, school environmental action clubs, urban community gardens and a public environmental forum).

vi industrial areas (together with the University of Natal's Pollution Research Group, the Durban Metropolitan Authorities and the Outer West Local Council and Umgeni Water, encouraging industrialists to decrease pollution emissions through improved management, and developing an environmental ethic in the Hammarsdale Industrial Area through establishing an industrial conservancy).

A series of design processes was undertaken, to develop appropriate strategies and tactics for the broad range of activities, and it was understood that a combination of technical and social designs would be needed. Work on rainwater harvesting, water conservation and nutrient cycling design had already been developed and tested privately on Bachs Fen Ecological Farm, which my wife Christina, my partner Mabuye Ngubane and I own, and steps were taken to quantify the effectiveness of this design.

Once the programme's Consolidation Phase is complete, an Institutionalisation Phase is planned (2000-04) which should see appropriate catchment management institutions established and the first iteration of a catchment management plan developed and implemented. The NCMP team believe that we should no longer be required after 2004, and we have developed the following vision based on our understanding of local needs:

## VISION FOR THE MLAZI CATCHMENT

By the year 2004 the people living in the Mlazi catchment will be ensuring that the river and its tributaries are respected and cared for. They will do this by:

* complying fully with the law as it relates to their own land use;
* keeping agriculture, forestry, industry and mining out of the riparian zone;
* reducing the levels of pollution being generated;
* recycling and treating those pollutants that are generated;
* setting appropriate water quality and pollution load standards;
* monitoring water and environmental quality to ensure compliance;
* building up a data base of river quality through regular biomonitoring;
* participating, through conservancies and sub-catchment committees.

Sustainable management of natural resources and training in appropriate skills will result in the abundance of nature increasing and supporting all those who live in the catchment. Local organisations will be capable of functioning without the support of NCMP. Local leadership will work towards a more sustainable environment which is able to support communities physically, socially and spiritually.

Black farmers will have improved access to high potential irrigated agricultural land, and will be producing commercially using ecologically appropriate farming systems. The land will be used productively and in an ecologically sound way by all land users, with increased access of poor people to enough land to ensure household food security in rural and urban areas. All land users will cooperate to ensure that there is adequate care, as well as knowledge and resources for sustained production.

The Mlazi catchment will be well integrated into the economy of a thriving Durban Metropolitan Area, for which it will provide nutritious food, well-managed natural open spaces and a range of enterprises, resources and services which will contribute to the well being of the region. Its rural residents will be fully involved in a vibrant economy including tourism, food production, eco-forestry and cottage crafts.

Structure of the thesis

The complexity of the NCMP activities is compounded by the range of different and nested levels of aggregation: commodity, field, farm, subcatchment and catchment), and activities at the various levels should be analysed without losing the connections between the various levels. For this reason, this thesis is divided into three parts: the first part presents the conceptual and contextual framework, the second part describes research activities, grouped together as four thematic case studies, and the third part draws out the lessons learned from NCMP activities.

The levels of operation are illustrated on the front cover, which was designed by Christina Auerbach, based on Andrew Campbell's illustration of the levels at which Landcare Australia operates (Campbell, 1994). The back cover is a reduced version of the biomonitoring map which was produced by Artworks for the March 1999 issue of the Mlazi River Catchment News, based on information collected by Barry Patrick and Angus Burns. The notes for this map are reproduced on the inside cover pages at the end of this book.

People are at the heart of catchment management, and this study draws together community participation at various levels with technical research at various levels, and finds that social values inform both participation and research. Integrating technical, social and spiritual aspects requires tolerance and dedication to democratic processes. It is appropriate that the final revision of this book took place between South Africa's Freedom Day (27th April) and Bevrijdingsdag in The Netherlands (5th May), 1999. Colonial history is common to both South Africa and The Netherlands, and yet both countries are wrestling with the meaning of freedom. South Africa on the brink of its second democratic election is striving for an African Renaissance based on freedom and justice, while The Netherlands, looking back at over fifty years of postwar history, grapples with the limits of freedom, and with growing intolerance in its multicultural society.

While the north has established an economic foundation which has virtually eliminated poverty, northern countries have to ask themselves about their indebtedness to the south, for resources which they have used, and for their record of human exploitation as well. But the south, too, cannot adopt the position of a sanctimonious "victim" of exploitation. Much of value has been learned from the north, and as my teacher the late Robert Mazibuko used to say, "Zulus should be proud of their cultural heritage as Zulus and as Africans; yet we must also acknowledge what is of value in the civilisations of other cultures, western and eastern, northern and southern, and be ready to abandon that within our culture which does not honour the creator of the universe - where one finds soil erosion, one inevitably also finds soul erosion. The new South Africa must come about in the hearts of South Africans".

# *PART ONE: CONCEPTUAL AND CONTEXTUAL FRAMEWORK*

Integrated catchment management is complex. Participation and leadership are not always easy to facilitate. South Africa at the brink of the new millennium is full of uncertainty and change, full of exciting possibilities and frightening memories. Policies have been developed to try to build a more just, more open and more innovative society. Some practical steps have been taken, but there is widespread impatience. Violence and crime have been a feature of South African society for many years, and they do not disappear overnight, but the experience of Africa and of other parts of the developing and the industrialised world have much to teach us. This book therefore begins by setting out the context for the work. The research question posed in Chapter One arises in a society in transition. The communities we work with have been traumatised, surviving first a civil war and then a prolonged drought. Yet this is not a story of hopelessness, or of failure.

It is the story of a participatory action research programme which has embraced uncertainty, and ventured into unchartered waters. The Ntshongweni Catchment Management Programme (NCMP) has met with a remarkable level of positive participation and engagement. We have also had our failures and our difficulties. In the writing of this book, I have been advised by some to give less attention to the difficulties, as a negative impression could be created in the mind of the reader. We have many positive stories to tell, many successes to report and analyse. And yet, it is precisely the difficulties which gave the greatest opportunities to learn. They are also probably more instructive to anyone seeking guidance in addressing practical problems of participation and sustainable development than a description emphasising only the successful aspects of the programme.

This first section, having posed the research question, describes some key events in the research journey, and then examines design as a methodology for exploring change. Not random change, but purposive change in a desired direction. This is a legitimate field for science, and involves examining a number of perspectives on design, and linking these to how we progressed as a participatory action research programme, but also to the issues, resources and policies which formed the contextual framework within which the programme exists.

## Chapter 1: INTRODUCTION AND RESEARCH QUESTION

Water in Africa is precious. We depend on our rivers and dams, and this book is about caring for them, but also about managing water which has not yet entered a river or dam. Creative use of this water can reduce soil erosion while increasing farm productivity. Traditionally soil conservation has concentrated on getting rid of stormwater safely, rather than using it productively. The rainwater harvesting techniques discussed use wetlands and swales to slow down and spread rainwater, and to promote infiltration. Technically this book is about rainwater harvesting, conservation and ecological agriculture in the context of integrated catchment management. However, in practical terms it is people who manage resources, so this book is also about people and communication, learning and collective action. Finally, it is about local leadership, for unless dynamic local people encourage collective action, sustainable natural resource management will not become a way of life in Africa.

The research question which this book addresses is "How can diverse communities often characterised by conflict, be helped to come together to learn about natural resources and systems, and to manage them collectively in a way which is productive and responsible?" This question is at the heart of South African agricultural development, water resource management, land reform and environmental education and conservation. Rural health both reflects and depends upon all of these together. The research question incorporates questions of scale (local, community, province, nation) and the difficulties of scaling up. It includes trade-offs that must be made between productivity, equity, stability and sustainability. As Conway (1994) points out, these four aspects cannot all be maximised simultaneously. Keeping a balance between product and process requires an understanding of "hard" and "soft" systems (Checkland, 1981, Röling & Wagemakers, 1998). The "hard" systems require technical understanding and adaptation to local needs, while the "soft" systems only exist to the extent that local people agree to work together.

Both types of system require design processes in order to synthesise available technology, human resources. This needs communication between various groups and interests, and social learning (Woodhill & Röling, 1998) which focuses on social actors at all levels. All people living or working in an area have a particular role to play, and an actor-oriented approach means basing investigation on actor-defined issues or "critical events", identifying relevant actors and moving from social drama to "critical event analysis" (Long, 1997). Although the "hard" systems lend themselves to a linear design process, where a clearly definable goal needs to be achieved efficiently in a simple system, complexity requires communication and learning, leading to negotiated strategies and collective action. Collective action requires some sort of vision for the future, and this in turn requires effective design processes which synthesise what is known about aspects of resource management into effective strategies and action plans. The programme described in this book uses participatory action research to investigate collective action in catchment management.

The NCMP has been working with land users in the Mlazi River catchment in South Africa's KwaZulu-Natal Province since 1994 (Box 1). The high rainfall areas in the eastern part of the country account for more than half of the total annual runoff of South Africa river systems, and the potential for developing participatory catchment management and linking these to rainwater harvesting systems in this area is particularly high (Figure 1).

**Box 1: The Ntshongweni Catchment Management Programme (NCMP)**

Ntshongweni lies above the Ntshongweni Dam, between Durban and Pietermaritzburg in South Africa's KwaZulu-Natal province. The dam (built in 1930) is 60 % silted up, and water is heavily polluted. The dam was the main source of water for Durban but it was decommissioned in 1992. Development activities started by Msinsi Holdings (who manage the dam and surrounding areas), helped to bring communities together into development committees, and form the Ntshongweni Liaison Forum. Having been asked for help early in 1994 by local gardeners at Ntshongweni, I worked through this forum, organising several meetings of interested people. Participants suggested that I should find funding, convene a workshop to identify problems and possible solutions, and then work closely with the communities concerned to develop a catchment-based approach.

In November of that year, a workshop was held (with seed funding from Umgeni Water) where social, technical and planning aspects were discussed and problems identified with local leaders and other stakeholders (Auerbach, 1994). Before this, in May, an initial participatory rural appraisal (PRA) exercise was held at Ntshongweni Dam where aspects of the history and farming systems of the area were analysed. Two weeks later, a follow up PRA workshop was held with Ntshongweni gardeners to identify resources and local priorities. A year of joint community action with the help of the local Department of Agriculture, resulted in the garden being enlarged and refenced. Vision building and participatory land use planning exercises were held there in May 1995 (Auerbach, 1996).

Subsequently, through cooperation with the Department of Agriculture, with Durban's Outer West Local Council and with the Department of Education (Mpumalanga Circuit), 18 community gardens, 5 craftgroups and 20 School Environmental Action Clubs were established. Later, conflict resolution committees and subcatchment committees were established. The NCMP team has helped redesign the Durban Metropolitan Open Space System, and helped to develop an Environmental Management System for Durban and an urban agriculture plan as part of the Outer West Integrated Development Plan.

The goal which the South African Water Research Commission set for the NCMP is to develop a framework for community participation in catchment management in South Africa (see Preface). The NCMP approach was partly based on rainwater harvesting and ecological farm design on Bachs Fen Farm in Peacevale and also drew on earlier practical work with community gardeners in KwaZulu-Natal. Programme activities developed from a request for help from a gardener at Ntshongweni. From individual level, we moved out to the local level, working with community gardens, with groups of commercial farmers, with schools and with local government. The thesis discusses this work, and its relevance to provincial and national water management, Landcare and rural development policy.

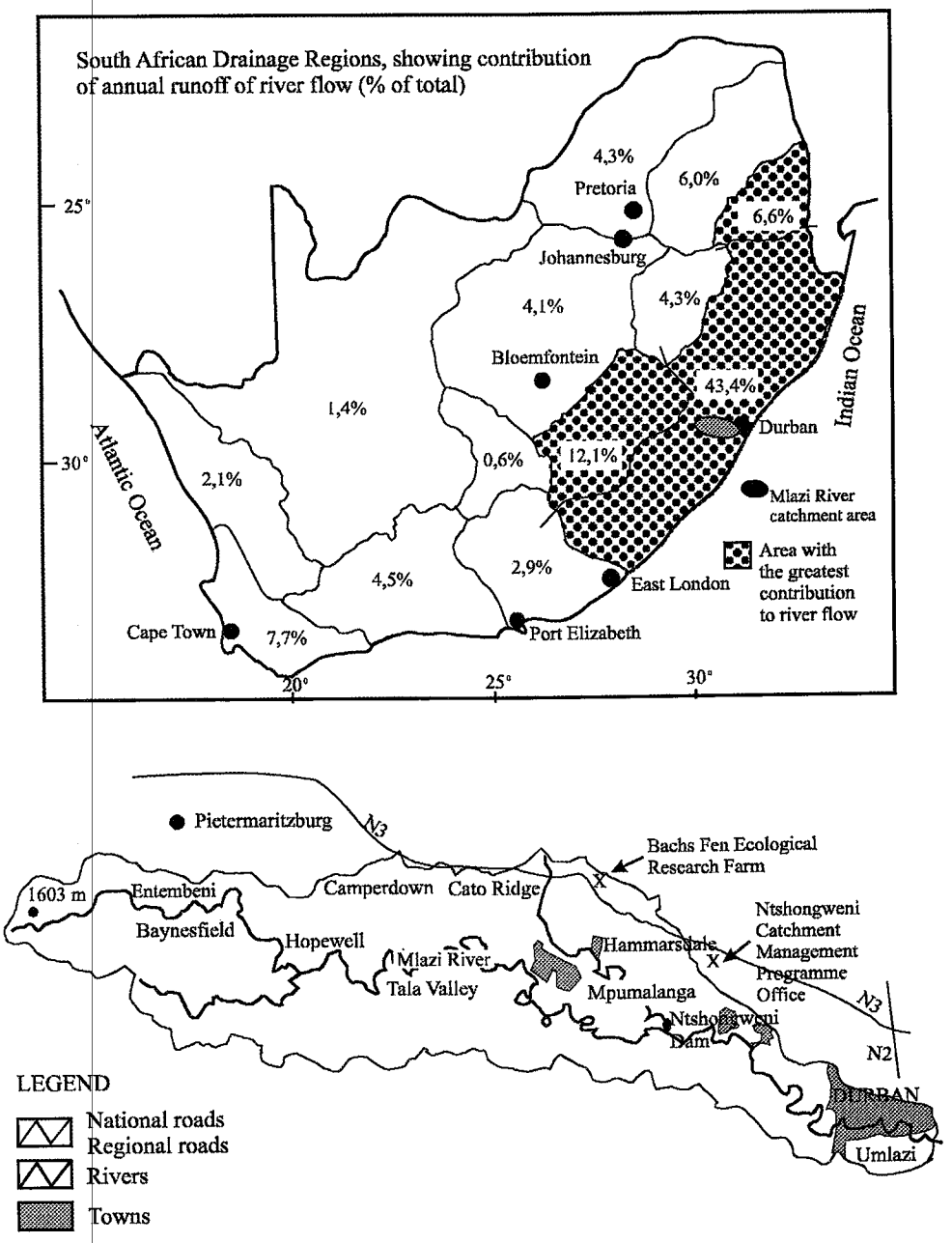



**Figure 1: South Africa, showing total annual runoff of the river systems (Backeberg *et al.*, 1996) and the Mlazi River catchment area.**

The 1998 South African Water Bill (Act 36 of 1998) provides for catchment management committees as part of the practical machinery of caring for our water resources. Although the Department of Water Affairs and Forestry faces the enormous responsibility of managing the country's water resources, it is hoped that this thesis will show that the people of South Africa are willing and often able to assist in this process. Indeed, it cannot be done without their active involvement. The international Convention to Combat Desertification, Local Agenda 21 programmes, as well as the South African Landcare Programme (Department of Agriculture, 1999) and our new Environmental Policy (Department of Environment and Tourism, 1998) are based on this premise. The South African Government has recognised that it is not possible for any government to manage natural resources nationally. On the contrary, water resources must be managed at local level, with the active involvement of water users and local organisations. Integrated catchment management requires even more interactions and multi-disciplinary cooperation because catchment management includes much more than water management. Breen *et al.* (1995) say that resolution of conflict lies at the heart of effective river basin management. Although this requires the participation of civil society, government's proper area of responsibility is to ensure that the short term interests of individuals do not take precedence over the long term interests of society.

Caring for natural resources in Africa requires the full participation of landusers, individually and collectively, in sound landuse supported by responsible policy and efficient service delivery. With local people, the NCMP is developing a vision and supporting local leadership in the Mlazi River catchment in South Africa's KwaZulu-Natal province. Integrated catchment management (ICM) is an approach uniquely suited to the new South Africa; our history of social engineering to encourage separation makes it particularly important that future nation building is based on integration. All people need water, and our mutual dependence on rivers can unite us with a vision of clean and abundant water available to all.

Efficient production must be combined with equity and conservation to move towards more sustainable development. The relationship between these four concepts is illustrated in Figure 2. Production, equity and conservation are all important, but all have associated strong and weak points. Production technology is efficient in the short term, but often maximises production at the expense of people and the environment; socially supportive approaches promoting equity tend to take care of the poor, but are expensive and can result in degradation of the resource base if they are not well-supported technically; conservation is also expensive, and while it takes a long-term approach, it may also under-play the role of people and the need for productivity. All three perspectives need to be taken into account in order to move towards sustainable agriculture in the context of sustainable development. Röling & Jiggins (1998) comment "The institutional dimension of transfer to a more sustainable society is rapidly emerging as a crucial area of interest. If one recalls Conway's (1994) enumeration of policy goals (production and productivity, equity, sustainability and stability), one could say that most institutions serve production and productivity (factories), equity (labour unions) or stability (schools, police forces), but only few institutions have emerged to support sustainability. ..... Overcoming the social dilemmas inherent in managing natural resources in a sustainable manner places heavy demands on trust, on agreed upon procedures, on covenants among stakeholders, and on mechanisms for collective decision making".

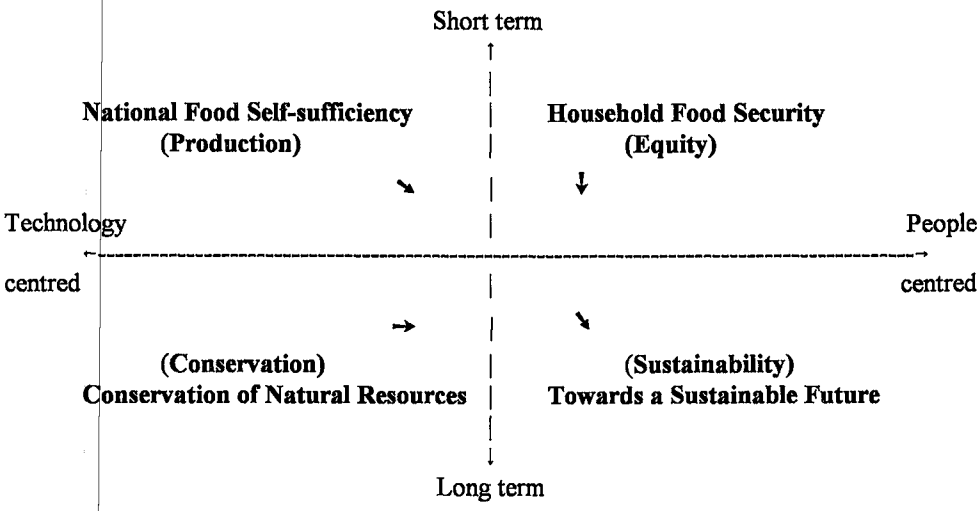



**Figure 2: Perspectives on agricultural development (Auerbach, 1994)**

Balancing short term individual interests (so important to wealth creation and the provision of efficient services) with long term measures to increase both productivity and equity of access to resources, investment in human and infrastructural development and conservation of the resource base is a mighty challenge. It cannot be done without South African citizens committing themselves to responsible behaviour as custodians and users of global resources through individual and collective action. We should all have access to earth, water, air, space and a place in the sun, but with our rights come responsibilities: we must care for these resources, which none of us made. Local leadership and education are thus key aspects of developing a vision for a future which is lawful, just and inspiring. Local institutions which support this process, it will be argued, are an important condition for supporting a move towards the emergence of effective Landcare and ICM movements in South Africa.

Addressing the research question (how to bring communities together to manage resources sustainably) required diverse strategies, which are reflected in the structure of this book. The process has been a research journey. Having been exposed to the problems of developing sound policy for land reform and equitable agricultural development, I set out to investigate with other people who live or work in the Mlazi River catchment what problems face the area, determined to learn together how to tackle these problems effectively (Chapter 2). Ecologically sound agriculture and forestry, nature conservation, effective use of water, development of replicable prototypes, these were all areas requiring design processes on a physical or technical level. Environmental education and communication required design on a more subtle or social level. Developing appropriate values and leadership required design at a causal or spiritual level. Design as a methodology is discussed in Chapter 3. The South African context, ICM, rainwater harvesting and the Mlazi catchment area, are described in Chapter 4. Four designs for aspects of participatory catchment management are then described, which are illustrated in Figure 3. All support the capacity of local people to manage natural resources sustainably.

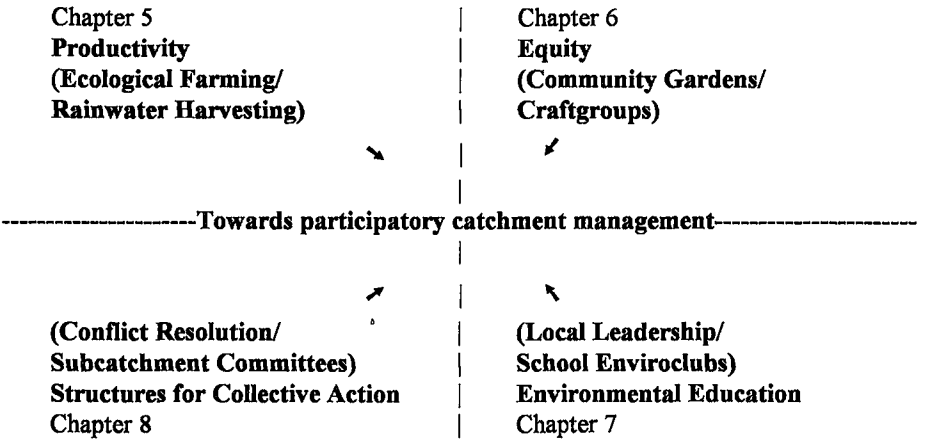



**Figure 3: Summary of main strategies employed to contribute to sustainable development in the Mlazi River catchment**

Initially, as local small scale farmers we designed and developed Bachs Fen Ecological Research Farm (Chapter 5). This formed a practical backdrop to the design and development of other local level activities in the catchment. Responding to a request for help from community gardeners in Ntshongweni led to a study of the range of farming systems in our area, and some practical suggestions about effective use of water and nutrients in ecologically sound community vegetable gardens. As the research programme developed, the NCMP team worked with the gardeners at trying out and adapting some of these ideas (Chapter 6). Work with local leaders, teachers and young people has led to the establishment of School Environmental Action Clubs and a range of monitoring and communication activities (Chapter 7). Interaction with the Umlaas Irrigation Board, the Entembeni community and Mondi Forests (South Africa) led to joint projects which included bringing together diverse and complex activities. This required the stimulation of a catchment identity through the development of platforms for resource-use negotiation. Subcatchment committees, conservancies and conflict resolution committees have developed to manage collective action. The process of bringing people together to discuss the management of resources in the catchment is described in Chapter 8. Finally, the lessons learned through our successes and failures are discussed in Chapter 9.

Every river catchment is unique, and even within a given catchment, there are many dynamic systems and inter-acting people, policies and events. There is action at farm or garden level, district level, subcatchment or catchment level and provincial or national level. Individuals respond to risk and to markets. We cannot hope to present a manual for catchment management. What I have done is to describe some aspects of our experiences over the past five years, in the hope that they will give some ideas to others who are wrestling with the complexities of farming, development and natural resource management. As a multi-disciplinary team of participatory action researchers we worked with local people to help them identify and address their problems; we also respected diversity within communities, and avoided imposing a theory of catchment management.

## Chapter 2: A RESEARCH JOURNEY

*Padam, padam, prātipadam; arharti iti prātipadikam.*

Step by step, at each step, there lies waiting, quite perfect, what is needed for that step.

This chapter is a personal account of my research journey over the past five years. Although the following chapters present data, sometimes technical and sometimes social, a programme which aims to promote community involvement in catchment management must respond to what is encountered. The fact that I, my wife Christina and my partner Mabuye Ngubane are ourselves farmers in the Mlazi River catchment influences the way we respond, and also influences the way people respond to us. Asian experience with catchment management suggests that both local leadership and an ethical or spiritual dimension are essential parts of successful catchment management (Sharma, 1997). Thus the myth of the objective scientist in the white coat, unaffected by the results of research is very far from the reality which I experience daily. I am part of local leadership in the catchment, as farmer and philosopher, as resident, rate-payer and researcher. I make no apologies for this fact, but it is important to document my situation, my values and some experiences which shaped the research programme.

### 2.1 Bachs Fen Farm

Having sold our dairy farm in Kokstad, we arranged to view a farm with an Estate Agent in 1991. Christina and I arrived with Dr and Mrs Bockemühl (who were visiting from Germany, and are involved with biodynamic agriculture, landscape design and forestry in Europe). When I saw that the farm had the N3 Highway as its southern boundary, I did not want to look at it at all. Living next to the freeway was not something I was prepared to consider.

And yet .... a small but interesting wetland; a hill and a freeway above, which could be used for rainwater harvesting; a farm located where it could serve as an education and research centre; the beautiful valley below; Key Ridge, the gateway to Durban, above; Cliffdale, centre of small scale Indian farming over the road; two strong boreholes with excellent water quality and quantity; seven hectares of land, just big enough to be a commercial farm, yet small enough to be relevant to local Zulu farmers.

The Bockemühls pointed out the possibilities of landscape development. The house was delightful, the small dairy well equipped, adequate shedding, reasonable soils; we decided to buy the farm. Priorities were tree planting and wetland development. Animal numbers were cut back, and invasive alien plants cut out of the wetlands. Coffee trees (1600), and an Oak Grove were soon planted, as well as 300 indigenous trees and bananas, paw-paws, avocados, litchis, mangoes, macademias (and elders around the compost area). Perennial herbs were planted, and swales, channels and later stilling ponds were constructed for rainwater harvesting. Mulches and compost conserved water and increased the water holding capacity of soils. Further details of farm development are given in Chapter 5.

## 2.2 MaShelembe asks for help

In 1978, I had worked as a Professional Officer for the KwaZulu Department of Agriculture. During this time, I had worked with Ntshongweni gardeners at the Hlanganani Community Garden, about 20 km from Bachs Fen Farm. I had also been involved in the area nine years later, when I joined the Institute of Natural Resources, and set up Nansindlela Research, Training and Demonstration Farm at nearby Inchanga. After the 1987 floods, I had managed the process of rehabilitating the community gardens in the Mpumalanga District, mainly near the Mgeni and Msunduze Rivers, which had been devastated by the floods (Auerbach, 1987).

Once I had completed my MSc research on maize production in southern KwaZulu farming systems in 1994, I visited some of the gardens to see how they were getting on. One of my first stops was Hlanganani Garden, where I met MaShelembe Ndimande, Chairperson of the garden committee. The garden was a mess. The fences were severely damaged, and goats were happily grazing on what few vegetables had been planted. MaShelembe asked for my help. The agricultural officer had been removed during the violence which had plagued Ntshongweni and nearby Mpumalanga Township during the 1980's. His house and office were still there, but the drought of the early 1990's had effectively prolonged the unproductive period, even though the historic Ntshongweni Peace Accord of 1989 (Zwane and Sibisi) and Mpumalanga Peace Accord of 1990 (Mlaba and Hadebe) had brought about an uneasy peace in the area. "Help us to replace the fence and expand the garden", she asked. "You can see that we are in a desperate situation". "Here are people who have suffered, but who have at least made the first steps towards reasonable co-existence", I thought. "It is important to help these people to rebuild their communities, and redevelop their agricultural production". I began a process of re-establishing communication with the Department of Agriculture's local Mpumalanga District Office. The KwaZulu and Natal departments had recently been merged, a process in which the Farmer Support Group (FSG) had been intimately involved.

Msinsi Holdings was already working very effectively with KwaZulu Training Trust to set up civil organisations in the communities around the dam. I worked with Steve Hulbert of Msinsi and Nonhlanhla Kunene of KwaZulu Training Trust to understand farming systems and development efforts in the area. It became clear that there was a great need for reconstruction and development, and my experiences with policy development, although exciting, had led me to believe that it was essential that some practical work should be undertaken to show what was meant by participation, ecological agriculture, empowerment, gender sensitive farming systems research and extension, and participatory land use planning. I set about consulting with local farmers and leaders, and those involved in infrastructural development, to see whether we could work together on an integrated catchment management programme.

## 2.3 Reconstruction and development

At this time the FSG had been working with the African National Congress (ANC), and later with the new government on appropriate approaches to agricultural extension and natural resource management (FSG, 1994; LAPC, 1994; Department of Agriculture, 1995). Our work contributed to the development of agricultural policy for the ANC which was included in the Reconstruction and Development programme (African National Congress, 1994), and later the national White Paper on Agricultural Policy (Department of Agriculture, 1995). We had also been broadening the training base for South African participatory rural appraisal activities (PRA) through training courses, notably that at Stoffelton, in the upper Mkomazi River catchment. Input from Professor Niels Röling and James Mascarenhas into extension thinking and PRA respectively were seminal at this stage (Röling, 1988; Mascarenhas & Pretty, 1991). Röling's approach can be summarised as moving away from technology transfer ("doing to" farmers) and diffusion of technology ("doing for" farmers), towards participatory approaches ("doing with" farmers). Jimmy Mascarenhas facilitated the Stoffelton PRA training workshop, which trained many of those currently active in training others in this field in South Africa today (Participants, 1993).

The FSG was made up of practical farmers and scientists with rural development experience and a commitment to more equitable and sustainable agricultural production. Its mission as a service unit of the University of Natal is to serve resource poor farmers including women and the poor, by helping them to manage natural resources more sustainably, helping them to develop the capacity for collective action, and helping them to access resources. Bachs Fen Ecological Research Farm became a resource for local people in the Mlazi River catchment, where it was located, and the NCMP developed in tandem with the farm, as local farmers innovated and responded to the challenges of the local environment.

Our approach at FSG had been deeply influenced by Professor Richard Bawden, who had evaluated FSG before I joined the organisation, and recommended the adoption of a participatory action research (PAR) approach, based on an understanding of soft systems (Checkland, 1981, Putnam, Argyris & Smith, 1985, Bawden, 1995, Röling & Wagemakers, 1998). Bawden also reviewed the outreach activities of the University of Natal at the request of the university's senior management, and has since been involved in a process of helping the university to become a learning organisation (Bawden, 1993). His analysis of FSG was that the organisation was strong on practical outreach activities, but weak on reflecting on the significance of the practical work for rural development in general. He recommended to FSG that they should strengthen their understanding of the systems approach, and suggested that they should work with me on this. I was subsequently invited to join FSG as Research Coordinator.

## 2.4 A vision on Cliffdale Hill

At FSG, I was asked to take on our catchment management programme at Stoffelton, in the Upper Mkomazi River catchment. I was reluctant to do this, as I did not know the area, and it was some 150 km distant from our farm. I did not wish to be a "rural development tourist" (Chambers, 1983), visiting an area for a couple of hours, giving some technical advice which might well be inappropriate, and driving home again. I wanted to bring together my practical ecological farming on Bachs Fen and a rigorous participatory action research approach. My

brother David had earlier written a thesis entitled "Towards an ecology of education" (Auerbach, 1972) in which he argued that the word ecology means "knowledge of the home environment", and that unless education helps students to understand their home environment, it runs the same risks as a medical science which has become divorced from the *materia medica*, and thus prescribes drugs which address symptoms, rather than understanding what is needed for a cure.

I had left the Institute of Natural Resources because I had not been able to bring together environment and development in my work there, and now it seemed the same fate was overtaking me at FSG. Practical work with ecological farming systems at home, and professional work advising on fertilisers and poisons would continue to be inevitable. Colleagues at FSG were addressing the practical, short-term needs of client farmers, and were sceptical about the value of research, while research colleagues in the Faculty of Agriculture were sceptical about the scientific validity of participatory action research. Farmers (large scale and small scale) remained sceptical about the value of most extension and research activities, many of which they saw as impractical work by people who were out of touch with the realities of problematic input supply, expensive credit and an erratic market-place.

I walked over the farm one day, and took the route through the tunnel under the N3 Highway, and up the Cliffdale Hill, so that I could have an overview of water harvesting activities on the farm. As I sat on the hill reflecting on the above issues and gazing out to the north over Bachs Fen, I became aware of some of the "other realities" which I could see from there . Away to the south-east lay Ntshongweni, where MaShelembe Ndimande and her gardeners lived with very few resources, a lower rainfall and thus a high-risk situation for rainfed crop production, and all the problems associated with smallholder agriculture in a resource-poor situation. To the east lay the rapidly-growing Durban Metropolis with all its environment and development problems, and a small but dedicated band of environmental managers and urban planners who were trying to conserve some open space. They were also trying to improve the quality of the environment in Durban's southern industrial basin where half a million people live with severe air, noise and water pollution problems. To the south-west lay the Hammarsdale industrial area, where uncontrolled industrial development had been encouraged by the *Apartheid* regime, as part of an industrial decentralisation policy designed to keep black people out of the cities. Immediately below me was the Cliffdale area, farmed mainly by Indian farmers, who had brought much of the diversity and innovation of India with them when they came to South Africa several generations ago. To the west lay the rich irrigated commercial farmland of the Tala Valley, Killarney Valley and Baynesfield, with the extensive forestry plantations of Mondi Forests and others.

I was looking at a microcosm of South Africa. Almost all of the problems of South African development, both urban and rural, occur in the catchment of the Mlazi River. Not only that, but I am part of this catchment. I live here, and I know something about agricultural production in this area, I thought with growing excitement. This is the place where I can practice ecology, "knowledge of the home environment", while farming practically, helping others to farm, carrying out participatory action research and innovating together with my neighbours. Such is the power of a mountain, which gives those who are prepared to climb it a broader view of the world. My reality as a farmer-researcher was supplemented by other views, that of the resource-poor smallholder, the commercial farmer, forester, industrialist and urban planner. Inasmuch as I could appreciate their view points, it was possible to see a bigger picture of how collective action could lead to sustainable development in the Mlazi River catchment.

## 2.5 Dinner with Professor Niels Röling

A few weeks later, having completed a provincial consultation process on the future of agricultural research and extension in South Africa, FSG organised a National Workshop on Agricultural Extension Systems for South Africa (FSG, 1994). After this workshop, participants had a farewell dinner together. I had the good fortune to sit next to Professor Niels Röling, whose work (Röling, 1988) had profoundly influenced my approach to research for my MSc thesis on Zulu farming systems (Auerbach, 1993). We discussed the future requirements for sustainable rural development in South Africa. I explained to him what we were doing on Bachs Fen Farm, and the help which local farmers were asking for. I expressed an interest in starting an ICM programme in the area with a strong emphasis on ecological agriculture.

Professor Röling was very supportive, and suggested that Professor Eric Goewie, Head of the Department of Ecological Agriculture at the Wageningen Agricultural University, might also be interested. In September 1994, I visited Wageningen and developed a research proposal with the help of the two professors. By then I had already had several meetings and discussions with local farmers and other stakeholders, and had arranged for a planning workshop to be held in November, followed by a series of participatory rural appraisals.

The key methods to be used included Röling's "Platform building for resource use negotiation" (1994), Goewie's "Design for ecological farm production" (1993), and the participatory action research (PAR) approach which we had been using for some time at FSG (Bawden & Valentine, 1984; Argyris, Putnam and Smith, 1985;). These methodologies would support an open-agenda research journey. My task was to help other people in the catchment to identify problems, and to find ways of addressing and solving these problems, individually and collectively.

## 2.6 Lecture by Professor Jan-Douwe van der Ploeg

Soon after the initial discussion with Professor Röling, a delegation from Wageningen Agricultural University visited the University of Natal. Professor Jan-Douwe van der Ploeg gave a lecture which analysed how the land reform programmes of many countries had excluded a large proportion of those living on the land by emphasising the concept of an optimal economic holding. This is usually defined on the basis of expected price levels, technology development and production functions. In Egypt in the 1950's, the economic holding was 44 % higher than the empirical man/land ratio then current; in Tunisia in 1964 it was 166 % higher; in Chile in the 1960's it was 260 % higher; in Peru in 1969 it was 400 % higher, and attempts at land reform based on this target led to the downfall of the Peruvian government in 1975. The World Bank had just at that time calculated that an economic unit for South Africa would be about 1000 % of the average man/land ratio then current. This would have resulted in the dispossession of rural people, who are supposed to be the beneficiaries of land reform. The result of such programmes is often frustration and revolution. These figures were later published (Hebinck & van der Ploeg, 1997). Fortunately, the South African government did not heed these World Bank recommendations (see van der Ploeg, 1998).

The question of how land reform could bring about more efficient use of land without forcing rural people off the land is linked to the current modernisation of agriculture, which has seen

European Common Agricultural Policy pushing for larger farms and more intensive production. Van der Ploeg (1995) argues that this process brought about some important positive changes to European farming, but that the process has progressed "From structural development to structural involution". He emphasises the importance of respecting different farming styles, and local approaches. Local farmers are showing that they can respond very efficiently to nature conservation, food processing and marketing, and ecological agricultural product and market development. The problems of agricultural development in Europe, then, are not so different to the developing world's problems. Thousands of Dutch farmers have been forced off the land over the past twenty years - land reform excludes them just as effectively in the name of modernisation and efficiency as it did the Peruvian farmers. Like Röling, van der Ploeg was emphasising the need to allow local people to take collective action based on their specialised knowledge and on social learning, and to help them to develop appropriate systems within their local context. Technology has an important role to play, but upon what social principles is it based, what is its vision for the future?

## 2.7 Discussion with Graham Moore, Philosopher and Teacher

Having decided that a rigorous approach to the development of the catchment programme was important, it was also necessary to ensure that whatever resulted from the catchment programme was both worthwhile and beneficial to society. I consulted Graham Moore, my philosophy tutor in the School of Philosophy, and asked him how I could find basic principles which would help to illuminate the work (pers. comm., 1995). His response was to ask why I was engaged in rural development. After a long discussion, we traced my involvement back to my childhood, when my father had given me Rudyard Kipling's book "All the Just-so Stories" with the inscription on the fly-leaf, "For Raymond, who loves people and animals". My love for all beings resulted in an early commitment to help people to be free. Graham Moore asked me what I saw as the bondage which people suffered. My reply was that many people lack skills, confidence, wealth and access to resources. This traps them in a cycle of poverty, so that they live in a small and often miserable world. Mr Moore advised me to keep this in mind throughout the work. "In all you do, the emphasis should be on helping people to work with care and attention. All that is done should be done precisely and beautifully. This will help people to live in a wider world".

During a further discussion three years later, Mr Moore commented that any sustainable success which the programme was experiencing was due to a raising of the level of consciousness of people in the catchment (pers. comm., 1998). He pointed out that it was little use if people were helped to carry out a whole range of activities, if they were not given the means to gain the skills and confidence to access resources and create wealth. To accomplish this they would have to become more aware, more conscious of the laws of nature and the ways of the world. Sustainable development demands that people take responsibility for their own lives. Neither Raymond Auerbach nor any one else can develop another person. However, if I cannot help people to wake up to what President Mandela calls "The genius within each person", then as soon as the programme is over, the situation will return to its previous level.

Just as my meditative overview from Cliffdale Hill had enabled me to transcend the limitations of a local farmer's perspective, each person within the catchment who would be called upon to give visionary leadership would have to transcend their own limitations and widen the circles within

which they moved. As Woodhill and Röling (1998) point out, the crisis is not so much "out there" in the "environment"; it is within. Although technical studies of the environment are important to our understanding of the problems, they point out that effective environmental management will have to devote far more attention to the social causes of the ecological crisis we find ourselves faced with. Technical tools need to be directed by sound policies, and integrated with broad-ranging social, political and economic transformation, which requires that we focus on integrating the creative capacities of people, whether they be land users, rural residents, natural scientists, social scientists, policy makers or politicians.

Technology, human experience and visionary leadership have been described by Toon van Eijk as representative of the positivist, constructivist and transcendentalist paradigms respectively (1998). He has described how the limits of technology and individual experience can be transcended by raising the available level of consciousness through a meditative connection with consciousness itself. Leon MacLaren (Founder of the School of Economic Science in 1936, now known as the School of Philosophy, pers. comm., 1994) describes how natural law operates according to this principle, and how those who practice can gradually decrease their personal limitations, which result from their determination to defend a particular point of view. Such persons can eventually relinquish the limitations imposed by personality and dogma, and gradually become universal.

The wise through the ages have been characterised by their ability to allow reason to inform their judgement, rather than the limited perspective of one or other faction. In the past, the wise were always consulted about the government of the nation, and only recently has this become relatively uncommon, largely because there are so few truly wise people available at present. MacLaren points out that the real government of the people depends on what people will accept, what they consider to be right. This in turn depends on who they accept as leaders. These include poets, artists, heroes and all of those who inspire humanity, and thus set the tone for society. The tone set over the past fifty years has often been morally decadent, materialistic and uninspiring. This has led to a technologically dominated society with a weak sense of the capacity of humanity to integrate the physical wonders of the world with the astonishing capacities of human beings to learn and to care for one another and the world we live in. What shines through all this for participatory action research is the need to speak the truth, to set the best example one can, give leadership where one can and the importance of not defending a personal opinion, but rather simply saying "I do not know" and trying to find someone who does.

### 2.8 Meeting with the Umlaas Irrigation Board

How, then, could a worthwhile vision be developed and implemented in the Mlazi River catchment area? The approach seemed to include learning with local people, identifying local leaders and helping them to strengthen positive initiatives, educating young people about the proper care for the environment, and bringing groups of active people together where appropriate, so that synergies could develop between various groups with differing backgrounds - a process of platform building (see Figure 3).

The NCMP team began to work with resource poor farmers, and with teachers and students in Mpumalanga Township and around the middle of the Mlazi River catchment area. Although

FSG's mission emphasises that resource poor farmers are our main client group (see Preface), it was clear that ICM requires the involvement of as many of the diverse actors within the catchment as possible. During 1995, I had several discussions with groups of commercial farmers about the possibilities of a cooperative approach to catchment management. Many of them liked the idea, but as soon as I began to speak about problems associated with fertilisers and poisons, they seemed to lose interest. After one of these talks, Jenny Dean, a local conservationist who had done much work on wetland rehabilitation, came up to me with a charming smile, and said "Raymond, don't try to persuade the farmers to use less fertilisers and poisons - they don't want to hear that message. Start off by explaining what beautiful plants and animals live in the wetlands, and how creative approaches can conserve and rehabilitate wildlife habitats without reducing production". After my male ego had recovered from the initial rebuff, I saw her point, and asked her whether she would like a job doing just that. She accepted, and so, like the rest of the NCMP team, a highly competent and motivated person began (or in her case, continued) to work at local level to help people to understand local problems, and to work with them on solving these problems.

About a month later, Jenny invited Laurie Forsyth, Chair of the Umlaas Irrigation Board (made up of large scale commercial farmers), to attend a University of Natal College Lecture I had been invited to present on the work of NCMP. As a result, Laurie invited me to address the Umlaas Irrigation Board a few weeks later. After I had outlined what we were trying to do (carefully refraining from critical remarks about fertiliser and poisons!), there was a short but positive discussion, after which the Board agreed that they would cooperate with NCMP. Then Laurie Forsyth reported on his attendance at a workshop to discuss the new Water Bill, which at that stage was still in draft form. He informed the Board that the new law would classify all water as a public asset, and the existing water rights would no longer be valid. There was no plan to compensate farmers for the loss of water rights. The Board members were not at all happy with this information, and a lively discussion ensued about what should be done to bring KwaZulu-Natal Irrigation Boards together to defend the rights of farmers, and explain the important role of economically sound irrigation in terms of food production and local employment.

Rather tentatively, I remarked that the Minister of Water Affairs and Forestry had a mandate to ensure that greater equity should be brought about with regard to access to water resources. I suggested that if the impression created by the Board was that they were opposed to a new policy which set out promote equitable access to water, the likely response of the Minister would be to regard the Board as interested only in its own short-term interests, and those of its members, all of whom were white commercial farmers. I suggested that if a pro-active stance could be taken which showed that the Board was committed to making resources available to all residents within the catchment, then the Minister was likely to take a far more positive position in supporting the Board's attempts to use water resources fairly and productively.

The Board members saw the logic of the suggestion, and two weeks later, I was asked whether I would work with Angus Burns, the new Conservation Officer whom they had decided to appoint. Since then, the Board's Catchment Management Project and the NCMP have worked very closely, and the imminent transformation of the Board into a Water User Association marks an important step towards participatory catchment management. Important conservation work has been carried out by the project and local farmers, and three subcatchment committees have already been established in the Upper Mlazi River catchment area (see Chapter 8).

## 2.9 A walk with Professor Giancarlo Campolmi

During 1996, I was elected as African Representative to the Board of Governors of the International Association for Farming Systems Research and Extension (AFSRE). I was asked to go to the 1996 International AFSRE Symposium in SriLanka with Ted Stilwell to present the Southern African Association's proposals for the 1998 AFSRE Symposium to be held in Pretoria, with Ecological Agriculture and Farming Systems as the theme. At the suggestion of Professor Fergus Sinclair of the International Union for Forestry Research Organisations, the final theme was "Farming systems and the environment: Going beyond the farm boundary". This was an attempt to broaden the discussion of farming systems to include the social and the physical systems (such as river catchments or bioclimatic zones) within which farming takes place.

At the SriLanka Symposium, I reported on our participatory action research approach to ICM, and outlined how we had applied Kolb's Learning Cycle in staff training programmes and how we based our approach to working with communities on experiential learning (see Figure 4). This approach stresses that reflection on actual experience is fundamental to learning about the real world. Having reflected on my concrete but subjective experience, I try to make meaning out of it, fitting it into my conception of the world at a more objective level. Thereafter, I may devise experiments to try out my conceptual understanding, leading in turn to new experiences. Dangbégnon (1998) explains the relationship of experiential learning to adaptive resource management, through social learning about ecosystems, social processes of planning and decision making, and collective action. He has also been using this approach to ICM in West Africa. However, although Kolb's experiential learning cycle had been very useful in helping me and my colleagues understand how adults learn, the step from reflecting on actual experience to conceptualising one's own experience on an objective, rather than a subjective level, bothered me. It appeared to contradict my own experience of universal consciousness providing insights better than my own theories possibly could.

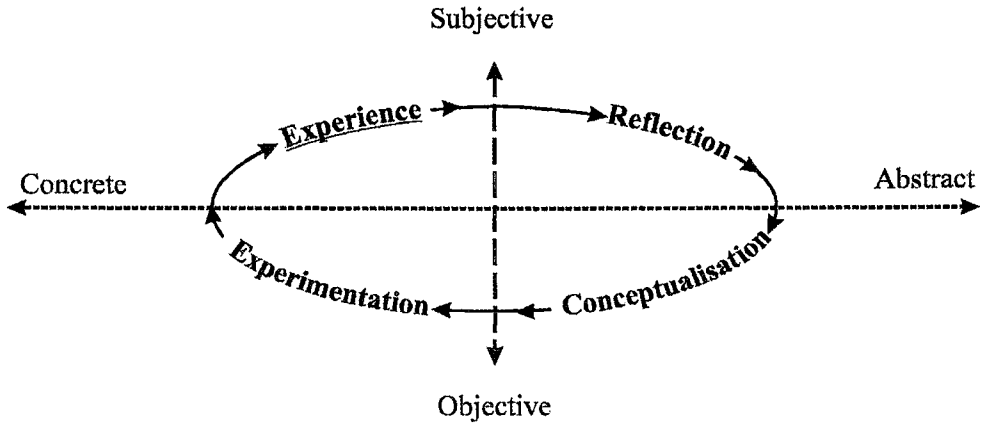



**Figure 4 : The experiential learning cycle (after Kolb, 1984)**

At the time, I was studying Vasishta's Yoga (1993), an ancient Indian philosophical classic. According to Vasishta, conceptualisation is the enemy of the unconditioned consciousness. He urges those who would become free of personal desires to abandon conceptualisation. The intuitive in me leapt in recognition of the truth of these words, and yet the rational insisted that we do try to make meaning out of our experiences, we do try to fit them into systems, into patterns that allow us to deal with the world we live in with some measure of predictability. The verse which heads this chapter emphasises the immediacy and miraculous perfection of the present moment, if we are only awake enough to be there when it happens! This was known from my own life experience, and from my personal struggle to subdue an over-active discursive mind, which is too inclined to offer opinions, and often not well enough disciplined to listen to what others have to say. And still, my rational voice told me that people, and more especially scientists, spend much of their time trying to explain the patterns of existence, the laws of nature. Reconciling these two approaches has been an important part of the research journey.

After the conference, some of the participants toured the Kandanura area of SriLanka. We visited several research stations and were shown the wonderfully diverse ecoforestry production systems of the area. SriLanka is a country where Buddhist kings have ruled for many centuries, with occasional periods of Hindu ascendancy when the Tamils were in power. The two characteristics of a good Buddhist King were considered to be that he built reservoirs for irrigation, and that he upheld Buddhism. Once again, two themes, attending to the spiritual needs of the nation and practical physical provision for the future. Pereira (1973) notes that the earliest water storage works for irrigation in SriLanka are believed to have begun in 2100 BC; by 1100 AD there were some 15 000 storage reservoirs, the largest of which covered 2 400 ha with over 8 km of stone faced earthworks. In the evening, Professor Campolmi and I were not yet ready to go to sleep, and we decided to walk around the enormous reservoir, which is known as Kandy Lake. This beautiful man-made lake is centuries old, and covers over forty hectares.

Professor Campolmi and I walked together in the night, discussing what we had seen during the day in this wonderful environment so new to us. As we reflected on our experience, he drew out his pipe, and rhythmically tamped down some tobacco as he listened to my attempts to make meaning out of the farming systems approach, with all its limitations. "Why does science always have to conceptualise, to adapt experiences which are valid in a particular context to general theories, which are only partially true?" I asked. "How can we as researchers encourage farmers to experiment, to innovate, to adapt what they see elsewhere, to remain alive to what they see unfolding before them moment by moment as knowledge?" "Am I not a fraud, meditating and propounding the abandonment of conceptualisation, while I plan my work carefully, and write copious reports and papers which are full of conceptualisation?" Giancarlo walked in silence for some time, pondering. At length, he stopped, withdrew the pipe, and gazed into my eyes. "My friend", he said, "when I have a problem which I do not understand, I let go of it, for thinking will not solve it. I take my pipe, just as I am doing now; walk, just as we are doing now, and enjoy what is around me. By the time I have finished my walk, all that I need to know is usually clear enough for me to carry on with the most important matter which I am called upon to face. How this happens is a mystery which I am content to live with".

## 2.10 Research journey, research questions, research design

So the tension between conceptualisation and immediate knowledge is a creative one, which I, too, am content to live with. Methodologies and careful record-keeping are a part of discovering truth in this magnificent creation, and yet, it is often not appropriate to destroy the freshness of a sunrise, the sweetness of a carrot or the beauty of a child's expression of wonder with too much analysis. So this research journey can only be an account of what I met and what I hoped and felt and planned and observed, even though it draws on the experiences and theories of hundreds of scientists and explorers.

The difference is largely that between dualism and monism. Dualistic philosophers such as Immanuel Kant (1971) and Descartes (1965) hold that we can know only about the physical world, and that all spiritual matters belong to the realm of faith. This dualism of mind and matter, subject and object gives rise to the dualistic approach of positivist science, based on the representational model in which the individual subject gains knowledge about an external world of objects as they are represented in the mind through the senses. Empirical science builds on this by introducing experimentation, and rigour in observation. This is for many the unshakeable foundation, the source of "truth". Woodhill & Röling (1998) postulate the constructivist alternative to positivism, based on recognising that consciousness and "reality" arise from language, and not vice versa. "This shift places the emphasis for understanding knowledge not on the subject-object relationship but on the relationship between human subjects. What we experience as 'reality' and hence knowledge is to a very large extent constructed by social processes. Thus, different groups in different eras can have different but equally valid (though not necessarily equally desirable) 'realities' 'brought forth' through language". This is quite true, but no less dualistic than the positivist approach; in fact, dualism is replaced by pluralism. In place of an individual subject gaining knowledge about the external world of objects, constructivism has multiple individuals gaining knowledge about that external world.

Monistic philosophy such as the ancient Vedic *adwaita* philosophy (*adwaita* is a Sanskrit word meaning "not two") recognises that one consciousness underlies past, present and future; one consciousness unites the waking, dreaming and sleeping states, one consciousness enables humanity to transcend these three periods of time and these three common states of consciousness (Mandukya Upanishad, Shankarāchārya, 1990, see p.i). Although we appear to act independently, it is only our conditioned consciousness which gives this false impression. Being all participants in the drama of life, we have come to think that the part we play in the drama is who we really are. Failure to recognise this is the essence of dualism. The drama unfolds inside the one universal consciousness. "All the world's a stage, and all the men and women merely players" Shakespeare tells us (1951). What I see physically in the waking state, what I dream or think at a subtle level, or simply being without any thinking, as happens in deep sleep or meditation, all take place within that universal consciousness.

Conceptualisation is a mighty tool in the understanding of the world and of people, but it can be forced artificially out of a linear, dualistic thought process which over-simplifies reality. Until realisation of unity dawns through transcendence of a limited point of view, the observer is limited, bound by nature. As a human being, however, there is always the choice between attempting to access reason and the opinion of the wise, or simply going with logic according to material appearances. A person who moves in the small world of the senses and individual likes

and dislikes is limited indeed. The circles of awareness can expand to include the family, the community, the whole of humanity and eventually the whole universe.

Other monistic philosophers are Plato, Socrates, Ficino and Steiner. In 1924, Rudolf Steiner's anthroposophy gave rise to biodynamic agriculture, one of the oldest European responses to modern industrialised agriculture (Gerber & Hoffman, 1998). His doctorate was on monistic epistemology (1886), and his book "Filosofie der Freiheit" (Steiner, 1992), carries that work further and remains a classic on perception, conception and intuitive knowledge. Marsilio Ficino, who died five hundred years ago, was a major initiator of the Florentine Renaissance. As teacher to Lorenzo de Medici and head of the Platonic Academy (which he started with Lorenzo's grandfather, Cosimo), Ficino brought together and inspired many of the great artists, writers and leaders of the fifteenth and sixteenth centuries. Through translating Plato's works into Latin, he made Platonic philosophy available once more to European thinking. His great achievement was to establish the equal authority of Judeo-Christian religion and Greek philosophy (Ficino, 1975). Writings such as his 123rd letter (*Ibid.*) convinced his contemporaries that these two strands of European tradition are both valid: lawful philosophy is no different from true religion; and lawful religion no different from true philosophy.

Socrates (in The Allegory of the Cave) tells us that our concept of reality is limited by our way of looking. If we are unchained from the dim cave where we see only the shadow of reality (the allegory is to the purely physical world), we can begin to perceive what lies behind the physical phenomena (Plato, 1991a). The dualism of Descartes and Kant arises from believing that what is seen from the perspective of the dim cave (or, to use Shakespeare's metaphor, from the actor's point of view) is more real than consciousness itself.

Plato, Socrates, Ficino, Shankarāchārya and MacLaren agree that this requires discipline, a teacher and the practice of meditation. However, this is a process which each person has to undertake themselves; no-one else can develop them. The best teachers are those who listen and help one to discover for oneself. What is relevant here is the awareness that one can move towards a life which is wider, freer and more universal through cultivating openness, honesty and reason, or towards an ever smaller life, through defending personal opinions. If we can help people to live in a wider world, then perhaps we do contribute to sustainable development. A glimpse of this wider world was given to me on Cliffdale Hill (see 2.4) through grace, or inspiration or what van Eijk calls the transcendental consciousness factor (1998).

To summarise what I have learned during this research journey regarding the process of research: positivism (and the natural scientific approach) is valid when one is dealing with the honest and accurate observation of natural phenomena, and technical aspects of the development of ecological farming systems. Precision, accuracy, replicability, statistically significant differences between different approaches, are all important in this sphere. When one moves to the field of social learning one has to accept the many different experiences of people, and their differing views of reality. Research is no less rigorous, but must take into account that each person constructs their own view of reality, based on their own experiences, values and beliefs. Constructivism (Röling, 1997) is an approach to dealing with this constructed reality, and it can help in the facilitation of social learning processes. Unless the different perspectives are discussed and appreciated, there will be little communication and collective action is unlikely to happen. Understanding the difference between "hard" (natural) and "soft" (social) systems is essential here

(Checkland, 1981). The platform approach (Röling, 1994) is useful in bringing together diverse points of view at a level appropriate to the resources to be managed. However, local leadership requires that people transcend their own personal limitations. The Asian experience (Sharma, 1997) also supports the need for leadership, ethics and a broader, more inclusive vision as essential aspects of effective catchment management programmes.

In developing a catchment management programme, however, all three approaches need to synthesise information using effective design. Design can be a top-down process of deciding on what is needed, and finding the "best technical means" to satisfy this defined need (positivist approach). If there are multiple actors, negotiation will be needed to reach agreement on what the problems actually are (constructivist approach). In addition, any leadership will require that ethical questions and a worthwhile vision are developed. This requires a design for the evolution of visionary leadership. These will be considered in Chapter 3.

So both the positivist and the constructivist perspectives are valid from their points of view. Down on my farm, designing rainwater harvesting systems, I was dealing with the physical world, and a positivist perspective was entirely appropriate (see Section 2.4). On the hill, I became aware of the perspectives of others, and of the social processes involved in their construction at a subtle or mental level. For social learning and collective action, this is also an entirely appropriate perspective.

However, to allow inspiration to visit me, like Professor Campolmi, I had to stop thinking, and simply become one with what I saw. Then I had to obey what was seen, and take reasonable action. The key to this can be found in the verse: *Naiwa kin-chit karômīti* - In truth, I do nothing at all (Bhagavad Gītā, 5.8, Shankarāchārya, 1990). "The carrots will reveal what they need to a person who is awake" said Mr Moore. "Your role is to be awake, and provide care and attention".

## Chapter 3: ON DESIGN

Designing is a legitimate scientific activity, which can proceed from a physical, social or spiritual base and this chapter reviews perspectives on design, relating to a range of topics. Initially, the straightforward process of drawing up a blueprint for a clearly defined product shows that already a process of synthesis is required. Design for ecological agriculture cannot use the blueprint approach, because of the complexity of biological systems, and approaches to ecological design at farm level are discussed, before moving to the even more complex question of prototype design, with all its dangers of oversimplification.

With all their complexity, prototypes for ecological farming systems are still relatively predictable, provided that the purposeful human management aspect is well integrated into the design, and the uncertainties of climate and market are evaluated. However, once one moves to design for education, and to design for collective resource management, negotiation, feedback and interaction become more complex, as the design objectives, the design methods and the process of implementation have to be negotiated at every step of the way.

Finally, the values and vision of ordinary people and of leaders are examined in the context of the newly developing South African democracy. These insights provide the methodological basis for the case studies presented in Part Two, and place the research question and the research journey within a conceptual framework.

### 3.1 Synthesis, analysis and participatory action research

If science is to serve society, scientists need to have some idea of where they are heading. The process of analysis, so fundamentally a part of the research process of the 20th century, has an important role to play in the discovery of new knowledge (see Figure 5); however, survival in the 21st century requires the integration of what we know into reasonable life styles which do not destroy the resources upon which we depend. Booysen (1979) pointed to the swing from analysis to synthesis in science, and cautioned universities in general and agricultural scientists in particular to serve the needs of society by synthesising specific knowledge into approaches which help society to move towards a sustainable future. In this, Booysen, then Principal of the University of Natal, followed in the steps of another famous South African, General JC Smuts, a leader of the Afrikaners in the Anglo-Boer war, and later South African Prime Minister and an important part of Allied Intelligence High Command in the second world war. Smuts was a keen biologist, and his work "Holism and evolution" (1926) was one of the first books on systems theory which dealt with the concept of organised complexity (see Checkland, 1981). The impact of Smuts' philosophy of Holism on South African agricultural research has been considerable. His Minister of Agriculture, Deneys Reitz, also a veteran of the Anglo-Boer war, emphasised the need for a holistic approach to both research and extension in dealing with the problems of landless Afrikaners resulting from the English scorched earth policy, and the aftermath of English concentration camps in which many Afrikaner women and children died (Department of Agriculture, 1936).

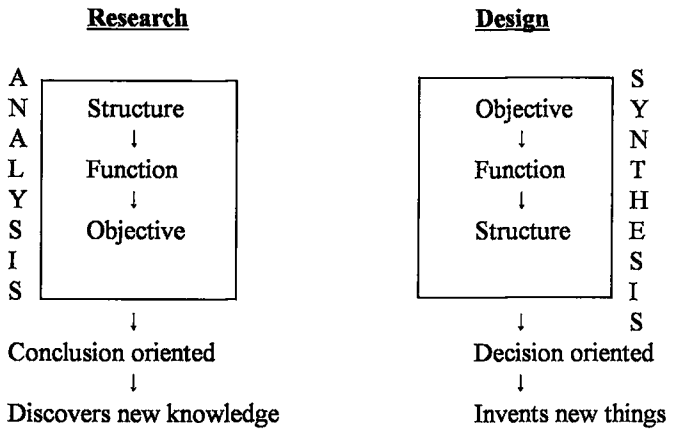



**Figure 5: The difference between an analytical research approach and design as synthesis (after van den Kroonenberg, 1992)**

Kuhn (1962) and Capra (1982 & 1996) trace the change in paradigm from specialist analysis towards a recognition of the complexity and inter-relatedness of components of living systems. Gleick (1987) outlines the development of chaos theory as a branch of physics seeking to deal with the complexity which is characteristic of biological systems and of complex physical problems such as turbulence. Synthesis is a necessary aspect of making analytical research useful to society. Design processes which deal with the complexity of ecosystems ("hard systems"), and with the complex social interactions involved in social interactions with ecosystems ("soft systems") are an important part of a participatory action research approach. Checkland (1981) states that systems thinking and analytical thinking are twin components of scientific thinking (see Box 2).

**Box 2: Design for technical processes and products**

**The process of designing is different to the process of analysis.** Analysis discovers new knowledge about a phenomenon through methodical research, and analysts generally communicate this knowledge by publishing the results of their analytical work. Designing, on the other hand, works the opposite way. The designer integrates knowledge to invent new and desirable processes or products. Rather than starting with an object which is investigated, the designer starts by thinking about design objectives. Then appropriate methodologies are selected, and decision support systems developed. Thus the designer works in a scientific way to create something which did not exist before. Effective design requires a conceptual understanding of the principles involved. While analysis is appropriate to the discovery of new knowledge about a given object or process, design starts with an idea of what should be, and sets out to bring it about according to certain design parameters. It brings together the elements required into suitable structures after clarifying the functions they are to perform in bringing about the desired future state.

In the case of catchment management, the need for integrating design approaches to farming, forestry, nature conservation, water management and education has been argued in many fora internationally (Petersberg Declaration, Development Policy Forum, 1998a; Berlin Recommendations, Development Policy Forum, 1998b; Backeberg *et al.*, 1996; Heim & Abernethy, 1992). Water conservation and nutrient cycling are aspects of ecological agriculture which are also currently receiving a great deal of attention from researchers (Hatibu *et al.*, in press; Bergström & Kirchmann, 1998; Smaling, 1998), along with animal welfare (Dawkins, 1990; Broom, 1991a & b; Wiepkema & Koolhaas, 1993), landscape management (van Mansvelt & van der Lubbe, 1999), and integrated pest management (Röling & van de Fliert, 1998).

Managing complex processes such as these means that one has to operate at a variety of scales, from the individual land user's level, to the local level where collective action can lead to effective resource management. At local, provincial and national level, the three tiers of government have a host of regulatory and planning obligations. The interaction between "bottom-up" processes originating with land users at individual and local level and "top-down" processes from government at local, provincial and national levels can be conflictual, neutral or synergic. Participatory design processes, through creating platforms for negotiating about resource use, can help to address conflicts and develop a joint vision for a catchment, thus maximising the chance of building synergy among the various stakeholders - this involves designing "soft systems". The process of bringing people together, however, is greatly assisted if it is preceded by practical problem-solving work at individual and local level.

With increasingly complex systems, a different approach becomes necessary. Even farm, forestry and nature design processes (especially the latter) deal with complex systems. When one moves to education and communication design, the shift to "soft" systems requires an iterative planning process, if it is to avoid over-simplification. Holling (1995) shows in a comprehensive review of large-scale ecological research, policy, design and management efforts, that very often a complex problem is defined too narrowly. This leads to a technical solution, which succeeds in its narrow aim of holding variability at a certain desired level. Thus the design appears effective: uncertainty is reduced, and initially the management intervention seems to have solved the problem. However, Holling points out that it appears to be a characteristic of complex systems that their variability, their very complexity, allows them to absorb a wide range of disturbances. Simplistic interventions often reduce the resilience of ecosystems, because they increase homogeneity. This is often compounded by the switch of the attention of managers from monitoring to managing the "successful intervention". He concludes "The very success in managing a target variable for sustained production of food or fiber apparently leads inevitably to an ultimate pathology of less resilient and more vulnerable ecosystems, more rigid and unresponsive management agencies, and more dependent societies".

Holling and co-contributors to the book which he co-edits (Gunderson, Holling and Light, 1995) examine the tendency of inflexible managers to lose sight of the complexity of the systems they manage once a simple and apparently effective management policy has been developed. Holling (1995) points out that two critical points emerge: firstly, the reduction of ecosystem variability inevitably seems to lead to reduced resilience and increased vulnerability. Secondly, there seems no other way for agencies to manage and to benefit from resource

development. He then searches for examples of narrowly controlled systems which are successfully managed in nature. The example of warm-blooded creatures proves interesting. Tightly regulated endotherms are indeed less resilient and more vulnerable in the sense that if their body temperature varies outside a very narrow range, they die. Terrestrial ectotherms ("cold-blooded" animals) can survive a much wider range of temperature variation. However, two interesting aspects appear after careful examination. Endothermy does persist, and is thus a "revealing metaphor for sustainable development ... First, the kind of regulation is different. Five different mechanisms, from evaporative cooling to metabolic heat generation, control the temperature of endotherms. Each mechanism is not notably efficient by itself. Each operates over a somewhat different range of conditions and with different efficiencies of response.

This overlapping of "soft" redundancy seems to characterise biological regulation of all kinds. It is not notably efficient or elegant in the engineering sense. But it is robust and continually sensitive to changes in internal body temperature. This is quite unlike the examples of rigid regulation by management where goals of operational efficiency gradually isolated the regulating agency from what it was regulating" (Holling, 1995).

Another important aspect of design for "soft" systems is actor-oriented analysis, which views intervention as a multiple reality constituted by the ongoing social and political struggles that take place among the social actors involved. Here, the focus is more on how the intervention practices develop as shaped by the struggles between the various participants (critical events) rather than developing intervention models, based on the conceptualisations of planners, implementors or clients (Long & van der Ploeg, 1994; Long, 1997). This is particularly relevant to some of the difficulties which the NCMP faced in working in certain communities where there were high levels of conflict, and difficult power relations.

Remmers (1998) emphasises the importance of local farming styles, which constitute an aspect of localised design based on local experience. Local level heterogeneity is often overlooked by planners, yet the importance of local collective action based on specialised knowledge and social learning is an important part of designing and developing appropriate systems. Incorporating these into modernisation plans, land reform processes, or Holling's resource management interventions are three variants of negotiating the problem definition with the actors (or building platforms for resource use negotiation). Developing theory from practical action is what Argyris, Putnam & Smith (1985) call "Action science". Their definition is given in Box 3.

**Box 3: Action Science defined by Argyris, Putnam and Smith (1985, p.53)**

"Our focus is on knowledge that can be used to produce action, while at the same time contributing to a theory of action (and in this differs from action research). In proposing an action science, we hope to articulate the features of a science that can generate knowledge that is useful, valid, descriptive of the world, and informative of how we might change it".

"The action scientist takes a normative position. Mainstream science has sharply separated empirical theory from normative theory, and has cast doubt on the scientific legitimacy of normative theory. The split between empirical theory and normative theory is related to the split between theory and practice. Practitioners in the applied behavioural sciences have long recognized that their practice has a normative dimension. From the perspective of the mainstream account, the values of the practitioner must be sharply distinguished from those of science. Many advocates of the counterview, also, have insisted that the theorist must take a disinterested stance. We take a different view, one that we explain by drawing on the idea of critical theory, as developed by scholars of the Frankfurt School, a group of German philosophers that includes Horkheimer, Adorno, and Habermas ..... Justification of the normative stance of critical theory is based on internal criticism of the practices of the community to which it is addressed. A critical social science engages human agents in self-reflection in order to change the world. From the perspective of action science, however, implementation is not separable from crucial theoretical issues".

This divergence between normative theory, which deals with policy formation and the values of society, and empirical theory, which deals mainly with that which can be weighed and measured, is related to the difference between synthesis and analysis. Whereas the analytical scientist manipulates variables within measurable systems to discover their function, the action scientist develops an understanding of governing variables (often policies, or sometimes the values of society) to design appropriate action strategies. Implementing strategies (or plans) gives rise to consequences on a tactical (or field) level. As Figure 6 shows, the consequences and the strategies themselves provide feedback to the other levels, according to the Theory-in-use model. Thus practice gives rise to theory, and through influencing the governing variables and the action strategies, experiential learning takes place. If practitioners ignores feedback at any level, it will result in theoretical policy makers, ill-informed planners or technical fieldwork which takes place in isolation from the larger context. This is too often the case with the work of non-government organisations, as Bawden (1993) comments in his evaluation of FSG and other University of Natal outreach programmes. Linking implementation with theoretical issues and strategies can give rise to public reflection (what Aristotle calls "Praxis", Box 4).

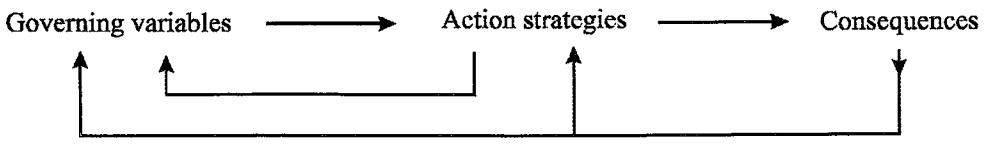



Figure 6 : Theory-in-use (Argyris, Putnam & Smith, 1985)

**Box 4: Aristotle's concept of "Praxis"**

Practical action science involves working with a community to create conditions in which members can engage in public reflection on substantive matters of concern to them and also on the rules and norms of inquiry they customarily enact.

But a more ancient meaning of practical goes back to Aristotle's notion of *praxis*, which referred to "the disciplines and activities predominant in man's ethical and political life".

The concepts of tacit knowing and reflection suggest a different model of relation between knowing and action than is customary. The customary model may be summed up in the statement "Think before you act". This is what people generally mean by conscious deliberation. It is also the model that is formalised in decision theory: The actor is to anticipate the consequences of possible courses of action, assign a utility to each, and choose that course with the highest expected utility. We can agree that this model captures some aspects of reality. But our preceding discussion suggests that a more appropriate model may often be, "Act and reflect on your action". This is almost a reversal of the conventional model, and might be caricatured as "Act before you think". The point is, of course, that intelligent action is informed by highly skilful and complex reasoning, most of which is tacit. It is necessary to act and then reflect in order to discover what reasoning informed the action. A second and more generally recognized reason for acting "first" is that action serves as a means for exploring a situation. Action produces information that can be used for the design of future action. Both of these considerations point to the importance of the dynamic aspects of the epistemology of practice. We must consider the stream of action, from acting to reflecting, with a view to future action .... The practitioner imposes a frame on the situation, and modifies it in the light of "back talk" of the situation. (Argyris, Putnam & Smith, 1985).

But public reflection is also a key process by which human beings learn to act more effectively. It is by helping members of client systems to engage in public reflection that action science can both contribute to general knowledge and help clients to improve their practice. (*Ibid.*).

As we have seen, embedded in the scientific enterprise is an ethic of responsible belief. Action science extends this ethic to the realm of responsible action. (*Ibid.*).

Participatory action research (PAR) within the NCMP has been guided by this approach to action science and *praxis*, with the implication that science can generate knowledge that is useful, valid, descriptive of the world and informative of how it might change it (Box 3). The term PAR is defined in the same way as action science, and is used because it is more descriptive. Within FSG, field workers come together to discuss our work and try to understand how it fits into policy, and how it relates to social values. We call these meetings "Field praxis" meetings, and they are an important aspect of experiential learning (see Figure 4), where we reflect together on our work, and try to understand its significance.

Much of our work on environmental education and platform building has encouraged people to engage in a process of public reflection based on *praxis*. The discussion with Professor Campolmi reported on in Section 2.9 finds an echo in what is said in Box 4 on "acting and reflecting on one's action". In understanding that intelligent action is informed by highly skilful and complex reasoning, most of which is tacit, Argyris, Putnam & Smith give a philosophical foundation for reflection and conceptualisation. It is necessary to act and then reflect in order to discover what reasoning informed the action. Acting "first" serves as a means for exploring a situation. In Kolb's learning cycle (Figure 4), the experience leads to reflection and conceptualisation, and then to experimentation. As Holling (1995) tells us, with complex systems it is easy to conceptualise too narrowly, and then lose sight of the complexity. This is a danger of modelling processes, which can over-simplify reality. The tacit reasoning process, which often happens instantaneously is unconditioned consciousness. Reflection on experience gives this insight which is unlimited, but in simplifying and trying to hold the insight, it is easy to freeze a caricature of the knowledge.

Bringing together Figures 4, 5 and 6, then, one can understand synthesis as an iterative process which results from exploratory actions and reflections on the actions, the reasons informing them, and the governing variables. Before looking at ecological farm design, it is appropriate to understand the complex processes at work within ecosystems. Complex ecological cycles cannot use simple linear design principles, but rather require the flexibility provided by adaptive management, which is receptive to feedback from the system, including the people who are a part of it.

An analogy can be drawn between experiential learning and ecosystem function, both of which can be seen as cycles: Holling illustrates an ecosystem cycle as composed of four ecosystem functions (see Figure 7), where exploitation of an ecosystem decreases the stored capital of the system to a certain stage, usually over a long period of time. Eventually, depletion ends the exploitability, and build-up, or conservation begins to take place, increasing both stored capital and connectedness of the system. The accumulation of biomass and nutrients is tightly bound, "preventing other competitors from using the accumulated capital, until the system eventually becomes so overconnected that rapid change is triggered.

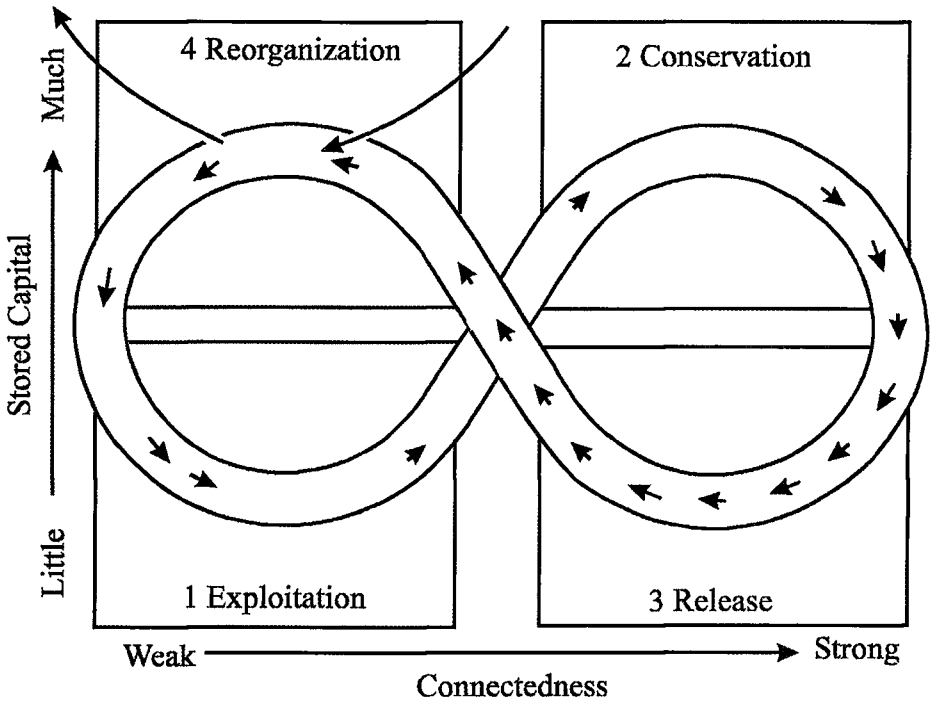



**Figure 7 : The four ecosystem functions ( after Holling, 1995)**

The agents of disturbance might be wind, fire, disease, insect outbreak or a combination of these. The stored capital is then suddenly released and the tight organisation is lost to allow the release of capital to be reorganized to initiate the cycle again"(1995). In this ecosystem cycle, exploitation can be compared to experience; this is followed by a period of introspection, giving a gradual "increasing connectedness" followed by the rapid (or instantaneous) "release" of tacit reasoning or inspiration, after which the new conceptual insight can inform future experimentation, or reorganisation of the knowledge system based on purposeful new activities. In designing individual farms, the dynamics of ecosystem function must be respected, and managed so that conservation and release become more stable and predictable, rather than the extreme system collapse triggered by over-exploitation of biological systems. This is as important for wider level integrated catchment management as it is for individual farm design.

### 3.2 Individual ecological farm design

Small scale agriculture faces diverse challenges: the challenge of aridity and climatic uncertainty, the challenge of the market-place and economies of scale, the challenge of cost-effective production, the challenge of ecologically diverse systems on small areas of land, the challenge of effective use of labour when demands of diverse activities are often conflicting, the challenge of effectively adding value to products and developing new products/ processes.

Moreover, in South Africa the *apartheid* system imposed severe constraints on the development of black smallholder agriculture. Since the democratic elections in 1994, the South African Department of Agriculture and Land Affairs has been assisting smallholders to enter the market place. The political context is discussed in detail in Chapter 4. Here, the concern is effective design approaches. There has been much discussion about small scale, low external input sustainable agriculture, but few practical examples in South Africa of what such farms could look like, or how they should be designed. At the individual farm level, as described in Chapter 5, two key design questions are:

(a) What strategies are available to help improve food security in a way which addresses aridity, poverty and restricted availability of land?

(b) Are there effective methods of producing good yields of crops without resorting to the levels of fertilisers, poisons and other technologies which have produced the environmental problems currently being experienced in Europe and America?

The first question addresses the production and equity aspects (see Figure 2), and many short-term technologies and extension strategies have been proposed. The second question attempts to bring in the longer term perspective, sustainable management of natural resources. When looking at individual ecological farm design, a central concept of the "organic farming" movement over the years has been that of "the farm as an organism". Organic farming is often thought to be named after the high value given to organic matter in these systems, and many scientists scoff at this idea, pointing out that plastic is just as "organic" from a chemical point of view as compost! However, such comments are based on a misunderstanding of the term "organic", as used by early pioneers such as Sir Albert Howard, Lady Eve Balfour and Dr Rudolf Steiner (1924). The word "organic" is based on an approach to farming which sees the farm as an organism, an organic entity, in a similar way to the Gaia hypothesis, which sees Earth as a living being, a living organism (Lovelock, 1979).

The task of the organic farmer is to design activities on a given farm in such a way that the inherent potential of the natural ecosystem is developed sensitively around a balanced production system. Nutrient cycles are fundamental to a balanced design, and a major consideration here is the relationship of animal and crop production. In dry areas, sufficient water is important, in wet areas drainage may be more of a consideration. Finding ways of working with natural ecosystems, with trees, with climate and microclimate, with soils and with the landscape, to develop a system which is efficient, productive, beautiful and also humane is the challenge of the ecological farm designer. There has been a proliferation of approaches to ecological agriculture, and often these are associated with a fairly narrow-minded exclusivity.

Many different approaches and practitioners have been brought together into the International Federation of Organic Agricultural Movements (IFOAM), and the European Union has set up standards for organic production (EEC 2092, 1991). One design system which attempts to integrate a range of successful practices in a structured manner is permaculture, developed in Australia by Bill Mollison. Since much of the practical design work described in this book used this system, it is outlined here as a methodology. Permaculture is similar in its practical aspects to Steiner's biodynamic agriculture (1924), but it does not demand a commitment to

esoteric philosophy from its practitioners, whereas the practice of biodynamic agriculture is difficult without a deep insight into Rudolf Steiner's philosophy of spiritual science. Given the practical situation of South African small scale farmers and the scepticism with which the esoteric aspects of biodynamics are often received by scientists, permaculture appeared to be a more practical approach to adopt. The theoretical prototypes of Vereijken (1998) and Goewie (1995) were not yet available at the time of designing Bachs Fen Farm (1991-95).

Permaculture design

Mollison (1988) defines permaculture as the conscious design and maintenance of agriculturally productive ecosystems which have the diversity and resilience of natural ecosystems. It aims for the harmonious integration of landscape and people providing their food, energy, shelter, and other material and non-material needs in a sustainable way. It is based on observing the patterns of nature, and using these to improve the productivity of systems by placing plants and structures in the system so that they fulfill several functions simultaneously. Mollison defines design as "The beneficial assembly of components in their proper relationships". Permaculture design courses (such as the one I attended in 1991, facilitated by John Wilson from Zimbabwe and Sue Buchanan from the United States of America) usually run for two weeks, and emphasise accurate and open-minded observation of the components of natural systems, and practical application of a number of techniques.

The permaculture design process begins with zone and sector analysis. Sector analysis examines energy (and potential energy) flows in the farm or garden, including such factors as slope and water, aspect, elevation, wind-direction and orientation (and its effects on flows of warm and cold air). In contrast to conventional land use planning procedures, which emphasise soil, slope and climate as the major unchangeable factors determining the production capability of a site, Mollison regards soil as a factor which can be modified relatively quickly by the correct biological processes. Wind direction, the arc of the summer (and winter) sun, the slope of land and the placement relative to that slope of resources such as springs, these factors are more difficult to change, and the reasonable designer will take them into account, and find ways of integrating structures and plants productively and functionally. Zones are areas defined by ease of access starting with Zone 0, which is where the farmer lives. The inner zones are easily accessible and elements of the production system requiring regular attention should be located here. Outer zones will be visited less often, and therefore if possible the more extensive aspects of the system should be located there. The outermost zones should be as natural as possible, and may serve as an area where the designer goes to learn from nature (the wilderness zone).

The concept of guilds in nature is important in permaculture design (Mollison, 1988), and is related to developing the "farm organism". Guilds are groups of plants that often occur together naturally. Examination often reveals mutual benefits associated with this "convivial togetherness" and increased biodiversity. Permaculture designs aim to become increasingly self-regulatory. Designing appropriate groupings of plants thus requires plants which grow well together and an idea of how a guild will develop with time, how natural processes will regulate the evolution of what has been planted as conditions of soil fertility and moisture holding capacity improve. Edge effects or ecotones are also important aspects of design. Often the area of transition from (for example) a wooded area to an open area will have very different climatic and moisture regimes than the woods or the meadow. Managing these edge

areas can often be highly productive, as the micro-environment can be designed to promote the growth of plants which would not otherwise thrive in the area.

Permaculture design gives attention to energy efficient buildings, placed appropriately so that water, sun and wind can be optimally used to create amenable living areas, efficiently supplied with resources and contributing nutrients and recycled moisture to the production system. Integration of human, animal and plant systems promotes efficient nutrient cycling and effective use of warmth and cooling capacities.

Forestry design and nature design are aspects which need to be taken into account in the design process, and since they inform some of the work discussed in Chapters 5 and 8, notes on these aspects are included in Appendices 1 and 2. Other approaches which emphasise more conceptual design processes are discussed in Section 3.3 (Prototyping). Given the importance of aridity in land degradation and in restricting the development possibilities of small scale agriculture, design methods for increasing available water will be discussed in the next section.

### 3.3 Rainwater harvesting design

The rainwater harvesting design on Bachs Fen Ecological Research Farm catches water from a hill and a highway above the farm, and spreads this water throughout a one hectare wetland. This slows down and purifies the water, and releases enough water to allow the area under irrigation to be more than doubled. Rain falling on the farm is slowed down, spread out and allowed to infiltrate, through a system of swales, drains, mulch and the wetlands, and the soil water holding capacity is increased through the use of compost, terraced beds and the inclusion of deep rooting plants in the rotational cropping system. The system appears to be unique in its use of wetlands for rainwater harvesting, and in its conversion of potentially hazardous highway stormflow into valuable irrigation water. The system is fully described in the South African chapter of a forthcoming book on rainwater harvesting commissioned by the Food and Agricultural Organisation (Auerbach, in press).

Rainwater harvesting is not a new concept. Apart from the SriLankan tradition of constructing irrigation dams four thousand years ago (see Chapter 2.8), Plato writes more directly of land degradation due to the decline in rainwater harvesting (in Criteas) in 400 BC: "There are mountains in Attica which can now keep nothing more than bees, but which were clothed not so very long ago with fine trees, producing timber suitable for roofing the largest buildings; the roofs hewn from this timber are still in existence. There were also many lofty cultivated trees, while the country produced bountiful pastures for cattle. The annual supply of rainfall was not then lost, as it is at present, through being allowed to flow over a denuded surface to the sea. It was received by the country in all its abundance, stored in impervious potter's earth, and so was able to discharge the drainage of the hills into the hollows in the form of springs or rivers with an abundant volume and wide distribution. The shrines that survive to the present day on the sites of extinct water supplies are evidence for the correctness of my present hypothesis" (Plato, 1991b).

The contribution of highway drainage to soil erosion has also long been recognised. Pereira (1973) comments that "By engineering tradition the highway designer leads his road drains to

natural creeks or gullies when possible, but otherwise discharges them down slopes, along drains prepared for a few yards only, i.e. enough to protect his road from erosion damage. Some of the most acute soil erosion to be seen in Africa starts from the out-turns of new highways built with modern equipment. The funds should be sufficient to improve the drainage ways to take the increased flows without severe soil damage." Pollution from oil residues and heavy metals (such as lead from petrol and cadmium from tyres) can be a problem when using this water, although tests on Bachs Fen Farm have shown that pollutants do not move far, and are effectively trapped by the reedbeds which have been constructed for the purpose (see Chapter 5).

Water management is a fundamental aspect of permaculture design. The principles of permaculture water management according to John Wilson of the Fambidzanai Permaculture Centre, Zimbabwe, are "slow down, spread and sink" (pers. comm., 1991). This process can be helped by the construction of swales, which Mollison (1988) defines as long, level excavations, which can vary greatly in width and treatment from small ridges in gardens, rock-piles across the slope, or deliberately excavated hollows in flatlands and low-slope landscapes. These structures are usually vegetated, with trees or reeds planted on the crest of the swale. Many large swales were constructed in Tennessee to combat "dustbowl" degradation under President Roosevelt's conservation and job creation programme, and are still functioning effectively (Mollison & Slay, 1991).

In many World Bank projects, soil conservation works were constructed and planted with vetiver grass (*Vetiveria zizanioides*), in order to stabilise soil against erosion, through providing a plant which is not palatable to animals, which has a dense mass of roots to hold the soil, and which allows water to pass through, while slowing it down so that much of the suspended soil is deposited above the soil conservation structure (National Research Council, 1993). The grass is coarse and does not set seed, so it is unlikely to become invasive. It can also be used for craftwork, and aromatic substances in the roots can be used for perfume. The plants grow up to two metres tall, and form a good windbreak. After pruning vetiver on Bachs Fen (see Section 5.5), we have found the cut grass to be a highly effective mulch which lasts well, being resistant to decomposition.

On Bachs Fen, vetiver grass was planted on all swales. The effect of the swale is to catch water which falls on the area above the swale, and to slow the water down, maximising infiltration. The vegetation on the crest holds the soil of the swale in the event of intense rainfall causing runoff flow to overtop the swale. The swale also creates a moist micro-climate in the furrow above the swale wall, which often becomes highly productive, as plant available moisture is much greater here. Swales are different to contour bunds commonly erected in soil conservation programmes. Soil conservation aims to remove water from the field without damage to the soil; swales promote water infiltration. Permaculture incorporates some aspects of Yeomans' keyline approach, also developed in Australia. Both aim to maximise water infiltration and productive use of water.

An engineer by training, and farmer by occupation, Yeomans (1954) was one of the early pioneers of water harvesting. He advocated a system using contour furrows to link dams at "keypoints" where the slope of the land begins to increase. Dams are constructed as high up as possible, and water is led along the contour furrows and spilled into fields using movable

"flags". There is a very slight drop below the contour, usually not more than a fall of 1:300 in hill country to 1:500 or less in flatter country). The area above the keyline is cultivated parallel to the keyline, using a chisel plough or deep ripper. This means that the pattern of cultivation will lead water from the head of the valley along the flanks to the drier spurs.

Yeomans thus showed how water could be kept as high on the farm as possible, while infiltration is maximised through pattern ploughing with tyned implements, such as the chisel plough. He and his son Ken showed me how the system worked on their farm near Orange, New South Wales during 1978. It was possible for one man to irrigate 8 ha per hour using gravity-fed water flowing along the keyline furrows and a simple system of canvas flags which spill the water out of the keyline furrow onto the area below. Yeomans was one of the first to write of the futility of separating soil conservation from production agriculture. His experience showed that water could be used to increase soil fertility if the water was effectively used by maximising infiltration using the keyline method. Although a protagonist of soil conservation, Pereira (1973) unwittingly backs up Yeomans scepticism when he states "The basic tenets of the soil conservation discipline are that the soil surface should be maintained in a receptive condition for the infiltration of rainfall and that surplus water should be led off along gentle gradients without reaching erosive velocities .... the surplus water should be guided along prepared drainage routes ... and be kept free of obstructions".

The positive side of the traditional approach to soil conservation should not be forgotten. Pereira refers to the work of the Tennessee Valley Authority which restored a complete watershed, over 100 000 $km^2$ in extent, "from conditions of poverty and erosion to those of present prosperity". As mentioned above, swales were also used in this process. Pereira gives the Snowy River scheme in Australia as another successful example of conservation engineering.

Boers (1994) says that large catchments yield less water than small. In extreme cases one ha may yield 20 % of annual rainfall as runoff, while 100 ha gives 3.5 % and 10 000 ha yields only 0.5 %! Tauer & Humborg (1992) agree that with larger catchment areas the retention effect increases, resulting in lower runoff rates. They propose a planning schedule to predict suitability for rainwater harvesting, leading to design with the aim of improving or expanding arable areas. Their design process includes checking suitability of topography, crop water requirements, water storage capacity of soils, water yield from associated catchment area, and finally design of rainwater harvesting structures.

Boers shows that the optimal size of catchment for rainwater harvesting can be predicted using various models. He warns that shallow-rooted crops will fail in dry years, thus discrediting rainwater harvesting in the eyes of local people. His suggestion is that deep-rooted trees such as Neem (*Adzaderacta indica*) make best use of rainwater harvesting schemes. Such systems have been tested in very arid (Negev Desert) and arid (Niger) areas.

Tauer & Humborg (1992) tested runoff irrigation in the Sahel. They directed runoff from a small (< 1000 ha) catchment after a storm to a nearby field enclosed by ridges, and increased soil infiltration and thus soil moisture content. Water was then subsequently available for uptake by the plant during the dry season, as soils were relatively deep and heavy. They report that runoff irrigation was used in the Negev Desert 1300 to 2900 years ago. The

principle is that water is collected in a catchment area and used in a field where the water is concentrated. Ratios of collection to concentration areas can range from 1:1 to 100:1. Although detailed local knowledge is needed, it can be a low-cost strategy. Because of limited planning data, Geographic Information Systems, through accurate satellite mapping, soil degradation estimates and vegetation surveys, can contribute to planning.

The role of wetlands in water resource management

Wetlands play a vital role in slowing down the flow of water through a catchment, and this characteristic makes their potential enormous in terms of water harvesting. In reviewing the literature on water harvesting, what is striking is the almost complete failure of researchers to link wetland conservation and water harvesting. Most literature takes an engineering-based approach, albeit participatory, small-scale and labour intensive. Reij, Mulder & Begemann (1994) do touch on some aspects of what they call cultivated reservoirs. This study will review a practical attempt to use the purifying, water-storing, ecological and productive characteristics of wetlands in water harvesting in the context of ecological agriculture and integrated catchment management (Chapter 5).

Scaggs *et al.* (1991) compared continuously measured outflow rates on paired 130 ha sites (drained fescue pasture and undrained wetland) in North Carolina. Runoff hydrographs for one 19 day period are illustrated in Figure 8. They found that peak runoff rates were two to four times greater for the drained pasture than for the undrained wetland. Runoff rates between peaks were substantially lower than the wetland areas. The wetlands absorb much of the rainfall, reducing peak runoff rates. This water is then released gradually over the following weeks. In South Africa, Schulze (1979) compared streamflow from two catchments in the Ntabamhlophe area of KwaZulu-Natal. The peakflow in the wetland-rich catchment was two months later (with a lower coefficient of variation) than the catchment with few wetlands (see Figure 9). Total volume of water was approximately 60 % higher for the wetland rich catchment. Schulze suggests that this is probably due to the storage effect of the wetlands. The characteristics of wetlands on Bachs Fen is discussed in Chapter 5.

Kotzé & Breen (1994) have studied South African wetlands extensively, including their water purifying, flood attenuation, water storage and production characteristics. They compare these to what is known of wetland functions around the world, and caution that wetlands cannot been seen as sponges which store water and can then be "squeezed out". Rather, the importance of wetlands lies in their capacity to slow down and purify water, while providing a biologically diverse and economically productive resource. Wetlands do have a storage function, but once they are saturated it is unclear how much additional water can be retained after a storm. Although wetlands do store water, their effectiveness is highly variable and needs to be established by careful measurement.

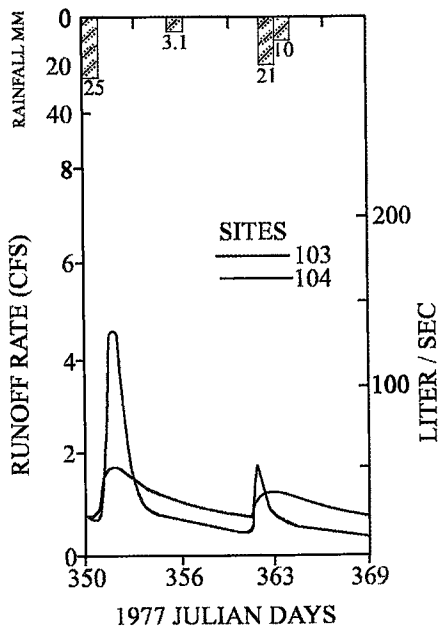



**Figure 8: Runoff hydrographs from a natural (104) and a developed (103) site in a North Carolina wetland (from Scaggs *et al.*, 1991).**

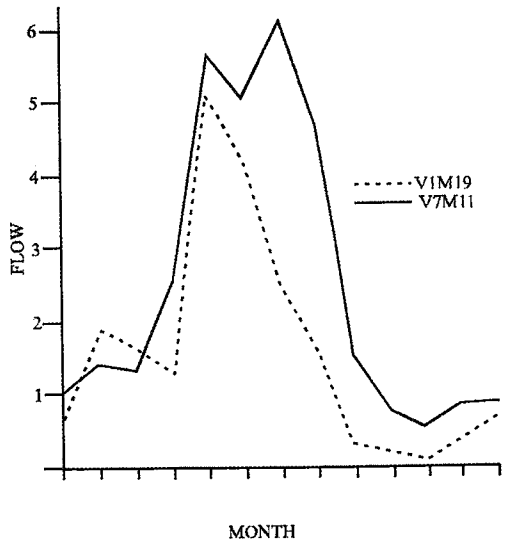



**Figure 9: Comparisons of mean monthly streamflows from a wetland rich catchment (V7M11) and a wetland poor catchment (V1M19) (from Schulze, 1979).**

Scoones and Cousins (1994) report that in Zimbabwean rainfed agriculture, conflict is often focused on control over low-lying, valley bottomland wetland resources (*dambos)*, which are very valuable for local production. Traditionally, the value of the *dambos* was recognised and respected. Sacredness was conferred on parts of these areas in order to protect them, and taboos developed to discourage exploitative use outside the bounds of what had been found to be sustainable. Crops were planted along ridges of those areas which could be used, with an intercrop of maize and rice closest to the stream channel. Rice would succeed in wet years and maize in the drier years. Finger millet would be planted on the sandy soil fringes. Water flow was carefully managed. A mutually agreed analysis of the situation had resulted in those controlling the resource negotiating resource use (building platforms), and developing land use based on sound practice (see Section 3.6).

Historically, the state introduced a ban on *dambo* cultivation in 1927. Because of their political influence, white commercial farmers were able to get this revoked for their land, but control over wetland use in tribal areas remained. Commercial farmers were able to convince authorities that damage to the wetlands was more than off-set by commercial gain. Black farmers continued to resist control, arguing that fencing off of the *dambos* was inappropriate. Because of the failure to build platforms which respected the perspectives of the entire range of actors, state controls have remained in place but have proved ineffectual. Evidence increasingly suggests that traditional forms of controlled access to *dambo* resources are sustainable

Scoones and Cousins argue that support for locally designed models of agricultural development and grazing management that enhance the key resource function of *dambos* needs to be a priority, and the resolution of conflicts based on local management and political organisation is essential. Legislation therefore needs to provide an enabling framework for wetland use and management based on a commitment to learn from local experiences of wetland resource management and sustainable use. Clearly, such a strategy has major implications for water harvesting.

Rainwater harvesting in South Africa

Research into rainwater harvesting in South Africa, too, has mainly adopted an engineering-based approach: pioneer researchers such as Lea, Alcock, Bromberger and Melis at the Departments of Crop Science and of Economics at Natal University started a Subsistence Agriculture Study Group which looked in some detail at domestic rainwater harvesting in the Vulindlela District south-west of Pietermaritzburg in the early 1980's. Alcock constructed some rainwater harvesters, but the technology-intensive approach was not easy for local resource poor farmers to adopt (Alcock, 1985, Lea, Alcock & Melis, 1985). Instead, the rapidly urbanising area saw a series of spring protection programmes followed by a major water reticulation scheme. This accords with the experience of many water harvesting programmes which have found that "the engineering approach" is not a viable answer for agricultural development.

One different approach is to look to nature for models of biological systems which harvest water, and see if they could be integrated into productive systems. In studying wetland dynamics, Kotzé & Breen (1994) review the understanding of the potential of wetlands to attenuate flood peaks and raise the level of low-flow in streams and rivers. Although this is

complex, depending on soil type, topography and on whether the soil is saturated before rainfall events, there is substantial evidence that the potential for the above functions is high. Water storage potential is more controversial, however, as wetlands tend to be shallower than dams, and to have high levels of evapotranspiration. However, wetlands are not only capable of slowing down the passage of water, but also of purifying the water and producing a range of high value products in the process, as Scoones and Cousins (1994) point out. A combination of relatively small dams below wetlands would prove a very effective means of preventing siltation, attenuating flood peaks, storing water effectively and maintaining biodiversity.

Conservation-minded farmers through the centuries have recognised the importance of wetlands, and of finding ways to slow down rainfall runoff and increase water infiltration. Many South African commercial farmers (such as James Rennie and Neil Murray of Kokstad) visited Australia in the 'seventies to learn "Keyline" water harvesting techniques (Yeomans, 1954, 1968). I learned many water harvesting techniques from Alexei de Podolinsky, Trevor Hatch, Donald Rathbone, Farry Greenwood, Gavin Dunn and Haye Haisma of the Bio-Dynamic Agricultural Association of Australia between 1973 and 1976.

The tradition of water harvesting in black areas of South Africa is more difficult to trace. South African agricultural production was disrupted not only by white colonisation and *Apartheid*, but also by the expansion of the Zulu nation in the time of King Shaka. This phenomenon, known as the *Mfecane*, saw the movement of many tribes to the south, west, northwest and north ahead of Zulu imperial expansion (Guy, 1994). Following this enormous disruption, the white colonists effectively destroyed what was left of black farming systems. The Glen Grey Act of 1897 made it illegal for black farmers to own more than 10 acres (4 ha) of land. In spite of this, some farming traditions have survived. Old Xhosa farmers in the Kokstad area, such as the late Samuel Gwiji, dug furrows below springfed wetlands for irrigation. At the turn of the century, Gwiji was a large scale commercial farmer, delivering ox-wagon loads of beans and wheat to Kokstad market.

Pioneers such as the late Robert Mazibuko developed a unique water harvesting process which mimicked the function of wetlands in nature. He worked in the 1950's and 1960's in the Valley of a Thousand Hills, where he applied his "trench-garden" system to water harvesting on the steep hills of the area (Bloch, 1996). He told farmers that they had to create "valleys on the hill". Mazibuko acknowledged what he learned from Father Bernard Huss at the St Francis Teachers' Training College at Marianhill in 1928 (Engel, 1990). He also travelled extensively as a teacher in many countries of Africa. During his early years, he learned much of traditional African methods of production and water harvesting. He also became convinced of the importance of indigenous tree planting as a soil conservation and water harvesting strategy, having met and learned from Richard St Barbe Baker (1944). Some of Mazibuko's ideas have been adopted by gardeners at Nkululeko in the Valley of a Thousand Hills, and together with a study of the system on Bachs Fen Farm, these were reported as South African case studies in rainwater harvesting (Auerbach & Jansen, 1997).

Mazibuko's trench system removed soil from the bed, placed organic material at the bottom of the trench, and replaced the soil taking care to form a terraced bed which was designed for maximum water retention. His trench gardens retain water dramatically compared to ordinary

garden beds, but they do require an investment of labour to develop. The alternative without water harvesting in areas of low rainfall, is that most of the effort which goes into crop production is wasted, and regular crop failure has made many communities abandon crops such as maize and beans.

I learned much from the practical work of Mazibuko, Rennie and Gwiji during the 'seventies and 'eighties, which has contributed to the development of ecological farming systems at our farm Bachs Fen in the Mlazi River catchment. This in turn has contributed to the development of participatory catchment management in the area.

### 3.4 Prototype design and its dangers

In designing ecological farm prototypes, it is all too easy to fall into the trap of providing a technical recipe. This is even more likely to happen when policy makers recognise that conventional agriculture threatens the future of human existence on earth through industrialisation and pollution (Röling & Wagemakers, 1998), and that some regulation of what farmers do with their land is required over and above quotas to regulate the volume of production. This chapter will describe some European efforts to develop ecological agricultural prototypes, but will bear in mind two important cautions: first, these prototypes are developed in Europe, where there is too much of everything (nitrate, manure, capital, production) - applying them in Africa, where there is too little of everything will require major adaptation. Second, ecological agriculture requires a change in the relationship between farmer and farm, with the farmer seeing the farm as part of an ecosystem, as van Weperen, Proost & Röling (1998) explain. They review the integrated arable farming programme in The Netherlands (based on a "policy-driven need to introduce viable alternatives to conventional high external input agriculture"). This included 38 volunteer farmers who converted their farms on the basis of research farm results. They conclude that there are two components in changing over to ecological farming. The first has to do with technology adoption (which does not require a major change in the way the farmer farms). The second aspect requires "a transformation in farming practice, i.e. managing the farm as an ecosystem based on observation, interpretation and anticipation". Thus feedback from the system has to be sought, understood and acted upon by the farmer. This requires learning, and a transformation of farming practices.

This is important for NCMP, because, as stated in the Preface, the Water Research Commission would like the programme to produce "a framework for community participation in catchment management in South Africa" based on NCMP experience. As with the policy-driven European integrated arable farming programme, so with both ICM and Landcare, the South African government is faced with an imperative of dealing with the constraints to water management and agricultural development. Frameworks are often seen as recipes, in the sense of "If you do this and this, you will get that result", but in South Africa we will only solve our water and Landcare problems if we deal with both the social and technical constraints to small scale agriculture. The constraints are aridity, poverty and access to land. These are analysed in detail in Chapter 4.

The work on Bachs Fen Ecological research Farm addresses techniques for dealing with low or erratic rainfall (ecological farming and rainwater harvesting), which is dealt with in Chapter 5. Addressing poverty is a far more complex process, and NCMP attempts are described in Chapter 6. The focus was on helping rural women to tackle food insecurity through community gardens, and helping them to generate money and learn about resource conservation through craftwork groups. Negotiating access to land and other resources is a constraint that we could only partially address in the programme, and Chapters 7 and 8 describe our work on environmental education and platform building. These processes are part of helping local people to develop strategies for the managing resources sustainably. The implication is that any framework for community participation will have to include a range of perspectives, and will have to be adaptable enough to allow for feedback from both the ecosystem and specifically the people who live in it (and are thus part of it).

Theoretical prototype design

Vereijken (1994, 1995, 1996, 1998) has been active in developing a system of designing theoretical prototype ecological farms with colleagues in ten European countries. Their approach is directed towards helping European farmers and farm advisers to identify some of the elements of future farming systems which can move away from the current agrotechnological approach, with its "degradation of nature and landscape, pollution of the environment and overproduction of food" (1994). Since 1979, when they started research, transition towards whole farming systems, towards synthesis rather than farm-level analysis (which yields little broadly relevant practical information). There is also a trend towards innovation for sound systems which are viable in the short term and also useful as examples for long term change. Vereijken's work has evolved from designing prototypes (1994), to testing them practically (1995), improving them (1996) and disseminating results (1998).

His approach is to start with a hierarchy of objectives (step 1), where he helps the farmer to define and prioritise the most important farming objectives. General objectives provide a framework, while specific objectives begin to focus on which elements of the design will receive priority. Objectives are then quantified (step 2), and methods are selected. According to Vereijken (1995) these include: multifunctional crop rotation; integrated nutrient management; minimum soil cultivation; ecological infrastructure management; integrated crop protection, environment exposure-based pesticide selection and farm structure optimisation. The specific objectives then lead to a theoretical prototype (step 3), which has to establish major and subsidiary methods to be used. Step 4 is then the testing and improving of the prototype in practice until the objectives as quantified have been achieved. To this end an Ecological Infrastructure Index and a Plant Species Diversity target are developed, using an approach similar to that described by Smeding (in press, Appendix 2).

In the dissemination phase of the programme, Vereijken (1998) stresses the need to interact with farmers if prototype farms developed are to be seen as useful by other farmers. Vereijken recognises that it is not practical for researchers to develop prototypes and expect extensionists and policy makers to attend to dissemination of the experimental design. Design results will need to be adapted to each farm, and since many of the ideas will be new for extensionists, they may find difficulty in elaborating farm-specific variants of the prototypes. An inter-active process is required, where pilot farmers develop adapted prototypes on their farms, and discuss results with neighbours. The increasingly restrictive legislation in Europe

regarding nitrate and pesticide contamination of groundwater and rivers means that farmers will increasingly be forced to adopt more ecologically sound approaches.

The development of the Dutch Nature Policy Plan has been an example of government instructing farmers to change in order to suit national policy objectives. The approach has been described by van Woerkum & Aarts (1998) as the DAD model (Decide, Announce, Defend) of communication. "Communication took place only after the plan had been approved. It is informative and motivating, but it does not create the desired level of acceptance". Like the Zimbabwean approach to *dambo* cultivation described in the previous section, the Nature Policy Plan was not developed interactively with farmers, and did not build on their intimate understanding of nature.

Nutrient cycling

German authorities have already set up Water Protection Zones, especially in the state of Baden-Württemberg (Vereijken, 1998). In addition, soil protection directives, set-aside incentives, production quotas, landscape management programmes and nature preservation incentives are offered to farmers to encourage a more responsible approach to the environment. The Integrated Arable Farming System has resulted in the formation of several groups of farmers, some of which have developed certification schemes to ensure that only products which are up to standard may be marketed as such.

Regional results are already encouraging, showing a gradual decline in mean nitrate levels in the soil profiles in Baden-Württemberg water conservation zones between 1991 and 1996, from an average of 75 kg/ha in 1991 to 29 kg/ha in 1996, a reduction of more than 50 % of the initial average content in the soil profile. Samples were taken in autumn, which is the most critical period for nitrate leaching, so that the areas now meet the required official standard of 45 kg/ha of nitrate in the soil profile. Since these summary results are taken from 80 000 samples from fields with different crops and varying locations within the water conservation zones (totalling about 100 000 ha), and since there has been wide-scale adoption of the system within the entire state, Vereijken concludes that the Integrated Arable Farming System recommendations are effective in moving towards more environmentally sustainable arable agriculture. However, it should be noted that farmers not conforming to maximum limits are fined heavily, while farmers who do conform receive reward payments. Therefore the success of the measures is not purely voluntary - the use of these economic instruments appears effective, but is yet another aspect of farm regulation which local farmers have to live with. Giving integrated and ecological arable farming systems legal status, would support bottom-up approaches to dissemination. It could also make compliance more economically attractive.

Yet the history of Dutch farm modernisation shows that Dutch farmers are on a treadmill (van der Ploeg, 1995; van Weperen *et al.*, 1998). As each technological development is shown to be effective by innovative farmers, it is generally adopted and then becomes a requirement for maintaining competitive efficiency. Prices of agricultural products drop further, and the farmer has to be ever more efficient. The same process is now threatening Dutch ecological agriculture. Until now, organic farmers were seen as romantic mavericks with strange ideas. Now, Dutch supermarkets are informing farmers that they want to exploit the growing market for organic produce, but wholesale prices must be cheaper. The Agrarisch Dagblad (Independent Agricultural Daily Newspaper) of 3 March 1999 quotes Harry Bruijniks,

Director of supermarket giant Albert Hein, who states that Albert Hein has been marketing organic produce on a large scale for a year, and they are pleased with the results. However, he wants both quality and quantity to improve, and wholesale prices to drop, so that the profit margin can increase. This is to be achieved by farmers becoming more efficient.

The following day's Editorial Comment pointed out that organic products should be recognised as providing a service to the environment as well as quality products to consumers, and that profiteering by supermarkets should at least be constrained by recognition of the real costs to the farmer and benefits to society of producing food in harmony with the environment.

Oomen *et al.*, (1998) also deal with the problem of nitrogen pollution in Europe, and show how mixed farming systems can help to alleviate the problems through more efficient nutrient cycling. Results from Vereijken (1998) presented above showed how ecological farm design can contribute to more efficient nitrogen use. Oomen *et al.* report on work at the Minderhoudhoeve in eastern Flevoland, Netherlands, where two prototype systems were set up, one an integrated system (which tries to use inputs as efficiently as possible), and the other an ecological farming system (which functions according to ecological principles). The expected advantages of such systems are: reduction of external inputs and increase in the efficiency of nutrient cycling; more efficient use of animal manure; incorporation of short-term grasslands into the crop rotation to reduce excessive accumulation of soil nitrogen; broadening the crop rotation to decrease use of herbicides and pesticides and increase yields because of fewer pest and disease problems; optimal use of legumes for biological nitrogen fixation; and a more even distribution of labour input and spreading of income risks. Results indicate that while maintaining acceptable yield levels, both systems were considerably more efficient with regard to nitrogen use. The expected N surplus was only 60 kg N per ha per year, which is less than 25 % of the average levels in Dutch agriculture. At this stage the integrated systems are outperforming the biological systems on certain parameters, but the biological systems conform to a range of ecological criteria, and are in the process of setting up long term productive systems.

There has been increasing concern about inefficient nutrient use in agriculture. The recent International Nitrogen Conference held in The Netherlands in 1998 looked at air, groundwater and surface water pollution, as well as critical loads, abatement strategies and policy development and evaluation (Erisman *et al.*, 1998). They conclude that nitrogen saturation of agricultural soils is due to overloading with animal manure and/or chemical fertilisers, and that it is a major concern in relation to drinking water quality. Understandably, intensive European agricultural systems operate at high levels of plant nutrients, and especially in The Netherlands this has led to many programmes aimed at reducing nutrient pollution. Reviews of Integrated Arable Farming pilot trials by van Weperen *et al.* (1998) show that phosphate and potash levels (and also poisons) are significantly reduced, but that nitrate reduction levels are still not satisfactory.

Soil nutrient cycling in the tropics, and in particular in sub-Saharan Africa, is characterised more by the tremendous nutrient deficiencies encountered than by excesses (Bergström & Kirchmann, 1998). In reviewing ten years of collaborative scientific work on the Tropical Soil Biology and Fertility Programme, Swift (1998) sums up by commenting that soil fertility

decline is being increasingly identified as the most critical constraint to small scale food production in Africa. Swift concludes that few smallholder farmers rely on inorganic fertiliser alone, even when it is available; they supplement wherever possible with such organic materials as are available. He advocates the development of decision support tools to optimise nutrient-use efficiency for scarce resources, in order to provide the basis for improved methods of soil fertility management, using a multiple-resource approach.

Quantifying objectives

The approach outlined by Goewie (1995) brings together the approaches of Mollison, of Oomen and of Vereijken and his collaborators. Goewie points out that effective design requires a conceptual understanding of the principles involved. One of the weak points of current organic farming practice is the absence of quantifiable objectives. He maintains that Vereijken's approach to design can contribute to the development of quantifiable objectives, and towards prototype farms which can serve as a basis for helping conventional farmers to convert towards more ecologically sustainable production methods. Before this can happen, the design objectives have to be clear, and the conversion process has to be practical, affordable and achievable. To Vereijken's approach and Mollison's design considerations, he adds the four categories of Conway (1994), namely productivity, stability, sustainability, equitability (see Figure 2). He also points out that autonomy in terms of reducing the levels of imported inputs, is an important principle in ecological farm design - nutrient cycles should be as tight as possible, otherwise the instabilities inherent in Holling's ecosystem function (see Figure 7) can increase, as they are doing in conventional agriculture.

Goewie thus summarises the process of ecological farm design into the following five steps:

| | |
|---|---|
| First step: | Identify constraints, plot against key agro-ecosystem properties, construct hierarchy of farm objectives with the farmer; |
| Second step: | Transform into quantifiable parameters and define; |
| Third step: | Propose methods; |
| Fourth step: | Prototype framework; |
| Fifth step: | Draw up action plan. |

Goewie emphasises that designing an ecological farm requires that the designer has a clear vision of objectives. This must be based on local knowledge of the environment and on intimate interaction with the farmers concerned. In practice, when approached by landowners to assist with conversion of conventional farms into more ecologically sound enterprises, Goewie works in three broad research areas (pers. comm., 1999): firstly, quantitative (hard) information about the farming systems is required (soils, climate, cropping and animal systems, physical infrastructure); secondly, ecological observations about the natural environment must be collected; this information is no less "hard", and is similar to Mollison's sector analysis, but requires different skills and understanding. Often, it would be gathered by a different person or team (see Appendix 2). Thirdly, "soft" information about farming objectives, experience of the farmer, phenomenological observations concerning the more subtle aspects of the social and spiritual environment need to be appreciated. Without understanding the nature of the human beings involved in the enterprise and the energies available within the area, an appropriate design for the farm which is both achievable and sustainable is unlikely to emerge.

Kabourakis (1996) used Vereijken's approach under the supervision of Goewie, in a process of interactive prototyping for olive production in Crete. Here, emphasis was placed on the interactive development of objectives. Olive monoculture using poisons and high levels of fertiliser has been the too-narrowly focussed response of agronomists. As in the cases which Holling reviews, the Cretan olive groves were ecologically destabilised, and became more vulnerable to disease, and the high levels of poisons used were both expensive and undesirable from a marketing point of view. Kabourakis, being the son of an olive farmer, thus developed innovative prototypes. This process of diagnosing with farmers and designing prototypes with them took three years. It shows that defining the problem with clients is a slow process, but the alternative is an overly narrow problem definition which requires rigid management enforcement. Kabourakis, on the other hand, was able to find volunteer farmers who learned about systems in a similar way to the Integrated Pest Management's Farmer Field Schools in Indonesia (Röling & van de Fliert, 1998).

After extensive discussions about the pilot project, and development of a theoretical prototype, more practical farmer trials were undertaken. The five steps of Vereijken (1994; 1995) were followed in prototyping, as well as the three steps suggested by Röling & Jiggins (1996) for facilitating the dissemination of prototypes (form pilot groups; follow up with a dissemination group to introduce the ecological knowledge system; form a network of satellite groups to spread through the region).

Kabourakis (1996) concludes that the weaknesses of prototyping include the long periods required, with many iterations of designing, testing and improving needed, and many social actors involved. Also, current institutional settings for research and education are narrowly focussed and do not support the kind of teamwork required for prototyping. The importance of design processes which take the different perspectives of those involved into account is supported by the experiences of Kabourakis. His situation was similar to mine, in that we both are actors ourselves, as local farmers.

In summarising what has been learned about ecological knowledge systems through the contribution of van Weperen *et al.* (1998) and many others, Röling and Jiggins (1998) state that "Ecologically sound agriculture cannot be expected from merely introducing different methods and technologies to individual farmers. Required is a transformation of the entire complex soft system which can be called 'conventional agriculture' to an equally complex but different soft system which can be called 'ecologically sound agriculture'. Also, the change to ecologically sound farming is not only the outcome of technological intervention, but is a negotiated outcome based on accommodation among paradigms, coalitions, institutional interests and politics". Remmers (1998) shows that rigid management interventions based on formal authorities are less likely to work in the future than local knowledgeable leaders taking a role of "situated authority". He draws a parallel between jazz improvisation and the performance of farmers who have a feel for farming in their area and often farm "with balls and mastery" (this is also the title of his thesis); the "balls" represent the courage to take on the challenges of farming, the mastery being that local flare similar to the musician's .

Remmers does warn, however, that over-reliance on this approach to designing can lead to a lack of learning capacity. Like Holling's warning about too rigid management, based on too narrow an understanding of ecosystems and their problems (1995), Remmers stresses that love

and a learning attitude are important to continuing success. Remmers concludes with a call for a "sociology of design" where the processes of analysis (belonging to the past) and synthesis (belonging to the future) meet in the present. Farming styles and fuzzy logic can be used to bring social actors together in an iterative process of design. In this process, there is much to learn from the creative processes used by artists; the conditions giving rise to creativity and experimentation, to new processes of meaning-making, to building organizations and enhancing their capabilities. Remmers, too, sees vision as central to this process: "La *visión* es un elemento central en los procesos creativos, y del proceso de construcción de coherencia". The process of visioning as a social process of collective design has great potential, says Remmers.

Animal welfare

Creativity and coherence should also be informed by humanity and compassion. Farmers work with animals, and increasingly industrial agriculture sees these living creatures as "production units". Because of the importance of balancing plant and animal production in ecological agriculture, animals should not be left out of the design process. A few principles relevant to animal welfare are presented as a further example of feedback mechanisms, which can be ignored in the name of productivity, but which should remind designers that equity has non-human connotations as well.

Dawkins (1990) reviewed what is known from scientific studies on animal behaviour about animal welfare. She develops an objective basis for deciding when an animal is suffering, based on what an animal is prepared to do to attain or escape a situation. She then outlines how these principles can be used in designing environments for animals which give priority to these "areas of inelastic demand" (situations where the animal continues to work for change despite increasing costs associated with this behaviour). Wiepkema & Koolhaas (1993) characterise welfare of an individual animal as "a state of mental and physical health indicating living in harmony with its environment".

They have shown how animal behaviour is related to predictability or controllability of their environment (*Ibid.*). The effects of (mild) stressors rapidly increases when predictability and controllability of these stressors is lost. Animals appear to behave rationally within the bounds of their understanding of their environment. They respond well to a predictable routine, although minor variations appear to add interest to their life, especially with higher vertebrates. "When rats or chickens can choose between free food and food for which they have to work, the latter is preferred. Recent data strongly suggest that performing species-specific behaviour to obtain food facilitates adequate endocrine changes in the gastro-intestinal tract". Examples given are scratching and pecking in poultry and rooting in pigs. "Offering hens a substrate in which they can scratch and peck or pigs one in which they can root, significantly reduces the tendency to feather-peck or to tail-bite respectively". They conclude "There is, however, general consensus that housing and husbandry systems associated with injurious behaviour should be abandoned and replaced by better ones. Finding such better systems is often facilitated by good biological knowledge of the species involved".

Conclusion

So the animals, like the farmers, are prepared to work to live in harmony with their environment. Prototyping can give some guidance on appropriate conditions under which reasonable and humane considerations can be incorporated into support and regulation of agricultural production without undermining the ability of the farmer to survive economically, psychologically and environmentally. Like the farm animal, the farmer to needs some predictability, some control and the variety which is the "spice of life"!

The implications for design processes are important: even here in the relatively "hard" world of ecological production, negotiation and social learning are important. As we move on to education and communication design, the levels of complexity and the importance of negotiation and social learning become central to design. Referring back to Figure 2, it appears that from the production perspective (top left quadrant), van den Kroonenberg's design approach is reasonable (Figure 5). It can help to solve technical design problems. When one works with social processes which are more people-centred (top right quadrant), Figure 4 is more relevant, in that experiential learning is central to innovation. However, Remmers and van der Ploeg remind us that vision and local action are also crucially important, and Röling & Jiggins outline some of the processes involved in social learning (see above). These perspectives show how rich and complex the top right quadrant becomes if people are to be involved in issues of improving equity and access to resources. Figure 5 is no longer an adequate model for describing this design process. Adding to the complexity, Holling shows how introducing the unpredictable nature of ecosystems makes the management of natural resources highly problematic (Figure 7). The bottom left quadrant of Figure 2 represents this perspective of natural resource management. All three of these perspectives are important, and can contribute to a move towards sustainable development (bottom right quadrant of Figure 2).

## 3.5 Design for environmental education

In education as in other aspects of life, technical information is important. However, the ability to stimulate creative discovery, delight in gaining an understanding of the world, represents the difference between mediocrity in education and the brilliance which characterises a gifted teacher. In both agriculture and the environment, there are vast amounts of technical information, huge numbers of approaches and theories, and voluminous publications of research findings. The word "educate" means "to lead out" and as Auerbach (1972) points out, an ecology of education should be based on leading the child out into a full appreciation of the world and its wonders. "Nothing compares to nor can replace the creativity of a dedicated teacher in lighting the fire of the student's own creativity" says van Mansvelt (1990).

He also stresses the importance of basing education not only on thinking, but on a balance between thinking, feeling and doing. Mastering a skill requires a progression from imitating a good example, to experimenting with technique, until eventually mastery gives a certain independence. In agriculture, until the student is proud to be identified as an agriculturalist, the process of education remains a "transfer of technology". Only when there is a recognition that the role of farmers cannot be reduced to "a social sub-system" or a collection of

technologies, does the role of agriculture as human endeavour come to its rightful place (van der Ploeg, 1991). The same is true of environmental action. The process of discovery learning can allow students to understand the systems within which they live while showing them that they are part of those systems, and can impact upon them positively or negatively.

Bearing in mind the foregoing discussion on the importance of involving a range of social actors, of building platforms where creative visioning can take place, and of combining local knowledge with outside technical expertise, the development of School Environmental Action Clubs was able to follow a design process which built on these learnings, both within NCMP and through other researchers, some of which have been quoted in the previous section. Based on experiential learning (see Figure 4), School Environmental Action Plans were developed with teachers and students in such a way that they would provide discovery learning opportunities around practical conservation activities.

The South African Department of Education has adopted a form of experiential learning in its Outcomes Based Education approach (Department of Education, 1998). It is attempting to make education more directly productive of "outcomes" in the form of actual skills which students acquire in the course of their education. Environmental education is one area where such outcomes can relate the awareness of students to action in their local environment (Taylor, 1997). This has the potential to contribute substantially to rural transformation if resources are made available to make this policy into a reality in rural schools. Resources within rural schools in South Africa are generally of a much poorer standard than those in urban schools, and this is a factor which contributes to the large number of rural pupils leaving school before even achieving a basic level of literacy (Auerbach, 1978).

Recent trends in environmental education have much in common with the participatory action research approach. Interactive learning processes have been found to be far more effective than the presentation of messages, since social change is not a matter of technical and administrative reform (Popkewitz, 1981). In his doctoral thesis on the development of Share-net as an environmental education resource centre, Taylor (1997) reflects on his earlier approach as an expert: "Instead of the presenter (myself) presenting messages to the audience (target group), the material and even the environmental messages, were 'co-constructed' through engaged processes with participants ..... This led to vigorous debate and active learning sessions where previously participants had simply been enthusiastic listeners". This change from "expert" to "learner" allows the learning process to empower all of those who participate actively. He points out that assuming the role of expert "reflects a distinct power gradient from those who 'know' to 'others' and can be disconcerting" to those who receive the message. Relatively little "message adoption" took place until the approach was changed to one of interactive hands on problem analysis.

Share-net, Umgeni Water and the KwaZulu-Natal Conservation Service have developed a River Action programme, where the students' own local environment is used as a basic instrument in educating him or her about this environment. The River Action Programme has developed learning resources including the Water Testing Kits which NCMP uses, and which are described in Chapter 7. The children are guided through a process of experiential learning about rivers through regular observation of changes in water quality. Facilitating a process of discovery learning which is meaningful for children, however, requires the structuring of

learning situations with adequate resources are available to support this process. The environmental education strategy described in Chapter 7 was developed in a state of restricted availability of resources. However, the multidisciplinary NCMP team has turned out to be a major resource for teachers. This is also linked to an understanding of adult discovery learning, and our physical model of the catchment, our newsletter, and our biomonitoring programme based on the South African River Health Programme, also contribute to its success.

Discovery learning

Hamilton (1995) points out that capturable outcomes of developing good teaching materials include: improving definition of the problem situation; providing a communication framework; and allowing stakeholders to seek their own solutions. This is as true in school-based learning as it is in adult learning, if teachers are prepared to take an outcomes-based education approach. Another important area of support for teachers is in helping them to become facilitators of discovery learning, rather than experts (Hamilton, 1998).

Power gradients also result in gender bias in terms of the provision of educational resources. Boserup (1970) argues that economic innovations often replace women's traditional economic activities with more efficient forms of production controlled by men. Bembridge, Steyn and Williams (1983), in evaluating the KwaZulu Agricultural Extension Service, comment that "the institutional and cultural constraints under which rural women operate in KwaZulu are formidable". Jiggins (1994) points to the importance of educating girls and women if food security and rural well-being are to improve.

Education design processes are in many respects similar to the platforms discussed in the following section, but their development as discovery learning initiatives once again poses the problem of balancing process and product. The danger of arriving with a blue-print about what should be learned and how, is that one stifles local creativity, and also that one defines the problems too narrowly and proposes easily implementable solutions which destabilise local ecosystems or local learning patterns. On the other hand, especially given the relatively chaotic situation prevailing in many under-resourced KwaZulu-Natal schools, a well-structured approach could support teachers in what is currently a very difficult task. Classes are large, resources are few, especially in high schools the level of negativity from students can be very high, and many of the schools lack even basic facilities such as windows and desks (Auerbach, 1978). The general level of amenities in the Mpumalanga/ Ntshongweni area is also exceptionally low, with not a single library in any school or elsewhere, and almost no other recreational facilities (Shangase, 1992).

Helping to stimulate a process of discovery learning has thus formed the focus of environmental education activities in NCMP to date. Some of our experiences are described in Chapter 7, with a focus on the School Environmental Action Club activities, and in Chapter 8 with a focus on adult discovery learning as a tool for developing platforms for designing collective action strategies.

Catchment identity

Another problematic area is that in general people do not see themselves as part of a particular catchment. The concept of a watershed or catchment exists for geographers and water managers, but it is very abstract for most people who regard themselves as living near a particular town or administrative area, or under a particular chief or political leader, rather than in this or that catchment. Here, the NCMP is addressing the problem with three vitally important tools. The first was a physical model of the catchment at a scale of 1 : 50 000, brilliantly built by Margaret Dedekind, which has been an invaluable "conversation piece". People cluster around the model and locate their homes, schools, factories, relatives. Discussion inevitably then broadens to include concerns and problem areas, land use patterns, soil and water resources, and it is very much easier to guide discussion from the known world as expressed by a group of participants.

The second tool is the development of a newsletter designed to help establish a catchment identity. We started by bringing out a description of the problems of the catchment (Auerbach, 1995). This was followed up by a catchment newsletter, which is a crucial part of creating an effective network of active local people. Already NCMP has a difficult (but fascinating) task in acting as a conduit for news and views from diverse people and groups within the catchment. The newsletter serves to focus this function, and make it a little more manageable.

The third tool for building an awareness of the catchment is our River Biomonitoring programme, which the NCMP ecologist has set up with the Umlaas Irrigation Board Catchment Management Project and the National River Health Programme ( Roux, 1997). River Health can be assessed using biological physical or chemical indicators. Biomonitoring focuses on the first of these, making use of the South African Scoring System (SASS) which is a biotic index for the rapid biological assessment of water quality. Biomonitoring using the SASS technique samples benthic invertebrates which live in a variety of habitats in the river. These habitats include stones, gravel, sand, mud or vegetation. Benthic invertebrates are animals such as worms, crabs, dragonfly larvae, water bugs and beetles, fly larvae, and snails which live on the river bottom. A sample is collected in a standardised way from as many different biotopes (habitats) as are available. The invertebrates found in the sample are identified to family level and each is assigned a value based on its tolerance or sensitivity to organic pollution (1 = very tolerant, 15 = very sensitive). ... The habitat is carefully assessed as the greater the diversity of biotopes, the greater the potential biotic index score". Total and average value of Benthic families is combined with the habitat assessment to interpret results (Patrick, 1998). Over time, a good picture of changes in river health emerges.

The South African River Health Programme

Applying an experiential learning approach to involving local people in River Health, the South African National Aquatic Ecosystems Biomonitoring Programme (known as the River Health Programme) has devised a set of methodologies for monitoring ecological integrity, based on the understanding that a healthy ecosystem depends upon social well-being, economic development and ecological integrity within that ecosystem (Roux, 1997). Some aspects of social well-being and economic development have been discussed and will be discussed further in the balance of this chapter. The approach to monitoring ecosystem integrity is briefly discussed now, as the Mlazi River is one of the pilot rivers to be monitored

in the River Health Programme, and NCMP serves on the Provincial Implementing Team of the programme in KwaZulu-Natal. "The in-stream biological condition of a river ecosystem is determined by a multitude of factors including its geomorphological characteristics, hydrological and hydraulic regimes, chemical and physical water quality and nature of riparian vegetation. Since the resident aquatic communities integrate and reflect the effects of all these and other chemical and physical impacts occurring over extended periods of time, they are regarded as good indicators of overall ecological integrity" (*Ibid.*).

Biological monitoring or biomonitoring is based on the assumption that measurement of the condition of aquatic communities can be used to assess the condition of the associated ecosystem. In the operational context, the term aquatic biomonitoring refers to the gathering of biological information in both the laboratory and the field for the purpose of making some sort of assessment, decision or in determining whether quality objectives are being met regarding the aquatic environment" (*Ibid.*). "To address the current need for information regarding the overall response of the aquatic environment to multiple stressors, the South African Department of Water Affairs and Forestry has launched an initiative to develop a national programme for monitoring the health of aquatic ecosystems" (*Ibid.*).

"A monitoring programme is usually developed in response to a need for information. The programme design *per se* will, however, not provide the required information. The design needs to be implemented, and the programme must be maintained and modified through ongoing learning, to match our evolving information needs" (*Ibid.*). It is heartening to see that the programme designers are aware of the dangers which Holling warned (1995). Roux's design phases start with the framework design and the conceptual design, which have both been completed. The implementation design is currently underway, and NCMP is part of the "Pilot application and prototyping" process. The process will now include the selection of "Reference sites" (relatively unimpacted sites) in all 18 South African bioregions, as well as "monitoring sites" (sites identified as important in assessing the condition of a river or reach known or thought to be experiencing an impact on water quality or habitat degradation (Roux, 1997).

In the case of the NCMP river biomonitoring programme, our ecologist has selected the South African Scoring System version 4 and the Habitat Assessment Matrix as the primary tools for monitoring (*Ibid.*; Patrick, 1998). These will be monitored three times annually, and will be supported by occasional Fish Community Index and the Riparian Vegetation Index determinations.

### 3.6 Designing platforms for negotiating about resource use

Sustainable natural resource management means that some decision-making and intervention capacity must be created at a level of social aggregation which is appropriate for the ecosystems that need such management. Ecosystems are thought of as "hard systems" studied by biophysical scientists who are convinced that reality exists independently from the observer. Platforms are "soft systems" created by activists and social scientists who believe that things change through people's actions. If sustainability is desired it is necessary to couple ecosystems and platforms so that society can move from exploitation of resources towards

sustainable management. Once again, various land users will have varying perspectives and priorities, and the step of exploratory analysis will have to precede the building of resource use negotiation platforms. Once there is communication on the basis of some shared perceptions, it is possible to help people start with the design process (Röling, 1994). Röling distinguishes three stages in the process of bringing about collective action:

- First, exploratory analysis for each group: initial intervention, social analysis (in the case of NCMP, Participatory Rural Appraisal, Vision building, Participatory Land Use Planning, see Chapter 6). In our case, the groups can be formed for each of the seven main land-uses (large-scale agriculture, small-scale agriculture, forestry, grazing, industry, urban and conservation). We started with the most marginalised category, and this was important - they might not have had any attention otherwise; as it is, only a few small-scale agricultural communities have been helped so far.

- Second, platform building: groups within the catchment are put in touch with one another (in NCMP, building a catchment identity using a physical model of the catchment, developing a newsletter, supporting conservancies, linking groups to local, provincial and national government structures).

- Third, drafting and implementing a plan for collective management (in NCMP, an initial draft catchment management plan. This is an iterative on-going process of negotiating, implementing, monitoring, evaluation and re-planning.

The third step, in fact has two components, planning and implementation. I have illustrated this process in Figure 10 as discreet phases, although the first does not have to be complete before the second is started. It is certainly dangerous to start developing or implementing catchment management plans before there is broad representation from the different types of communities involved. There is a great danger of catchment managers trying to hurry along a draft catchment management plan before the local organisations are strong enough to be represented adequately.

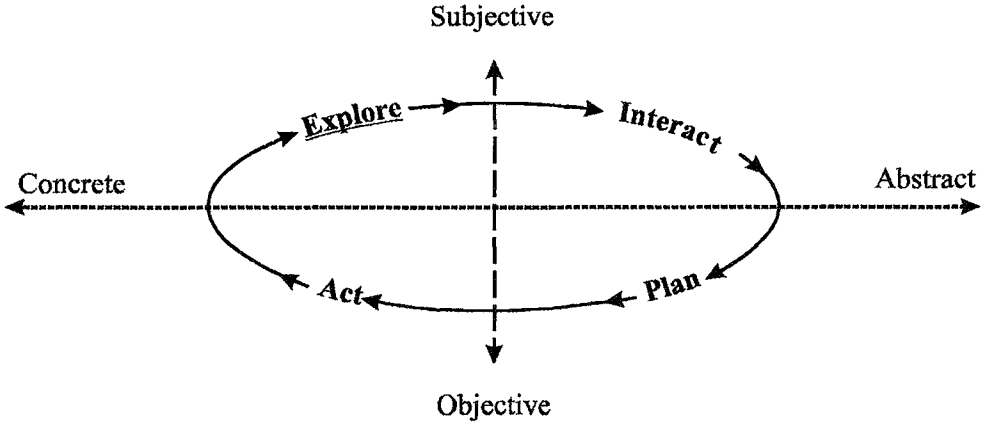



**Figure 10 : Steps in platform building**

The first and second steps are far more important to integrated catchment management than the third. Görgens *et al.* (1997) point out that end-users of any development must be drawn into planning and management aspects if participatory catchment management is to succeed. Each activity should in itself be a cycle of experiential learning, following the cycle described in Figure 4 (experience, reflection, conceptualisation, experimentation), and the similarity between the two processes shows how platform building is a special case of experiential learning.

In attempting to bring people together to look after a catchment or sub-catchment, three aspects are of cardinal importance: local credibility and acceptability, a willingness to engage with local people in analysing the problems together and the provision by the implementing agents of resources which are seen by local people as useful. Here again what Taylor (1997) has to say about power relationships is very relevant. As environmental educators, Taylor and his colleagues started off believing that they had knowledge which had to be transferred to a "target group" through a "message" which would create awareness. He points out that this orientation reflects a distinct power gradient from those who "know" to "others" and can be disconcerting to those who receive the message. Relatively little "message adoption" took place until the approach was changed to one of interactive hands on problem analysis.

Discussing the socio-economic sustainability of land use systems, Röling (1997) argues that human survival currently depends on society-wide learning and on collective action at household, community national and global scales. The mission of agricultural science is to develop the best technical means towards increased productivity, and more recently efficient use of natural resources, "But in a situation where human activities are such a great threat to society, such a mission defines the agricultural sciences as part of the problem, not the route to the solution. There is no technical or economic "fix" to be discovered by science. ... This is a challenge too for social scientists. They must leave their comfortable inward-looking disciplinary nests and expose their ideas to the scrutiny of those whose understanding of the state of the environment leads to an urgent need for "ideas that work". The challenge is transforming "the human project" from becoming as rich and comfortable as possible, to living within our ecological means.

Coupled systems

According to Röling (1996) interaction means the active participation of those being researched in the construction of the "findings" about themselves. Since reality is not imprinted on the mind but is constructed in inter-subjective sense making, collective learning about our environment is a necessary condition for understanding how we can adapt to ecological imperatives, and for formulating the norms and criteria which ensure that we act within our ecological means. Referring to Figure 10, this process is one of exploration, of trying to gain understanding of the resource base, or in terms of the experiential learning cycle (Figure 4), grounding understanding in practical experience.

Platforms for land use management are thus needed when natural resources are perceived to be in need of collective management for sustaining their ecological services. The use of the natural resource is usually contested among stakeholders, who exploit it with conflicting objectives, and who increasingly experience the negative impact of their own and other stakeholders' use of the resource. Therefore, the only way to manage it in a sustainable

manner is to construct a soft system among the stakeholders, based on shared learning, negotiation and accommodation, so as to take stakeholders along a learning path towards effective platform development (Box 5).

Within ICM, coupled systems are essential if "hard" ecosystems and "soft" natural resource management platforms are to work effectively. As Roux (1997) comments in discussing the South African River Health Programme "The success of the [programme] will to a large extent be determined by the effectiveness of communicating results to the different target audiences" and "neither the South African Department of Water Affairs and Forestry nor the Institute for Water Quality Studies has the regional infrastructure or resources to implement or maintain the programme on a national basis. To achieve implementation and ongoing maintenance ... shared custodianship and partnerships will be required to accumulate a sufficiently large resource base to sustain the programme" (*Ibid.*). The same is true for ICM as an approach, and this has been the experience of NCMP in bringing together scientists, resource managers and other catchment residents. Learning and making the state of the land visible affect the norms and values of stakeholders, and leadership can bring about effective collective action and resolve social dilemmas.

**Box 5: Coupling "Hard" and "Soft" systems for sustainable land use (Röling, 1997)**

"Land use can be considered as a system that couples (1) a system perceived as hard and (2) a platform. Coupling occurs through adaptive management which is based on:
- learning
- making visible the state of the land
- monitoring the impact of human activity
- negotiated agreement with respect to the norms for sustained use of the land
- collective action, for example with respect to resolution of distributive conflicts.

Such a coupled system seems essential for *sustainable* land use, because it is only in such coupled systems, at different system levels, that negotiated self-restraint of human greed seems possible."

**Social dilemmas (Ostrom & Schlater, 1996; Röling, 1997)**

"Understanding social dilemmas and the conditions under which people are willing to opt for the collective choice is a key issue in sustainable land management." This is so particularly where common pool resources have to be managed, and exclusion or control of access by potential beneficiaries is problematic, and where each user is capable of extracting from the welfare of all other users. This is particularly relevant to natural resources involved in sustainable land use.

Participatory catchment management (PCM) has been applied in a number of Asian countries over the past twenty years. Recently, a workshop was held in Nepal bringing together representatives from ten countries with well-developed participatory approaches to watershed management (Sharma, 1997). The workshop showed some remarkable similarities among the case studies. In the Philippines, Sri Lanka, Thailand and India, clear leadership was important in initiating and building the organisation of PCM. Although this was important for starting PCM, there is also a danger of programmes becoming too dependent on one leader. Building management mechanisms was essential, according to most countries. One important element of management is communication networks which allow for democratic decisions and equitable distribution. Finally, people need to obtain confidence in their own capabilities to meet their needs. So ownership of the process by local people, as well as ownership or control of the resource base, are essential. Some countries gave 25 or 50 year land use agreements for state land.

Under the heading "Benefit generation" Sharma comments "In all the cases reported, there was also significant enrichment of social, spiritual and cultural life of the local people, which created better community feelings and strong bonds. Better appreciation of nature's gifts, and better relation with nature and the universe have helped develop confident human beings. This also created a better and a secure social life. ..... In the past, many soil conservation, reforestation and other watershed development activities have been financed by many governments and donors which did not generate any benefits to the people while they were asked to participate in them". Sharma also reports that although special efforts were made in the terms of reference to identify how women had been involved, and whether they had actually benefited from PCM, not one woman attended the workshop, and little quantitative gender-segregated data was available to analyse this aspect.

### 3.7 Values and spirituality in design

The above discussion of design as applied to a range of topics relevant to ICM points to several common elements in the design process. Firstly, design is, by its nature, integrative. It is concerned with synthesising knowledge in a decision-oriented way, so that new things are invented, new processes arise. At the individual farm or forest level, design requires an understanding of the systems involved. As Checkland (1981) points out, complex inter-relationships require an understanding of entire systems. Checkland distinguishes between "hard" systems (such as computer systems, or even classical ecosystems) which take the world to be systemic, and "soft" systems (such as Röling's platforms) which assume that the world is problematic. In order to integrate hard and soft systems thinking, Dangbégnon adopts a coupled systems approach to ICM in a range of case studies in West Africa (1998). He found that understanding cultural norms such as the West African invocation of nature is important in adaptive resource management design. Purposeful problem solving brings together detailed knowledge about how elements of local ecosystems operate with an understanding of local values and cultures.

Argyris, Putnam & Smith (1985) show how normative, strategic and tactical levels of decision making all contribute to the design process. Agricultural scientists too often operate only at the strategic and tactical levels, while social scientists often operate mostly at the normative

level. This gives rise to what Chambers (1983) describes as the conflict between technical intervention, which though it may not understand local social systems, at least does try to solve problems, and the often highly negative condemnation of these technical interventions by social scientists. With the wisdom of hindsight, social scientists often analyse why what was done was totally inappropriate! By bringing together a soft systems approach to platform building and education and hard systems approaches to the various fields of ecological farm design, wetland rehabilitation, rainwater harvesting and forestry and agroforestry design, the strengths of local and outside knowledge can be coupled with participatory processes to lead towards more sustainable natural resource management. This combination of technical and social skills has been advocated by many writers recently (e.g. Chambers, 1983; Conway, 1994; van der Ploeg & van Dijk, 1995; Hamilton, 1995; Röling & Wagemakers, 1998). In conflict management and adaptive resource management, NCMP has adopted a coupled systems approach, in line with Bawden's recommendation that the University of Natal should be critically coupled with the communities which it serves (Bawden, 1993).

The technical approach to production fits into the realm of logical positivism, while equity, conservation and sustainability, with their social perspective, fit more into the constructivist realm. However, without the unifying effect of vision based on an ethical approach to a future which is lawful, just and inspiring, little seems to change in practice. This third aspect is referred to by Sharma (1997) in reviewing Asian ICM experiences, and is closely related to leadership. It is also partly addressed by van Eijk's concept of experiential spirituality as a different mode of operation to the single reliance on thinking-being, or discursive mind so common in the western world (1998). Just as Bawden (1995) states that innovation is an emergent property of soft systems development, van Eijk states that sustainability is an emergent property of experiential spirituality and rational morality based on negotiated agreements, and claims that the agency of transcendental consciousness facilitates the management of multiple aspects of development. Sustainability is an integrative, holistic property which encompasses wholeness in human beings and wholeness in society. Thus van Eijk concludes that "The attunement of hard, soft and critical systems thinking is not hindered so much by the difference between hard, soft and critical as by their common element, i.e. the reliance on thinking-being as the only possible mode of being".

Here, van Eijk is drawing on the ancient Indian *vedantic* teaching which distinguishes between discursive mind and intellect (see *Bhagavad Gītā*, 2:54-72). The question is put "What is the mark of a man of steady knowledge?", and the answer given is that the capacity of humanity to transcend desire and opinion is developed through leading a disciplined life where discursive mind is brought under control the control of reason through meditation. The *Bhagavad Gītā* and many of the *Upanishads* point to the higher knowledge which lies beyond the grasp of the physical senses. The Judeo-Christian, Moslem and Buddhist traditions are equally clear on the need for truthfulness, moderation and discipline. Covey (1989) reviews two thousand years of literature on leadership, and concludes that for all except the past few decades, these were the qualities which a leader had to master. Only recently has what he calls "the ethic of character" been replaced by "the ethic of personality", where leaders are encouraged to appear confident, shake hands with a smile, and attend to marketing themselves as charismatic personalities. The values which society accepts are thus clearly dependent on whom society accepts as its leaders. Let us therefore look at what leadership is.

### 3.7 Leadership

MacLaren (pers. comm., 1994) points out that the real government of society is carried out by the operation of the ordinary standards of behaviour and conduct of the people themselves, who decide what is acceptable. The behaviour of those people whom society accepts as leaders thus has a formative effect first at a normative level, and later at the level of general behaviour. This real government of society is based on law. In the eighteenth century Blackstone published his "Commentaries on the Laws of England" (1765). Since these examined from first principles the nature of law and of government, and the design upon which they are based, it is worth considering the relevance of what he had to say to leadership, vision and values. Blackstone argues that man is subject to the laws of his creator, as he is an entirely dependent being. He depends absolutely on his maker for everything. The will of his maker is called the law of nature. The opening pages discuss the first principles of law, drawing on the fifth century legal code of the Roman Emperor Justinian, who reduced the whole doctrine of law to three principles: live honestly, hurt nobody, render to every one its due.

Blackstone argues that it is the nature of man to pursue his own happiness. In order to discover which actions produce or destroy man's real happiness, it is necessary to have recourse to reason. If reason were always clear and perfect, unruffled by passions, unclouded by prejudice, unimpaired by disease or intemperance, the task would be pleasant and easy, and we should need no other guide than this. However, we find that our understanding is full of ignorance and error. We therefore must also resort to divine law to supplement our understanding of the law of nature. In addition, we develop civil law "commanding what is right and prohibiting what is wrong". Our wants and fears, our sense of weakness and imperfection, keep us together. The solid and natural foundation of society is that "the whole should protect its parts and that every part should pay obedience to the will of the whole; or, in other words, that the community should guard the rights of each individual member, and that (in return for this protection) each individual should submit to the laws of the community". Government arises to keep society in order.

MacLaren (pers. comm., 1994) links Blackstone's argument to the qualities which a leader requires. The true leader leads because he obeys. He obeys the law of nature, sees the situation as it is and responds to the needs of society. Covey (1989) defines leadership in a similar way, pointing out that people develop from a state of dependence as babies and children to an apparently independent state, which adolescents prize highly. If further maturing takes place, people begin to recognise their interdependence, and as Blackstone puts it "the whole protects its parts". Each individual contributes towards our understanding of human existence. At the heart of this picture of humanity is the conviction that it is natural for people to seek the truth.

While positivism seeks to discover new knowledge about physical phenomena ("hard"systems) through careful analysis and synthesis, and constructivism investigates "soft" systems and learning pathways through communicating and building platforms for interdependent collective action, visionary leadership requires obedience, clarity and a willingness to serve the needs of society. This is a truly monistic approach which moves towards unity, rather than separation. The three perspectives can be likened to a journey from an individual view of simple reality (a

farm and its technical production problems), to an appreciation of diversity and the constructed realities of a wide range of social actors (requiring platforms and social design and management of complex ecosystems), towards a vision of the entire system of creation, supported by one consciousness and a designer who understands the elements within the system perfectly, and who turns out to be the innermost self. Figure 11 illustrates the relationship between these three design systems.

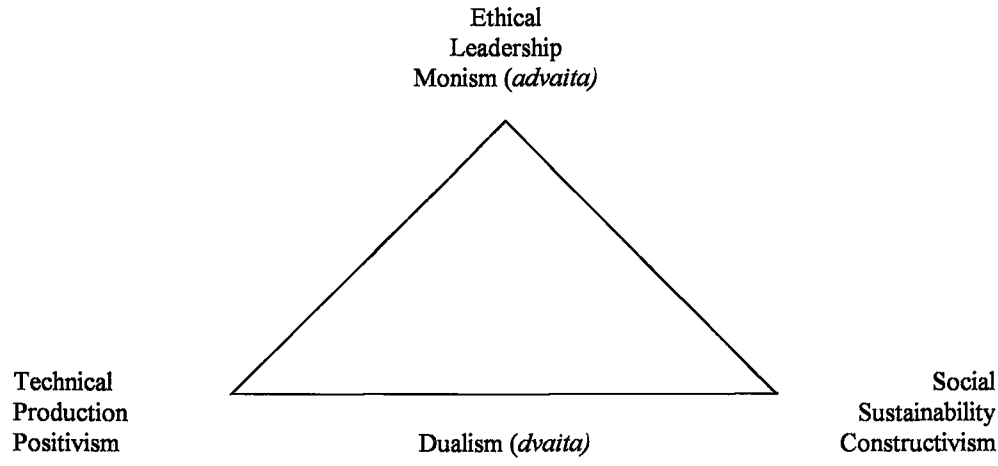



**Figure 11: Design considerations for technical, social and spiritual parameters**

While operating in the physical world, dualism is the common experience; there is subject and object, there is the physical world which can be known and the world of faith or intuition. In the physical world, design can be relatively linear and technical, where an objective may be defined, a process designed and implemented, and the desired result or new situation achieved (see Figure 5), or when people are involved in the more complex social design processes, where defining the objectives requires social learning through negotiation and discovery. When considering the world of ethics and leadership, it is possible to leave the dualistic world of thinking in which there are diverse opinions, to unite meditatively with the consciousness which underlies all of the creation.

According to de Vries (1998) the leader of the future has four tasks:

* Develop and implement vision; this creates order out of chaos and provides a route into the future. Among colleagues, this can help build confidence that they know what their goals are and they feel able to attain these goals.

* Create appropriate structures; these should support the efficient achievement of the vision.

* Seek and implement community values; this must be done in such a way that colleagues internalise these values and live according to them.

* Motivate and mobilise colleagues to achieve their own vision; personal development becomes a goal of the organisation. Effective leaders are convinced that given the right support and responsibility, their colleagues will be able to stretch their wings and fly. Moreover, effective leaders believe that this process of personal development is the goal of leadership. All people in an organisation are seeking meaning and identity. Successful organisations are able to create in their staff a feeling of belonging to a community, taking pleasure in their work and believing that their efforts can really make a difference.

De Vries says that organisations with such leaders have three meta-values in common: love, pleasure and meaningfulness. Meaningfulness is the antidote to the deadly poison of human anxiety. Pleasure removes the rigid division between work and free time. Love is a word that does not often appear in books on management. According to de Vries, it makes amazing things possible in organisations. Trust and respect grow out of caring and human relationships. Where there is trust, learning is possible. The combination of learning and trust makes shared leadership possible. Shared leadership can be spread throughout an organisation, and this makes it truly dynamic.

Leadership, chaos and organisations

Reviewing this chapter on design, the initial theme of synthesis based on sound analysis deserves to be recalled. In designing integrated catchment management systems, one is dealing with complex natural systems, which, as Holling pointed out, should not be over-simplified. One is also dealing with complex social systems, where respect for the opinions of others is important. At the normative level, one has to understand how the values of society are established, if sound leadership is to be given in developing new institutions. Physics has adapted over the past twenty years from a mainly linear mode of operation towards methods which help physicists to grapple with complexity (Gleick, 1987). The emergence of "chaos theory" as a discipline of physics and mathematics which examines non-linear processes is described by Gleick as follows: "Where chaos begins, classical science stops. For as long as the world has had physicists enquiring into the laws of nature, it has suffered a special ignorance about disorder in the atmosphere, in the turbulent sea, in the fluctuations of wildlife populations, in the oscillations of the heart and the brain. The irregular side of nature, the discontinuous and erratic side - these have been puzzles to science, or worse, monstrosities".

Capra (1996) outlines the development of systems thinking, and argues that although much of modern systems theory arose from cybernetics and computer development, it has its roots in biology, gestalt psychology and ecology, and proceeds from the understanding that living organisms function as integrated whole systems. The mechanistic paradigm which underlies the discoveries of Galileo, Descartes and Newton in the seventeenth century is analytical, and views the world as a perfect mechanism governed by exact mathematical laws.

The precision of the natural world was beautifully understood by Cartesian mechanism, and much of modern science is based on the insights and methods developed by these pioneers, in spite of Capra's dismissal of mechanism. Nevertheless, Descartes shared with Kant a dualistic

conviction that mind and matter are separate. He was convinced that the material world "could in principle be understood by analyzing it in terms of its smallest parts"(*Ibid.*). In tracing the development of systems theory, Capra discusses the difference between Neumann and Ashby's more Cartesian, mechanistic understanding of organisms, and Wiener's understanding of the importance of feedback, which gave rise to the word "cybernetics". *Kybernetes* is the Greek word for a steersman, and Wiener defined cybernetics as the science of "control and communication in the animal and the machine". Like the steersman of a boat, feedback allows living organisms to become self-regulatory through self-balancing and self-reinforcing feedback.

Writing about leadership within organisations, Wheatley (1992) links the new physics and biology which Capra describes, to organisational development. Agreeing with Capra and Wiener, she rejects pure Cartesian mechanism, and cautions against confusing control with order. "If organizations are machines, control makes sense. If organizations are process structures, then seeking to impose control through permanent structure is suicide". As with physics, one cannot predict exactly what will happen in organisations, but one can begin to see certain patterns, a whole system creating the conditions that lead to the sudden jump. Like de Vries (1998), she believes that structures which facilitate relationships are crucial to the development of effective organisations, and that effective leaders create these in a way which facilitates shared leadership. Just as Remmers (1998) compares the farmer to a jazz musician, so Wheatley uses the metaphor in discussing leadership. "As leaders, we play a crucial role in selecting the melody, setting the tempo, establishing the key, and inviting the players. But this is all we can do. The music comes from something we cannot direct, from a unified whole created among the players - a relational holism that transcends separateness. In the end, when it works, we sit back, amazed and grateful".

She also points to the importance of feedback mechanisms: "For many years scientists failed to notice the role positive feedback and disequilibrium played in moving a system forward. In trying to preserve things as they were, in seeking system stability, they failed to note the internal processes by which open systems accomplish growth and adaptation." The importance of feedback in ecological agriculture has already been mentioned.

In conclusion, Wheatley points to the importance of being awake to changes moment by moment: "In this new world, you and I make it up as we go along. Not because we lack expertise or planning skills, but because that is the nature of reality. Reality changes shape and meaning because of our activity. And it is constantly new. We are required to be there as active participants. It can't happen without us, and nobody can do it for us. ..... But in the midst of muddle ..... we can walk with a sure step. For these stairs we climb only take us deeper and deeper into a universe of inherent order".

This chapter has attempted to capture a variety of aspects of understanding this inherent order in the universe, with regard to technical, social and leadership design. In the next chapter, the subject matter shifts from the conceptual framework to the contextual framework, with regard to South Africa, wetlands, integrated catchment management and the Mlazi River catchment.

## Chapter 4: THE SOUTH AFRICAN CONTEXT

### 4.1 Small scale farming in South Africa

Small scale agriculture in South Africa suffers from three major constraints: the first is the often low and erratic rainfall in a hot climate, making rainfed production very risky. A second problem is rural poverty, which results in little money being available for inputs, relatively few skilled people (especially with management skills) remaining in rural areas and a profound lack of confidence on the part of many rural women concerning their capacity to change their lives for the better (Wilson & Ramphele, 1989; Cross & Preston-Whyte, 1983). Finally, land tenure and access to good quality arable land are factors which result in few rural families having secure access to more than one hectare of land (Kockott, 1993). Consequently, any strategy to stimulate small scale agriculture should address aridity, poverty and access to land as major factors in proposed development programmes. This must be remembered in developing policies or strategic frameworks for rural development.

Inclusion of the majority of rural people in the process of land reform has been shown to be a major part of successful land reform, as the analysis of Hebinck & van der Ploeg in Section 2.6 made clear. They showed that where the majority of rural people were excluded from the benefits of land reform, as happened in Peru, the rural people were alienated and refused to accept the policy, resulting in a second revolution.

This is described by van der Ploeg (1998) as a strange paradox: on the one hand, land reform is initiated in order to give "land to the tiller"; on the other hand, World Bank recommendations would exclude 90 % of rural South Africans from farm ownership on the basis of their definition of an "economic holding". In reviewing South African Land Reform Policy, van der Ploeg comments that the approach recognises the need for involvement of both state and private enterprise. In the words of Derek Hanekom, Minister of Agriculture and Land Affairs, the process is "not state driven, but state supported". The repeal of the Sub-division of Agricultural Land Act (Act 70 of 1970) opened the way for smaller units, but van der Ploeg comments that this does not imply the creation of a host of non-viable farms. Rather, the interaction of intensification, scale, time and off-farm employment make for a more dynamic approach to landuse as one element of economic viability. Land reform will thus have to go hand in hand with research into small scale commercial agriculture. At present, over 11 million rural South Africans live in poverty on holdings of less than one hectare. Land reform must look at how many of these can become small scale commercial farmers on farms ranging in size from five to fifty hectares. Pragmatically, NCMP accepted that in the short term, helping resource poor rural women to use the land they have access to productively and sustainably would contribute both to improving food security and to increasing the level of agricultural skills of those who wish to farm.

Historically, the South African Department of Agriculture served 60 000 white commercial farmers until the democratic elections in 1994. There had been various half-hearted attempts to offer some support to small scale agriculture in the so-called homelands, mainly based on the recommendations of the Tomlinson Commission that "Betterment planning" should be introduced. This meant a planning exercise to bring rural residents together into villages where services could be provided, while more efficient agriculture could proceed on the fields,

carried out by those who wished to farm commercially. The idea of the "economic holding" was also a part of the Tomlinson Commission recommendations (Auerbach, 1991), which attempted to deprive "peasant farmers" of their small pieces of land in exchange for a garden plot. The idea was to consolidate rural peasant settlements in areas where services could be provided, and thus make room for a few black commercial farmers. Implementation of betterment planning caused widespread unrest because of the way in which it was imposed on rural people. This legacy is one of the reasons why the new South African government has firmly rejected World Bank suggestions concerning land reform around relatively large economic holdings.

Given the history of South Africa it is hardly surprising that agricultural development has been drastically skewed in a number of directions: black citizens have been systematically deprived of title to land as well as access to land, and government policies aimed at maintaining political support in the rural areas have propped up inefficient farmers, while at the same time attempting to control the marketing of agricultural commodities through a range of control boards. These distortions contributed to a situation where the country had in 1988, perhaps 3000 good farmers (in commercial terms at least, as they were producing some 40% of the total agricultural product). Another 10000 farmers were surviving economically (producing a further 40%), while most of the rest of the white commercial farmers were in the grip of a debt crisis of frightening proportions (Huntley *et al.*, 1989).

In the past decades, the monetary policy of the government has inflated input prices, while food prices have been kept down by low consumer demand because of the recession. The removal of subsidies and the decrease in the political power of the rural lobby have also contributed to the worsening terms of trade experienced by commercial agriculture. Coupled with droughts and floods, this has affected red meat and summer grains particularly badly. Other commodities (especially those with substantial export markets, such as sugar, wine, deciduous and citrus fruits and some high value vegetable crops) have prospered, partly due to currency depreciation, and partly to the opening up of the export market to South African produce during recent times (Auerbach, 1997).

Government policies in the past allowed commercial livestock farmers to carry more stock than the land could support, and while these farmers profited from their heavy stocking rates in the good years, they were secure in the knowledge that they would receive help in times of drought. Black livestock farmers on the other hand, were harassed by a range of "livestock reduction schemes" aimed at reducing their cattle numbers without offering any marketing support to ensure that they obtained a fair price for animals sold (Kockott, 1993). Black farm labourers were employed under poor conditions, and since farms are geographically scattered and farmers generally hostile to unionisation, this sector of the labour force is still the most underpaid, uneducated and socially fragmented of all.

These policies in this ecologically sensitive environment have led to the current situation, where most of commercial agriculture is not sustainable at present. This is true socially, economically and environmentally. While the total contribution of agriculture to the Gross Domestic Product (GDP) declined from 11 % in the sixties to 4 % in 1991, and food production has increased by only 0.6 % per annum over the decade of the eighties, population has increased by 2.4 % per annum over the same period (Bawden, 1993). Although the

contribution of food exports to the GDP increased from less than 8 % in 1994 to almost 10 % by 1997, and the share of processed agricultural products increased from 34 to 50 % over the same period, agriculture's contribution to the GDP is still under 5 % (Department of Agriculture, 1998). The opening up of international markets to South African exports has provided a welcome boost to agriculture, but the long term prospects are still a major cause for concern, and require major structural reform to improve productivity, equity, stability and sustainability.

Poverty is still a characteristic of the rural areas (72 % of poor people live in rural areas, and 70 % of people living in rural areas are poor). This means that out of 23 million South Africans, 16 million live in poverty, and over 11 million of these are in the rural areas (Department of Agriculture, 1998). As the above-quoted Discussion document on Agricultural Policy in South Africa makes clear, this highlights the fact that although national food self sufficiency is adequate, food security at household level is not (see Figure 2). Home gardens and community gardens are an important strategy for improving this situation, and in particular the position of rural women, who form the majority (often as much as 75 %) of the rural population, will depend on ensuring that programmes make resources available effectively to rural women.

This has fairly dramatic implications for future agricultural policy in South Africa, and certain strategic choices will have to be made about resource allocation. Policy can emphasise national self sufficiency, maximising food production through "Best technological means" (Goewie, 1997), while ignoring equity and environmental issues. This would involve more government subsidies for commercial farmers in order to ensure that the nation as a whole has enough food. The emphasis would be less on land redistribution and more on helping efficient farmers to expand production. This corresponds to the "Production" perspective in Figure 2.

The socio-political perspective would emphasise equity issues such as household food security and access to the land. This would have cost implications for farmer support and land redistribution. If carried out efficiently, this approach would see long term growth in food production, but in the short term, as inexperienced farmers replace experienced and established commercial farmers, food production could decrease with a corresponding rise in food prices (the "Equity" perspective in Figure 2). A third perspective is environmental conservation, emphasising long-term survival and the preservation of the nation's resource base. The emphasis would be on increasing revenue and job-creation from eco-tourism development and probably large-scale food imports. Again, long term benefits would have to weighed up against short term costs and possible food shortages and price increases (the "Conservation" perspective in Figure 2).

Reconciling these perspectives into a long-term, people-oriented approach to sustainable agriculture, means bringing more people into commercial agriculture while maintaining our food producing capacity. Such an approach to developing more sustainable farming systems must be done in a way which avoids the mistakes which Europe, Australia and the United States have made to their cost. Technology has a role to play, but local people must be left in control of their development and production options (van der Ploeg, 1995; Röling & Jiggins, 1998). Systems based on the needs of our thin and fragile soil skin must be developed with local people. This approach is equivalent to the "Sustainability" perspective in Figure 2.

However, sustainability demands economic viability, which is intimately linked to political considerations such as access to land and farm size. Lyne (1990) points out that the variable costs of production may indicate that one system is more or less efficient than another, and the hourly return to labour may be more or less favourable, but unless the size of the farm is large enough to produce a total annual income larger than the net total annual income available from outside employment, no migrant workers will be attracted back to the farm unit. While economic measures such as gross margin analysis can give valuable insights into comparative efficiency, the importance of fixed costs must not be forgotten; if a family member cannot get work elsewhere, or is tied to the rural area for other reasons such as child care, then it is valid to consider the value of re-allocating labour from one duty to another. If, however, a choice has to be made between an off-farm job or working on the farm, then the annual income must be considered against total annual farm income. In the Mlazi River catchment, with its close proximity to Durban and Pietermaritzburg, off-farm employment is a more viable supplementary strategy than it would be in more isolated areas.

In such a case, Lyne argues, the fixed costs of farming include the loss of off-farm earnings. Fixed costs must be divided among the total number of hectares farmed; doubling the farm size from one to two hectares will halve the fixed cost per hectare. Lyne (1990) argues that farms of up to five hectares generally cannot attract semi-skilled workers back to the farm, but that once the farm unit exceeds five hectares, the economic returns become more favourable. In this regard Boserup (1970) cautions that it is often the women who are expected to carry out the extra work when larger areas are ploughed; unless extra help can be employed, women may be forced to reduce the amount of time spent on household tasks, or on social or leisure tasks. Lyne (1990) does allow for this increased burden by recognising the increasing value of leisure time as production or farm size increases. Again, extrapolation of this argument would lead to the danger of recommending "economic holdings" which are so large that they exclude substantial numbers of rural people. Lyne, Ortmann & Vink (1991), aware of this danger, subsequently argued that the development of a land rental market would contribute substantially towards making Southern African agriculture more profitable and efficient, and thus more sustainable, without developing a landless class. Tenure would be retained, but secure, long-term lease arrangements would safeguard both the owner and the farmer. They show that both the adoption of technology and the production of surpluses are positively correlated with farm size and the renting or borrowing of land.

These arguments serve to underscore the sensitivity of farm production to economic and political factors. Without commitment to addressing the problems of rural poverty by a re-allocation of resources and policies to support an affirmative action programme for small-scale farmers, change in the quality of life of rural people is not likely to be linked to agricultural development; more likely if it does happen at all, it will be linked to industrial development, either in the urban-industrial areas or, if the example of Taiwan is followed, through a decentralised integration of the industrial and agricultural sectors (Erskine, 1991).

Professor Finis Welch (1978) points out that farmers are averse to risk, and cannot afford to experiment very much with uncertain production systems; experimentation is however, one of the main ways in which farmers gain knowledge about production. Welch points out that if improvements are widely accepted this in turn impacts upon the prices obtained in the area where they are adopted. Large-scale increases in maize production may also have the effect of

saturating the local market for maize, and dropping the farm-gate price, unless a land-market can be developed which will allow farm size to increase without creating a landless class. In his paper 'The role of investments in human capital in agriculture', Welch (1978) shows that education levels affect production and sales, and argues the case for the importance of such investments. Bawden (1992) points out that experiential learning links the process of "finding out" to "taking action": what has been found out affects what will be done, and what has been done will affect future ways of finding out.

Thus sustainability in agriculture is dependent upon adequate resources being made available to educate farmers as much as on access to economically viable land units, food sufficiency and efficient use and stewardship of natural resources. Lyne's analysis of a minimum viable economic unit of some five hectares did inform our purchase of Bachs Fen, seven hectares in extent. Although such a small farm may not be expected to yield net farm incomes of the same magnitude as large commercial farms, the option of part-time off-farm employment, or full-time off-farm employment for some family members is very much in line with historical practice in South Africa.

Furthermore, establishment of small scale farms which are able to demonstrate ways of dealing with the risks imposed by low and erratic rainfall is an important aspect of farming systems research. The importance of developing working examples of small scale ecologically sound commercial holdings has as much to do with education as it has with research. Bachs Fen Ecological Research Farm therefore attempts to show one model which at a scale small enough to include a large proportion of the rural population, but just large enough to provide significant income potential. Clearly, the optimum size will vary depending on soils, climate and proximity to markets and off-farm employment. In addressing the problem of increasing water availability through water harvesting, Bachs Fen deals with one of the major constraints to small scale agriculture.

## 4.2 Agro-ecological zones and water scarcity

Tainton (1981) says that rainfall is the factor which most clearly defines the development of plant communities in South Africa. Approximately two-thirds of the country receives less than 500 mm of rain per year. The eastern seaboard is the wettest region, experiencing an annual rainfall of 600 - 1000 mm. The drier areas also show an increased variability in rainfall, as well as an increased rainfall intensity. There are many heavy storms of short duration. Runoff is therefore high and the efficiency with which the rain can be used by plants is correspondingly low. Although there has been a regular series of wet and dry spells over the century, following an eighteen year cycle (Maree & Casey, 1993), rainfall uncertainty is high, with uncertainty in the dry areas being higher (varying from 25% to 250% of long-term average). The following figure, taken from Backeberg *et al.* (1996) shows distribution of rainfall throughout Southern Africa (Figure 12).

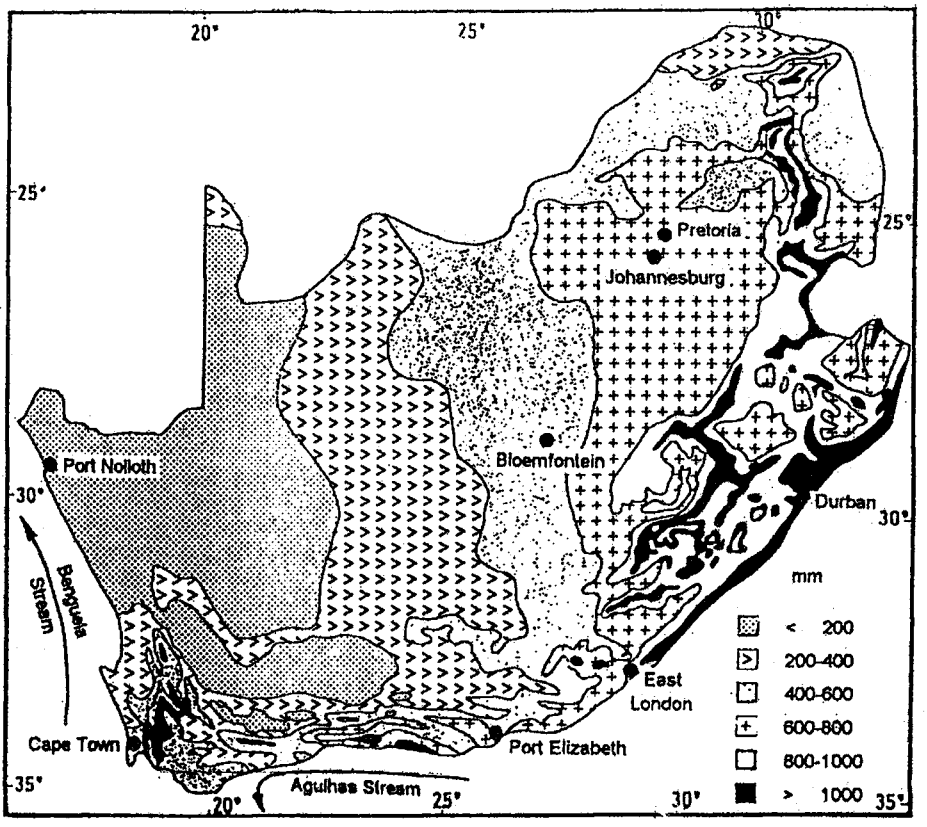



**Figure 12: Mean Annual Precipitation for South Africa (after Backeberg *et al.*, 1996)**

Because of low and uncertain rainfall, poor distribution of rain, high rainfall intensity and broken topography, vast areas of the country are best suited to extensive grazing of livestock. This also has implications for establishing large numbers of small scale commercial farmers in areas where infrastructure would be very costly to provide, and where isolation and climate militate against the development of marketing opportunities for small operators. Because of the rainfall patterns, the production of staples such as maize and wheat is hazardous in many areas at present. High rainfall intensity results in much of the water being lost to the farms on which it falls - it is not uncommon for 100 mm to fall in two hours. Many dams of varying sizes have been constructed in order to store river flow and farm run-off. According to Backeberg *et al.* (1996) more and more dams have been built over time and "normal flow" hardly exists anymore. Irrigation uses 51 % of South Africa's surface water resources.

In South Africa, the potential for irrigation is severely limited. According to Huntley, Siegfried and Sunter (1989) only 12 to 14 % of our 122 million hectares of land is arable, and about 3 % of the total is irrigable. Backeberg *et al.* (1996) put the figure at less than 2 % of the total. More than half of this land (1 300 000 ha) is already under irrigation. This land

contributes 25 to 30 % of South Africa's agricultural output, employs more than 120 000 permanent workers, and represents 15 000 medium-to-large scale farmers, and about 40 000 small scale farmers (Backeburg *et al.*, 1996). Of the irrigated land, approximately 240 000 ha is irrigated with groundwater.

However, in spite of our high-intensity rain storms, only 8.5 % of South Africa's average annual rainfall of about 500 mm finds its way into rivers as runoff. Little attention other than the innumerable farm dams has been given to mechanisms for slowing down surface runoff and storing it on the farm. Thus, its main effect is negative, in that it leaves the farm rapidly with valuable topsoil in suspension, eroding the most fertile soil, and, where it is impounded, it silts up farm dams rapidly. This situation becomes even more serious where road and rail engineers have concentrated run-off through culverts, which spill large volumes of water onto land below roads and railway lines. Pereira's comments on the inadequacy of road engineering design in Section 3.5 are highly relevant here, and it is this perception of the dangers of high intensity runoff coupled with the need to use all runoff as effectively as possible in the area where it is generated which motivated the rainwater harvesting design process on Bachs Fen Farm. Although only 8.5 % of total rain flows into rivers, reducing flood peaks and increasing the amount of water available in the dry season are key strategies for conservation and production.

If local rainwater harvesting programmes, or larger scale integrated catchment management can be shown to be viable in these areas, however, the scenario of continuing land degradation outlined by Huntley, Siegfried and Sunter (1989) could change dramatically, and the problem of poorly managed water causing soil erosion could be converted into an opportunity for enhanced production. It is precisely this possibility which has been examined on Bachs Fen Ecological Research Farm, using wetlands, swales, compost and mulches in a simple but effective ecological farming system (see Chapter 5). Rainwater harvesting can also lead to greater sustainability of production and improved food security. Backeberg *et al.* (1996) point out that rainfed crop production can currently feed approximately 20 to 30 million people. South Africa's population is currently over 40 million and expected to reach 60 million by the year 2010. Intensive irrigation production can only feed an additional 10 to 15 million people. Alternative approaches will have to be developed. Technical solutions will be important, but as Röling and Jiggins (1998) point out, simple transfer of technology will not solve the problem. Facilitating learning will require support institutions, conducive policy contexts and a recognition of interdependence, leading to collective action.

### 4.3 Food security and poverty alleviation

The link between the failure of Africa to adopt high input green revolution agriculture and the dependence of African farmers on erratic rainfall has been convincingly made in the literature. Conway & Barbier (1990) show that *per capita* food production in the developing countries has risen by 7 % since the mid 1960's, on average. The increase in Asia has been over 27 %, while that in Latin America has been about half as great. Only in Africa has there been a decline. The increase in Asia is attributed in roughly equal proportion to three factors: high yielding varieties, fertiliser and irrigation. While high yielding varieties have been developed for rice and wheat, breeding of white maize has been much less intensive. This is one reason

why African *per capita* food production has not kept pace with population growth. Another is the cost of agricultural inputs such as fertiliser, and the difficulties in getting them to the fields of isolated rural people. But undoubtedly the major factor is the lack of water in semi-arid sub-Saharan Africa. Large scale irrigation schemes have allowed a few farmers to produce at very high levels, but such schemes are expensive, and often require high levels of management support. They are also often ecologically and socially unsustainable, and can impact negatively on women, because of their increased workload, while incomes are often paid entirely to the men in whose name the plot is registered. Backeberg *et al.* (1996) put the number of small scale irrigation schemes in South Africa at 202 involving some 47 500 ha, of which 37 % are commercially oriented and 63 % are foodplot holders.

Rural poverty also means that little money is available for inputs, relatively few skilled people (especially with management skills) remain in rural areas and the lack of confidence on the part of many rural women concerning their capacity to change their lives for the better of results in fatalistic acceptance of a food-insecure situation (Wilson & Ramphele, 1989; Cross & Preston-Whyte, 1983). Letsoala points out that traditional land tenure arrangements were far more flexible than they subsequently became under the *Apartheid* regime (1987). Consequently, helping local people to develop community gardens in areas where it is possible to make small areas of land available directly for production of food for resource-poor rural (or urban) people is a highly rational expenditure of public funds. For this reason, NCMP concentrated most of the small scale agriculture support efforts on the establishment of community food gardens, and on strategies for improving the effectiveness of water use in these gardens. This is also directly in line with the Department of Agriculture policy (1998) which lists "Food security and drought" as one of the top priorities for agricultural research.

## 4.4 Integrated catchment management (ICM) and Landcare

### 4.4.1 Approaches to ICM and Landcare in South Africa

Most agricultural producers in southern Africa share a dependence on scarce water resources, and this makes the ecological unit formed by a watershed or catchment (an area which sheds its rainfall run-off into a common river system) a useful one to use in managing shared resources. In order to bring people together to manage soil and water resources in a way which is socially, economically and environmentally sound in our dry continent, it makes sense to use river basins as a management unit. Pereira (1973) comments that "In newly-developing countries local communications can sometimes prove to be a difficulty in the organising of agricultural communities on to a catchment basis, since the roads run mainly along the drainage divides and bridges may be far apart. Rivers are often the boundaries of tribal or clan areas, but even where they are also linguistic or national boundaries the logic of watershed discipline is inescapable if both sides are to develop the water resources of their common valley".

Some ideas on the philosophy and practice of ICM in South Africa have been brought together in a joint publication of the Department of Water Affairs and Forestry, and the South African Water Research Commission (DWAF, 1996). This publication gives an excellent overview of the challenges of ICM. The Water Bill (DWAF, 1998) also provides a framework for the development of Catchment Management Committees, which will work with Water

Management Area Authorities. The Water Bill attempts to institutionalise catchment management, but initial ideas of a Catchment Management Authority for each catchment were dropped in the final Bill, because of the cost of setting these up, and also the perceived lack of capacity in rural areas. However, it must be remembered that there will always be relatively small capacity in DWAF in relation to the magnitude of the management problem throughout the country; in comparison, as the Asian experience quoted above shows, there is potentially very large capacity in the rural areas, contrary to the opinion of many commentators. If the proposed Water allocation plans are revised every five years (as specified in the Water Bill), local people will need to be intimately involved in negotiations.

From the range of perspectives discussed above it appears that both land reform and farmer support need to recognise the inter-connectedness of our resources, many of which cannot be individually owned. Shared problem appreciation is a necessary condition for collective action. Both in Europe and in Africa it has been recognised to be the first step in the complex process by which people learn to take action at a higher level of social aggregation (Röling, 1994). Building a common vision of the nature of problems affecting shared resources can be done using three primary steps: exploratory analysis, platform building and design of strategies aimed at moving towards a more desirable situation. Most agricultural production in southern Africa is dependent on scarce water resources, and this makes the ecological unit formed by a watershed or catchment (an area which sheds its rainfall run-off into a common river system) a useful one to use in managing shared resources.

In considering ICM, Görgens *et al.* (1997), highlight the intimate connection between water resources and land use. They are concerned about the inadequacy of proposed structures if participatory management is to develop. Yet even they do not comment on the lack of involvement of the national and provincial departments of agriculture. It is precisely because FSG has agricultural skills that we are accepted as useful partners by many farmers and foresters. The fact that ICM tends to be driven by water managers may prove to be one of the greatest strategic limitations to its success.

Neither DWAF nor any other government department has the capacity to manage thousands of farms, smallholdings and factories. For ICM to become a constructive reality, it will have to be practised by thousands of farmers and resource managers because they believe that it is the right thing to do. Helping to bring about such a situation requires enabling support, but it has its limits. The Working for Water programme has shown how local energy can be harnessed in the service of the environment. However, a critical factor will be the extent to which paid labour with a defined goal can be transformed into voluntary responsible catchment management (Preston, 1998).

Görgens *et al.* (1997) point to fragmentation between national and provincial levels of governance. They point out that DWAF has little control over land-use. They fail to note the parallel between existing conservancies and the proposed catchment management agencies (CMAs) or "statutory participatory catchment forums". Our experience is that many of the people who are active in existing conservancies are the very people who are already motivated towards collective action. Often, they also have intimate knowledge of local resources, as well as useful skills and networks.

Görgens *et al.* (1997) state that Water Boards have a function, but should not become CMAs; as one of the relevant bodies, they should sit on the CMA. This agrees with our experience, where the Umlaas Irrigation Board has played an important pro-active role, but does not see itself as having a major mandate outside irrigation farms. The proposal in the new Water Act to transform Irrigation Boards into Water Users' Associations which should include all users is certainly a way of using existing structures, providing that sufficient resources are available to ensure that historically disadvantaged communities are adequately briefed and represented on such Associations. The relevance of this to ICM lies primarily in the need for institutional arrangements which promote cooperation between relevant government departments in meeting the needs of farmers (or, in the case of ICM, an even broader range of actors within the catchment). One major lesson learned through the recent review of farming systems research in sub-Saharan Africa is that cooperation at District level happens spontaneously if there is an enabling environment, or even if the Head Office personnel do not oppose cooperation (Anandajayasekeram, 1998). An understanding of farming systems, and the active cooperation of irrigation boards and other farmer groups, especially conservation committees, is therefore a vital part of successful ICM.

Görgens *et al.* (1997) express the opinion that the lack of technical and managerial expertise will seriously compromise decentralisation efforts. The Minister will have to rule by decree, as there is little provision for regulatory mechanisms in the Water Bill. Influencing land use, however, requires a combination of participatory planning, encouragement and semi-structured self regulation combined with clear and enforceable penalties for serious non-compliance. Here, the difficulties experienced in implementing aspects of the Environment Conservation Act 76 of 1989 are relevant: an attempt was made in 1994 to formulate draft regulations in terms of section 26 of the act, in order to make environmental impact assessments obligatory for specified activities. It is likely that they will not come into effect for several years. These and other problems have been pointed out clearly by Maritza Uys in Appendix D of Görgens *et al.* (1997). Various other acts could be administered by a catchment authority, notably the Conservation of Agricultural Resources Act 43 of 1983 and the Mountain Catchment Areas Act 63 of 1970.

The relevance of these Acts to the National and Provincial Departments of Agriculture is obvious, and their involvement is essential, as well as that of the Departments of the Environment. Already, DWAF is working on River Health with the latter department; the lack of involvement of agriculture departments is likely to pose a serious limitation to the introduction of ICM.

For the ICM approach to be effective in practice, people need to find ways of understanding the different perspectives which exist in the same catchment. Shared problem appreciation is a necessary condition for collective action. Both in Europe and in Africa it has been recognised to be the first step in the complex process by which people learn to take action at a higher level of social aggregation (Röling, 1994). Building a common vision of the nature of problems affecting shared resources can be done using three primary steps, according to Röling: exploratory analysis, platform building and processes of resource-use strategy design aimed at moving towards a desirable solution.

Sustainable natural resource management means that some decision-making and intervention

capacity must be created at a level of social aggregation which is commensurate with the ecosystems that need such management. Ecosystems are thought of as "hard systems" studied by biophysical scientists who are convinced that reality exists independently from the observer. Platforms are "soft systems" used by activists and social scientists who believe that things change through people's actions. If sustainability is desired it is necessary to couple ecosystems and platforms so that society can move from exploitation of resources towards sustainable management. This may be at a whole catchment level or at a local level where a water harvesting programme may be implemented. Once again, various land users will have varying perspectives and priorities, and the step of exploratory analysis will have to precede the building of resource use negotiation platforms. Once there is communication on the basis of some shared perceptions, it may be possible help people start with the design process (Röling, 1994).

### 4.4.2 Gender and catchment management

The position of women can also be further undermined by ICM and water harvesting if they are not implemented with great sensitivity according to D'Souza (1997). She reports that in small dry Indian catchments (500 -1500 ha, 150 - 800 mm mean annual rainfall), watershed development often results in women having to cope with extra work, because their roles of feeding cattle and keeping the home-fires burning are more difficult with the extra disciplines adopted. However, if sensitively handled ICM can lead to employment and income (afforestation and pasture development work), lengthened growing season and decreased risk due to increased soil moisture, more diverse agricultural possibilities and increased food security. Where male leaders have been encouraged to give greater space to them, women have gradually taken a greater role in decision-making structures in the villages. Feldstein and Jiggins (1994) have reviewed approaches to analysing and making space for the perspective of women in agriculture. Much can be achieved simply by structuring surveys and workshops in such a way that space is made for hearing the point of view of women.

Jiggins (1994) details some of the changes which will be needed in terms of a change of approach to the role of women if food security is to be achieved in the coming century. She emphasises the importance of educating women, pointing to the key role of women in managing natural resources. Since women are materially, biologically and socially more connected to life and the nurturing of life, Jiggins points out that they instinctively have an appreciation of the wholeness of life as a connected system. This insight can lead to the development of networks for collective management of natural resources if projects are designed and carried out with an understanding of both the potential of women and the constraints which they often face (due to workload and male prejudice). Whereas men in the majority of societies hold key leadership positions and invest time in maintaining formal organisational relationships, it is women who quietly hold personal relationships in society together. Jiggins concludes that the health, education and earning capacity of girls and women are intimately related to better management of natural and agricultural resources. Given this integrating aspect of women in community development, the relevance of involving women in collective action is clear.

The approach of the NCMP in working with craftswomen and with community gardeners was influenced by these insights, and the effects of both empowerment of women and its absence has played a significant part in successes and failures in the programme (see Chapter 6).

## 4.5 Description of the Mlazi River catchment

### 4.5.1 The natural environment and land use

The Mlazi River catchment is a microcosm of South Africa: the upper catchment has large scale commercial forestry, grazing, sugar cane and irrigated vegetable production, interspersed with black communities characterised by poverty and lack of access to resources. The middle of the catchment above Ntshongweni Dam, has small scale farmers, black, Indian and white (still mostly separated by our *apartheid* history, though this is beginning to change), as well as Mpumalanga Township and the Hammarsdale Industrial Area. The middle catchment below the dam has several small peri-urban communities, with some beautiful riverine environments, and many opportunities and needs for sound planning of a rapidly urbanising area.

Figure 13 provides an overview of the catchment, as well as the subcatchment divisions, some of which have been negotiated with local groups, while the rest are NCMP proposals at present. These do not follow the national hydrological quaternary subcatchment divisions. The total area of the Mlazi River catchment is almost 1000 $km^2$ or 100 000 ha. Roughly one third of this is urban area, one third grassland and one third arable agriculture. This is much higher than the national average of 14 % arable, and Figure 12 shows that the rainfall in the eastern part of the country is also higher than average. Thus this arable land has a high potential for agriculture. Approximately one third of the arable land is planted to commercial forestry, one third to sugar cane and one third to irrigated vegetables and rainfed crops. A brief description of land use follows, starting with the upper catchment area (Upper Baynesfield on Figure 13) and moving downstream, following the sub-catchment areas.

Upper Baynesfield Subcatchment

The Upper Baynesfield Subcatchment is about 20 000 ha, largely made up of the Maybole commercial forestry plantation (4500 ha) and Baynesfield Estates (12000 ha). A number of smaller commercial farms (100-500 ha in size) adjoin Baynesfield Estates, and have the same farming activities (dairy, forestry, pig production, avocado pears, citrus, maize, soya bean and sugar cane). Irrigation farming centres around the Baynesfield Dam, built by the Umlaas Irrigation Board in the 1970's. The Entembeni and Tafuleni communities (each numbering about 10 000 people) are located on the north western boundary of the catchment. There has been conflict over the years, especially between Mondi Forests and the Entembeni community, because of damage to trees by cattle, arson and theft of wood on the one hand, and cattle impoundment, refusal of access and a hostile attitude on the other. There is a Bacon Factory at Baynesfield, and the Richmond-Pietermaritzburg road forms the eastern boundary of the subcatchment, except that the Mkuzane River in the south is included in the Lower Baynesfield Subcatchment.

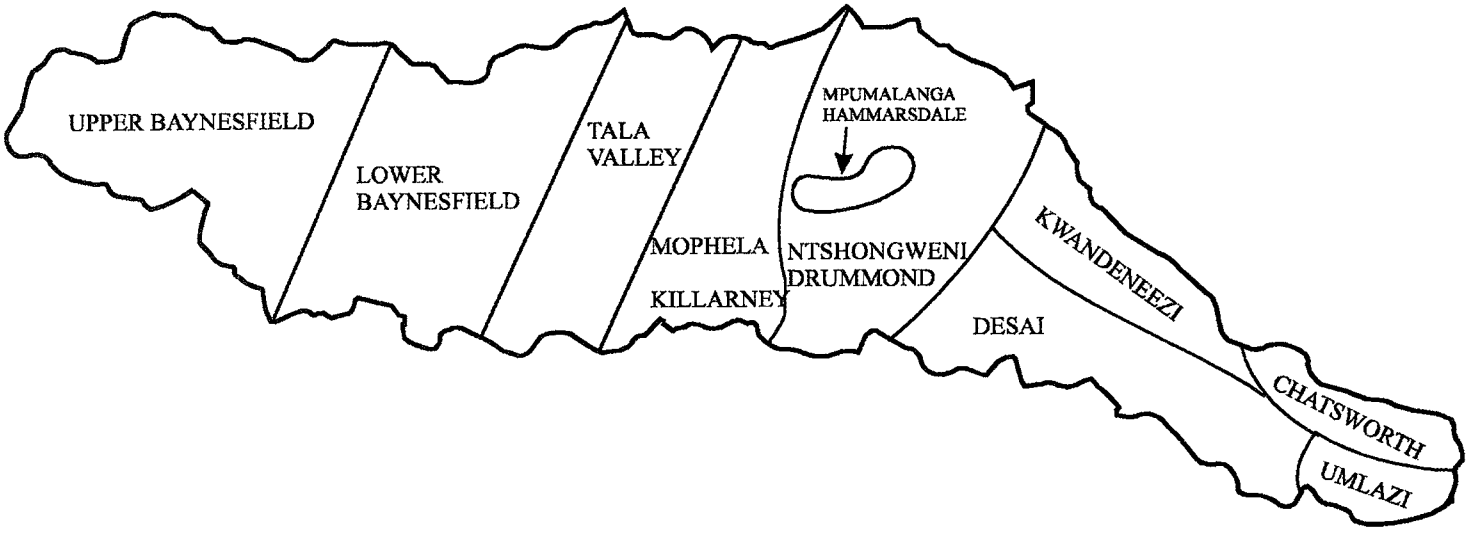



Figure 13 : The Mlazi River catchment, showing approximate subcatchment boundaries

Baynesfield Estates was developed by Joseph Baynes in the nineteenth century. He was a pioneer in establishing "modern scientific farming methods". He and his wife died without having children, and the Baynesfield Trust was established to run the estate for the good of the community. The Board of Trustees has set up training centres which initially trained farm labourers, but more recently changed their focus to small scale farmers. Due to lack of funds, the training centres have temporarily closed at present, which is a pity, given the great need for small scale farmer training in the province. Recent land claims by some members of the Entembeni, Tafuleni and nearby Willowfountain communities have recently been settled, with the agreement that several hundred hectares of land would be made available for community ownership. A community trust will be formed to manage the land.

Lower Baynesfield Subcatchment

The Lower Baynesfield Subcatchment is about 15 000 ha in extent, stretching from the Richmond-Pietermaritzburg road to the Ngomankulu Mountains, which form a natural barrier with the Tala Valley. They include mainly irrigated medium sized commercial dairy and crop farmers near the Mlazi River, similar to Upper Baynesfield, as well as smallholders in the Thornville area, and extensive grassland with some sugarcane and forestry elsewhere. Hopewell is a small urban area which was regarded by *Apartheid* planners as a "black spot". There is very little infrastructure in the township, and land invasion occurred recently onto the adjoining Argosy Farm. There has been considerable conflict between the residents of Hopewell (more especially the new residents of Argosy) and local commercial farmers. Complaints from the commercial farmers include hunting with packs of dogs, arson and theft, while some Hopewell and Argosy residents claim that "since God planted the natural grass, our cattle should be allowed to graze there". The newly built Mapstone Dam is adjacent to Hopewell - it was built by the Umlaas Irrigation Board in the 1980's.

Tala Valley Subcatchment

With a size of about 10 000 ha, the Tala Valley is a slightly smaller but highly intensive vegetable farming area centred around the Thornlea Dam, built in the 1960's by the Umlaas Irrigation Board. Most of the land is irrigable, and soils are deep red clay loams of the Hutton Form (MacVicar *et al.*, 1977). The area is sometimes called "the vegetable basket" of KwaZulu-Natal, but the intensive agriculture gave rise to a controversial investigation in the 1980's, after some farmers suffered crop damage which they alleged was from 2,4 D herbicide drift. Some claimed that intensive Lawn producers were using the herbicide at many times the normal dose, others pointed out that some of those suffering crop deformation symptoms were farmers who used very high levels of fertilisers and chemicals, and that their crops were therefore more susceptible to damage, others again blamed the forestry industry. The investigation concluded that "There are several problems in the Tala Valley, and 2,4 D is one of them" (pers. comm., Dr Robin Bennett, Officer-in-charge). The problems had the effect of establishing improved communication between farmers in the area, who recognised their inter-dependence, and that their activities could have an impact on the ecosystem and on other farmers or catchment residents. Crops are mainly vegetables (including potatoes), sugarcane, maize, avocado pears, citrus and some commercial forestry.

Mophela-Killarney Valley

This area is also about 10 000 ha, and probably a quarter of this is high potential irrigable land, in the Killarney Valley, with similar farming systems to the Tala Valley. Farmers are also

members of the Umlaas Irrigation Board, and there is a possibility of a fourth dam being built in the area to serve both these irrigators (who presently draw water from the already over-stretched Thornlea Dam) and potential Zulu irrigators in the Mophela area. The survey carried out by NCMP identified only three irrigators in Mophela, and relatively little irrigable land, although there is more suitable land further downstream below Ntshongweni. There are high levels of conflict between the commercial farmers and the residents of Mophela and Sankontshe, which are rapidly urbanising areas adjacent to Mpumalanga Township.

The establishment of a Conflict Resolution Committee by NCMP improved communication in the area and led to a decrease in crime. A subcatchment committee is currently being formed.

Mpumalanga-Hammarsdale Subcatchment

The Mpumalanga Township has about 100 000 residents, and very poor infrastructure, which is described by Shangase (1992). Its history of violence has been mentioned, and educational activities there are discussed in Chapter 7. Nearby Hammarsdale Industrial Estate has also been mentioned. The Mpumalanga Environmental Forum and the Hammarsdale Industrial Conservancy, both established through NCMP activities, have started to involve local people in caring for the environment, and in planning together for collective action. Mpumalanga Township and Hammarsdale together cover an area of about 5 000 ha.

Ntshongweni-Drummond Subcatchment

This area, some 10 000 ha in extent, is mainly made up of smallholdings of 10-50 ha, or of tribal land, which may be under traditional management of an *Inkosi* (Chief), under transitional management as Trust Land which was run by the KwaZulu Department of Agriculture, but is now mostly under the Durban Outer West Local Council, or privately owned by white, Indian or Zulu landowners. The area is highly diverse, both agriculturally and culturally. There is much steep land, some flat land, a little high potential irrigated land. The Drummond area to the north is affluent and has reasonable infrastructure, while the Ntshongweni area to the south has very little infrastructure. This area is described in detail in Chapter 6, and Bachs Fen Farm, which lies between Drummond, and the Cliffdale (mainly Indian smallholder) area, is described in Chapter 5. The eastern boundary of the area is the Ntshongweni Dam, and this marks the eastern limit of NCMP activities at present, except for a few gardeners and craftswomen at Zwelibomvu.

The lower Mlazi River catchment near Durban

The rest of the catchment is listed briefly, and the intention is that, based on the Open Space Management study by NCMP team member Barry Patrick (1998b), and the Durban Metropolitan Authorities Integrated Structure Plan to which it contributed, development of this area will proceed as part of the Durban Metropolitan Open Space System (Patrick & Auerbach, 1998).

KwaNdengezi Subcatchment

Area: 5 000 ha, mainly urban, with fairly poor infrastructure (KwaNdengezi Township).

Desai Subcatchment

Area: 15 000 ha, peri-urban with some relatively intact grasslands, and some spectacular scenery with high ecotourism potential.

Chatsworth Subcatchment
Area: 5 000 ha, urban, mainly Indian residential area with good physical and commercial infrastructure, and some small scale, intensive market gardens.

Umlazi Subcatchment
Area: 5 000 ha, mainly urban township including the Southern Industrial Basin of Durban. Residential Infrastructure is poor, although there are several colleges, sports facilities and schools. The first (and only) public library was opened during 1997. The area has many high rise hostels, mostly designed as accommodation for single men working as migrant labourers in Durban, where there has been much violence. Under the *Apartheid* policy, men were allowed to work in town, but not to bring their families with them. Although the law has changed, the culture of violence has not yet changed significantly. The Southern Industrial Basin is characterised by high levels of pollution, especially air pollution from the South African Petrol Refinery, the Engen Refinery and Mondi Paper's Merebank Mill. It is hoped that this industrial section of Mondi, as well as other industrialist, will join in catchment management in the future. The area was described in detail in the Strategic Environmental Assessment, which is summarised in the publication "Durban's Tomorrow Today" (Environment Section, 1998). Many areas have potential for urban agriculture and for recreational open space development.

Climatically, Durban and the lower Mlazi are almost tropical, having a mean annual rainfall of 997 mm (years 1871 to 1980) with a standard deviation of 230 mm (Zucchini & Adamson, 1984). The probability of thirty consecutive days with no rain in Durban is never more than ten percent, and is near zero from September to March.

### 4.5.2 The socio-political environment

The process of participatory action research required that there should be some understanding of the governing variables (norms and values) in the communities, before developing action strategies, which would have practical consequences (Theory-in-use model, Figure 4). Right at the start of the programme, before other staff members had been appointed, I convened a workshop bringing together community leaders, resource managers, and key informants, in order to develop an overview of the Ntshongweni area and its problems and needs. This was followed by a process of engagement with the EZakhiweni gardeners, which included a general PRA process for the whole of Ntshongweni, a local PRA at EZakhiweni and vision building and participatory land use planning processes with this garden. Once this process was in motion, other gardens (Magaba and Zimeleni) were started, as well as the EZakhiweni craftgroup. A summary of the proceedings of the workshop is now presented to give a more holistic overview of conditions in the Ntshongweni area, as these directly determined the responses of community leaders and of community members to NCMP activities.

Planning workshop, November 1994
In the past, community vegetable gardens were started by the KwaZulu Department of Agriculture only in areas where there was adequate water, and mainly as a strategy to improve food security. The PRA, Vision building and PLUP processes showed that major constraints were fencing, water and money. Research had been commissioned in 1992 by the Land and Agricultural Policy Centre, into the role of natural resource management in providing livelihoods to rural people in the Ntshongweni area, in order to inform the South African Land

Reform Process. The research showed that natural resources such as reeds, grasses, clay and natural dyes were used in craftwork by a number of women, and that income from this source was particularly important to the poorer women (Cross & Clarke, in Auerbach, 1994). However, Professor McCarthy also reported on planning initiatives for the Western Approach to Durban, and he argued that most of the residents of Ntshongweni were rapidly becoming urbanised, and their priorities were more related to improved infrastructure (especially water and electricity) rather than to agricultural and craft production (Auerbach, 1994). Cross and Clarke agreed that those who were employed in the formal sector had effectively become urbanised, but pointed out that *per capita* income was R136 per month. Nearly a third of households had a total household income of less than R250 per month. The likely costs of services at the time was R550 per household per month. Their data suggested that more than 40 % of households would not be able to pay for these services, and were thus totally dependent on the resource base. These resource-poor residents were often in competition for access to local resources with "resource pirates" who exploit the resources for financial gain, selling firewood, herbs and other resources in Durban.

Mr Zwane and Mr Sibisi had played a major role in the peacemaking process which led to the Ntshongweni Peace Accord of 1989. They had both been involved in the violence preceding this accord, Mr Zwane on the ANC side, and Mr Sibisi on the IFP side. They were thus both important social actors in the drama of Ntshongweni.

Mr Zwane's presentation at the workshop of the aspirations of the people of Ntshongweni (Auerbach, 1994) did reflect mainly urban aspirations. However, the Ntshongweni Development Liaison Forum had already commented at an Ntshongweni Liaison Forum meeting held in October that since Mr Zwane now lived in Durban, and only returned to Ntshongweni at weekends, he did not represent Ntshongweni residents. They nominated Mr Ngcobo to speak on their behalf, but he arrived late and was rather overwhelmed by the formal gathering of well dressed people (an example of how easily rural people are not heard in formal discussions of this nature), so Mr Zwane did in fact speak, making it clear that he had no representative mandate, and was merely giving his own views. Mr Sibisi added a few comments about the importance of economic and agricultural development in the area. Mr Ngcobo declined to make an additional comments when he arrived.

Fortunately, Ms Kunene (at the time Social Worker for the KwaZulu Training Trust, and subsequently Head of the Community Liaison Division of Msinsi Holdings, the managers of Ntshongweni Dam and other conservation areas), was able to deliver a highly articulate summary of social conditions in the area, and the need for good consultative processes (Auerbach, 1994). She emphasised the need for communication, participation and capacity building. She also spoke about the need to link skills of "the lady at home" to marketing initiatives, which could help women to contribute to family incomes. In her opinion, "rehabilitation of the natural resources will bring about various job opportunities for both males and females, provided coordinated efforts are made to build capacity".

Ms Murphy of the University of Natal's Institute of Natural Resources, reported on an assessment of basic needs which had been carried out in 1992, which found similar needs in the four communities (Ntshongweni, Salem, Zwelibomvu and Toni), although the first two were more developed than the last two mentioned. Needs included roads, water, telephones,

postal services, schools, creches and clinics. Mr Mander, also from the Institute of Natural Resources, gave insights into the practical aspects of riverine revegetation. He reported on work undertaken in the Mhlali River catchment in northern KwaZulu-Natal, which had concentrated on effective river bank revegetation. Technical aspects centred on planting indigenous trees in strategic clumps, at the points where there is a change in the river gradient (Auerbach, 1994).

Other speakers concentrated on the more policy-related aspects: Mr Quilling from the Department of Water Affairs and Forestry outlined how departmental policy was developing at that stage; Dr Bosch, Head of the Land Use and Hydrology Section, Forest Science and Technology, at the Council for Scientific and Industrial Research, explained that in the past research had been mainly either strategic at regional level or technical water optimisation studies at estate level. His conclusion was that "The challenge facing us is whether we can use our technical experience in catchment management to manage the resources of our catchments sustainably for the benefit of our people"(Auerbach, 1994).

Dr Howard and Ms Pillay of Umgeni Water, the water management agency for the whole of central KwaZulu-Natal, outlined the catchment's water quality problems (bacteriological contamination, high conductivity, nitrate and phosphate pollution, discolouration of water by textile dyes, heavy metal pollution and turbidity due to soil erosion). Ms Barclay of the University of Natal's Pollution Research Group provided technical details of the textile processes involved, and steps which had been taken elsewhere to remediate textile pollution. These included using membrane ultra-filtration processes to reduce chemical oxygen demand processes from the sizing process, where yarn is coated with starch, PVC or CMC to protect it from abrasive action in the weaving process, and recycling sodium salts used in exhaust dyeing to reduce conductivity problems. Dyes should be minimised at source, effluent should be segregated and more efficient plant should be installed. Disposal of effluent should be based on encouraging segregation of effluent streams, so that only concentrated effluent is treated, which is more cost effective, and on economic incentives to reduce contaminated effluent volumes through an appropriate tariff structure. Dr A Batchelor agreed that segregation of waste was important. Water contaminated with nutrients should be used creatively in agriculture, where nutrients are useful (Auerbach 1994).

Ms Barclay reported on the move internationally towards eco-labelling of products, and predicted that most exports will, in the future, be required to show that they have been produced in an ecologically sound way (Auerbach, 1994). Although not reported on in detail in this book, subsequent developments include the formation of a Hammarsdale Industrial Conservancy in 1998, with the help of NCMP. This has had a marked positive effect on reducing effluents from some of the factories, and on improving relationships, especially between Mpumalanga teachers involved in the School Environmental Action Clubs and several Industries which have been actively supporting them. Gelvenor Textiles recently obtained ISO 14000 certification after undertaking an in-depth review of production processes, and developing an incremental programme for reducing their impact on the environment. Both the NCMP and the Pollution Research Group were actively involved in assisting Gelvenor and other factories to develop such programmes.

Textile industries at Hammarsdale, sand-winning and quarry washings in the area, sewage

reticulation problems mainly at Mpumalanga and sewage works sludge disposals were the main causes of these problems. Hammarsdale activities pollute the Sterkspruit, while most Mpumalanga activities pollute the Mlazi River. Both rivers flow into Ntshongweni Dam. Ms Pillay pointed out that the Sterkspruit flows relatively strongly during summer, and pollution is not as much of a problem. However, during the dry winter months, most of the water flow in the Sterkspruit is generated by the sewage works, and thus the quality of effluent has a major impact on water quality of the Sterkspruit in winter. Both Ms Pillay and Dr Howard emphasised the need to encourage responsible management of factories at Hammarsdale, and participation from all land users and residents in monitoring and reducing the impact of activities likely to pollute rivers in the catchment.

At that point, the Shongweni Landfill Site was being upgraded from a General Site to a site licenced to accept Hazardous Solid Waste. Although this process posed an important potential hazard to water quality, few local people knew about it at that stage. The NCMP was subsequently involved in setting up a Monitoring Committee which now meets monthly to assist the Department of Water Affairs and Forestry in monitoring the management of the site, and its effects on the Mgoshongweni Stream below the site. This stream enters the Mlazi River downstream from Ntshongweni Dam, near KwaNdengezi Township.

### 4.5.3 The Ntshongweni Catchment Management Programme (NCMP)

The NCMP is funded by the South African Water Research Commission, and run by the University of Natal's Farmer Support Group. The mission of FSG, and the goal, objectives and product of the NCMP are set out in the Preface. The NCMP started to work in the upper Mlazi River catchment in 1994, and has since spread its activities to include most of the Mlazi River catchment above Ntshongweni Dam. Integrated catchment management and water harvesting are important activities of the NCMP. The programme has attempted to bring together commercial foresters, large scale commercial farmers, small scale farmers, conservationists, industrialists and urbanised communities, in an alliance which is gradually building a vision for the development of the catchment. The programme's goal is to develop a framework for participatory catchment management in South Africa. Various projects are addressing the development of water harvesting, ecological farming and forestry systems, cooperation between small and large scale farmers in the region, negotiated water use by the various players in the catchment, pollution reduction by industry and urban areas, greening of urban areas and joint action programmes to combat invasive alien weeds (Burns, 1998). A start has been made with the formation of the Mpumalanga Environmental Forum in 1997 and the Hammarsdale Industrial Conservancy in 1998. At the heart of the programme are school environmental action clubs (Auerbach, 1997).

A process of institutional development is underway, in tandem with an educational programme. Such a catchment management programme relies heavily on a process of bringing together diverse groups of people, by facilitating the development of platforms as envisaged by Röling (1994) and described above. However, while a catchment-based approach looks attractive to geographers and natural resource managers, it is often seen as very abstract by people who live in a catchment. Usually, people see themselves as part of a community defined in terms of a town, a village, an area, a faction. If not language, politics or culture, often schools, roads, bus routes or administrative boundaries define communities. In some rural areas, the unit of community is defined by a dependence on a common resource, such as

the local spring, and in such communities this can act as a very powerful social unit (Auerbach, 1993). Developing a catchment identity is not a simple task, but it is challenging because it is one way of bridging cultures and thus repairing some of the damage done by spatial separation due to racial segregation in South Africa. It may be that we need an integrative form of landuse planning in this country to counter the disintegrative social engineering of the *Apartheid* era.

Another key factor in helping people to take collective action is the presence of practical local examples. Farmers in particular are practical people. If they can see working, economically viable water harvesting systems, and ecological farm management, they are likely to be far more open to implementing those aspects which appear practicable to them. In the NCMP, one of the key factors has been the presence of the Bachs Fen Ecological Research Farm. Water harvesting systems on Bachs Fen have developed since 1992, and are described in Chapter 5. The location of the farm just north of the N3 national highway within the Mlazi River catchment is shown in Figure1.

Röling's four steps towards collective action in the management of the NCMP (exploratory analysis, interaction, planning and collective action aimed at moving towards a more desirable situation), as shown in Figure 10 formed the process outline for the development of institutions for collective resource management. Within the NCMP, the pilot phase (1994-1996) consisted of a process of exploratory analysis, although we were already moving towards more desirable solutions. Phase 2 (1997-1999) has seen considerable interaction and the beginning of platform building, and once there is a catchment management structure, phase 3 will see the implementation of joint planning and collective action through a catchment management plan. This is illustrated in Figure 14, covering the period 1994 to 2004, the proposed exit date for the NCMP (see Preface, Vision). The Pilot Phase marked a period of exploratory analysis, where networks were built up and information gathered. The Consolidation Phase is still underway at present, and has seen the establishment of interest groups and activities. The next phase needs to integrate catchment activities into existing structures, and establish subcatchment committees as a new local government institution.

Figure 15 gives an indication of the slow early development of the programme, and the exponential growth of activities over the 1998 year in particular. At the end of 1998, NCMP was helping with 18 gardens and 5 craftgroups, 20 school enviroclubs, 9 conflict resolution platforms and 4 subcatchment committees. Growth continues during 1999, but staff capacity (time and money) is somewhat constrained. The activities of the programme for the period 1994-1999 have cost approximately R2 million. It is estimated that continuing at present activity levels would cost approximately R1 million per year.

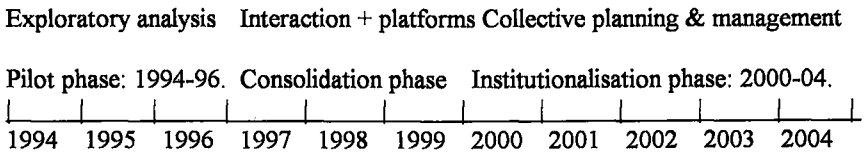



**Figure 14: Time-line for NCMP development**

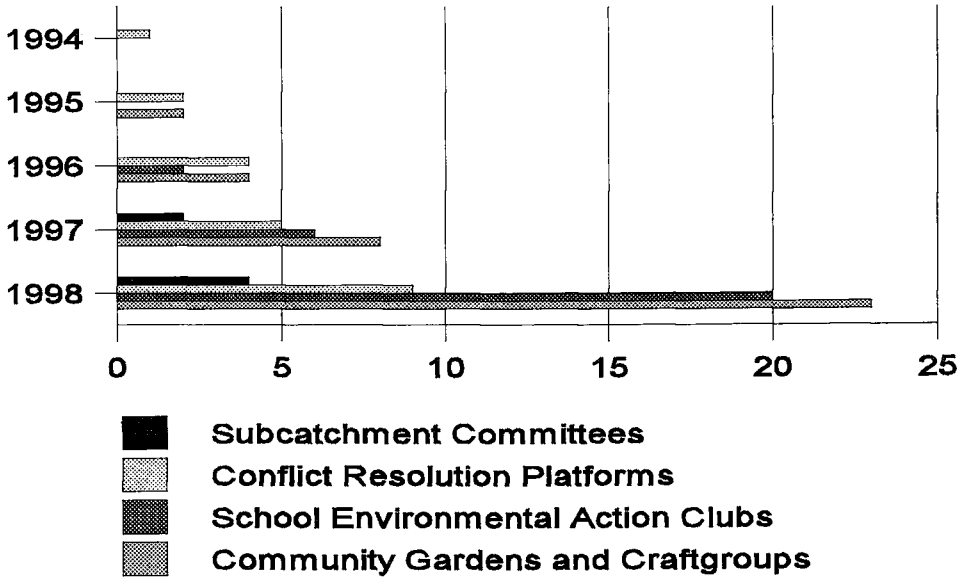



**Figure 15: Ntshongweni Catchment Management Programme Activities (cumulative)**

### 4.5.4 The Umlaas Irrigation Board Catchment Management Project

Following my meeting with the Umlaas Irrigation Board (see Section 2.8), they did indeed appoint a conservation officer, and local farmers, who had already voiced their concern about environmental health, especially during the controversy surrounding the use of 2,4D herbicide, have been very supportive of this programme. Angus Burns had already been working in the area, and discussing some of these problems with the farmers, and had experience while at school with a catchment management project on the Umhlatuzana River. He was appointed as Umlaas Irrigation Board Catchment Management Project Conservation Officer, and the project, working with local commercial farmers, has seen many wetlands protected, invasive alien plants removed and pollution of the river reduced (Burns, 1998). Burns started his work with an extensive survey of all irrigators in the Umlaas Irrigation Board area (Burns, 1997). He found that there were many major and minor problems, including invasive alien plants, river bank erosion, destructive harvesting of medicinal plants, wetland degradation and pollution of the river by farmers, abattoirs, factories and communities. He has worked closely with the NCMP ecologist and Umgeni Water staff to establish the regular biomonitoring process described in Chapters 3 and 8. The initiatives of the Board, and the cooperative efforts with NCMP in setting up subcatchment committees, and in securing funding for employment of local people to control invasive alien plants is described in Chapter 8.

### 4.5.5 Metropolitan development in Durban

The Durban Metropolitan Environmental Policy Initiative (DMEPI) is the initiative of the Durban Local Agenda 21 Programme which is being carried out by the Environmental Management section of the Durban Physical Environment Planning Department. A series of capacity building workshops helped to inform a wide range of stakeholders about issues facing Durban. During the course of 1998 and 1999, elected representatives of stakeholder groups have been helping DMEPI to design an environmental management system. I was elected as the Development (Non-government organisation) representative on the DMEPI review panel, which is synthesising recommendations of stakeholders, including public representatives, officials and consultants.

The NCMP contribution to process focussed on three aspects: developing policy to outline how Local Environmental Advisory Fora can be structured so that civil participation is built into institutional structures and procedures; the importance of building into the policy a strategy for developing urban agriculture as an integral part of open space management and human health initiatives; and the implications of the adoption of an integrated catchment management approach. Durban planners and consultants involved in especially the planning of parts of the Outer West Local Authority, have worked well with NCMP and client communities at identifying a number of developmental priorities in Hammarsdale Industrial Area, Ntshongweni, Mpumalanga Township, Peacevale and Cliffdale.

### 4.5.6 Farming systems and land tenure

Farming systems in the area have been described by Wisserhof (1995), who also analysed Bachs Fen production systems intensively. Local commercial farming is mostly either sugar cane or intensive irrigated vegetable production, interspersed with cattle ranching in the lower potential areas. The upper catchment is mainly commercial forestry plantations, previously predominantly pine, now with more gum trees being established (van Heck & Barten, 1997).

Approximately 300 ha of indigenous deciduous forest still remains. The establishment of the Umlaas Irrigation Board, and its pro-active irrigation development demonstrates some of the more positive aspects of South African commercial agriculture. As early as 1960, the Board began to plan the construction of its first dam, the Thornlea Dam (capacity $\pm$ 1 million $m^3$). This was followed by the Baynesfield Dam and the Mapstone Dam over the next twenty years, each with similar capacities. This development of irrigation capacity has had the effect of transforming the deep red irrigable soils in the area into the vegetable basket of Durban.

The Cliffdale area is too far away from the Mlazi River to benefit from the Board's irrigation development, but small scale farmers of Indian extraction have developed their own techniques of vegetable and herb production, drawing on Indian tradition as well as modern technology (Wisserhof, 1995). Much of the land has been brought under irrigation, but the sources of water are less reliable, being the Cliffdale tributary of the Sterkspruit (or *Mncadodo* Stream) and borehole water. As recently as 1991, most of the boreholes in the area were at a depth of approximately 40m; however, the drought of the early 'nineties saw the water table dropping dramatically, with new boreholes often going deeper than 120m. With the good rains of the past three years, the water table has again risen, but there will be another drought, and there is little evidence of any pro-active work to prepare for it.

Around the Ntshongweni Dam there are several thousand hectares of Zulu smallholder agriculture, characterised by subsistence livestock and arable activities in primarily low and erratic rainfall areas. Some areas on the Mlazi River floodplain were farmed intensively with flood irrigation by the Tshabalala, Meyiwa and Gumede families, among others. Over the last thirty years this activity declined, until in the late 'eighties there was no longer any irrigation farming in the area. Reasons given were the following (Mrs Gumede, local farmer, pers. comm., 1995): "There is less water; it stinks with pollution; the area is isolated; and criminal bands harassed us". Mrs Gumede has since passed on (her husband had already died when I interviewed her), and her donkeys no longer plough the river floodplain. Water reduction is probably a product of dam construction, increased afforestation and increased irrigation in the upper catchment, as well as degradation of wetlands and riverine vegetation. Pollution in this area is mainly faecal contamination from Mpumalanga Township (and much of this has now been addressed through improved sewerage infrastructure). The isolation of the area has been reduced by construction of some roads in the course of domestic water reticulation activities. The criminal element is less of a problem, although violent crime in the area is still a factor. Currently, only three commercial Zulu irrigation farmers could be found some distance upstream in the Mophela area. The Umlaas Irrigation Board has committed itself to working with smallholder farmers to extend access to irrigation, and is investigating viability of a fourth dam which could serve irrigators in the Mophela/ Killarney/ Sankontshe area.

There is a wide range of types of tenure: freehold commercial agriculture and forestry, leasehold land for commercial forestry, freehold small-holder agriculture, land held in trust by the Zulu King's *Ngonyama* Trust, tribal land, urban freehold and conservation trusts (Baynesfield Estate - 12 000 ha, agricultural; Shongweni Resources Reserve - 1 900 ha, conservation trust around Ntshongweni Dam). There is growing pressure on some peri-urban freehold land for urbanisation, but many landowners are determined to maintain their agricultural lifestyle and to resist pressures to sub-divide and sell their land (Meyiwa, *Pers. comm.* 1997). Approximately half of the 966 000 ha of the Mlazi River catchment is privately

owned commercial farmland. This is mainly in the upper two thirds of the catchment, including Baynesfield, Tala Valley and Killarney Valley.

Since the NCMP relayed the feelings of local landowners, town planning schemes in the Ntshongweni, Salem, Mpumalanga and Cliffdale areas have been modified to cater for a mixture of small holder agriculture and urban development with food gardens. The work of Patrick (1998b) has contributed to an understanding of open space management in the lower Mlazi River catchment, and Patrick & Auerbach (1998) reported on the role of urban agriculture. Planners have agreed to take into account the needs of urban agriculture, and to try to harvest stormwater and greywater (water which has been used for domestic purposes) so that it can be re-used productively. To date we have not been able to convince planners that intensive agricultural development projects should take place on the irrigable lands next to the Mlazi River, rather than on marginal lands with little irrigation potential. The areas currently earmarked for urban agriculture will certainly need supplementary sources of water, as soils are largely sandy and rainfall is less than 750 mm per year, with high evapotranspiration rates in the summer. Water harvesting and water conservation may contribute to raising production potential in these areas. A more detailed description of farming and social systems at EZakhiweni is given in Chapter 6.

### 4.5.7 Suitability of the area for rainwater harvesting

The Mlazi River catchment is characterised by steep topography, high rainfall intensity, many roads and rail links and urban areas with a high potential for urban agriculture. These factors result in many opportunities for rainwater harvesting throughout the catchment, and for this reason, a great deal of emphasis has been placed on water harvesting in the NCMP (Auerbach & Jansen, 1997). Backeberg *et al.* (1996) point out that although on average only 8.5 % of South African annual rainfall finds its way into rivers as runoff, the situation in the eastern plateau slopes of the country is very different; in this area some 43 % of the 870 mm mean annual rainfall runs off in this area, often causing a severe soil erosion hazard. Water harvesting thus has a very high potential in this area, but even the relatively modest quantities of water which water harvesting may yield in drier areas, may well reduce risks of rainfed cultivation dramatically in marginal areas. Techniques developed and evaluated in this catchment would also appear to have very broad relevance to many other areas in sub-Saharan Africa (see Section 3.3).

# *PART TWO: FOUR DESIGNS*

Part One presented the research question, and then examined personal aspects of the researcher's experience through key events which shaped the research, given that the researcher is also an actor in the social drama of the catchment and the country. Approaches to design were then examined with respect to a number of topics relevant to various aspects of integrated catchment management. Having developed this theoretical framework with respect to purposive design processes, the contextual framework was presented: constraints to small scale farming (aridity, poverty and land), the problems of water scarcity and food insecurity, South African government policies on integrated catchment management and Landcare, and finally the local context of the Mlazi River catchment and its surrounds.

With the theoretical and contextual framework developed in Part One as background, Part Two reports on four aspects of the practical participatory action research. First, as a strategy for dealing with aridity, technical aspects of rainwater harvesting, water conservation and ecological farming are examined in terms of their practical development on Bachs Fen Ecological Research Farm (Chapter 5). Then poverty is addressed, through practical attempts to share these learnings and insights with community gardeners through a process of discovery learning (Chapter 6). As access to land is beyond the scope of this study, it is discussed in relation to the transition from food gardens to small scale commercial farms such as Bachs Fen. A theoretical prototype design for a community garden is discussed. The inter-action with schools in helping them to establish School Environmental Action Clubs (Chapter 7) is another form of discovery learning, and its effectiveness as a strategy for developing an environmental ethic is discussed. The eighth chapter looks at the process of platform building, concentrating on the Upper Baynesfield Subcatchment Committee and the issues, processes and experiences associated with its formation. Its relevance as an institution for both Landcare and ICM is discussed. Each chapter is presented as a design, attempting to achieve design objectives using a range of design methods. Implications of the work and lessons learned are then synthesised in Part Three.

## Chapter 5: BACHS FEN ECOLOGICAL RESEARCH FARM

### 5.1 Introduction and farming environment

In designing a simple and robust ecological farming system for Bachs Fen, we concentrated on three factors: rainwater harvesting, water conservation and nutrient cycling. These three aspects are dealt with in this chapter in some detail, as they form the three basic innovations that were proposed to community gardeners, and discussion about their adoption or non-adoption forms a major part of the next chapter. They also contribute to the development of a theoretical prototype, and thus to some ideas on a framework for ICM and Landcare. The emphasis on rainwater harvesting in this and the previous chapter is mainly because of the severe limiting effect of lack of water on the possibilities for rainfed agriculture in sub-Saharan Africa. It would appear that my use of wetlands for water harvesting is an approach which has not been described previously in water harvesting literature. This innovation has attracted considerable interest from the Food and Agricultural Organisation, who commissioned a study on the system (Auerbach & Jansen, 1997; Auerbach, in press).

It was important to the practical orientation of the programme that our experience as small scale farmers in the catchment formed a basis from which we could interact with other farmers and exchange ideas. Most of the practical water harvesting systems were designed and implemented during the period 1991 to 1995. Wisserhof (1995) analysed farming systems. Verburg (1996) examined water use and hydrology. Jansen (1997) worked on water use efficiency of the wetlands and the design of water harvesting systems. Dlamini (1998) modelled the performance of the swales under the guidance of Dr Simon Lorentz of Natal University, who designed the v-notch weirs (devices for measuring water flows, installed and calibrated the automatic data collection systems, and analysed much of the hydrological data (Lorentz, 1998 & 1999). Bill York and his team built the v-notches, with help from Mabuye Ngubane and our team on Bachs Fen. All of these activities resulted in system descriptions, systems design and measurement of the performance of the systems.

Climate and location

Bachs Fen Farm is located in the coastal hinterland bioclimatic region of South Africa (Philips, 1973), 50 km west of Durban, which is one of the fastest growing cities in the world (Figure 1). Longitude and Latitude co-ordinates are about 30.5° east and 29.5° south. A plan of the farm is shown in Figure 16. The total area of the farm is 7.3 ha, of which 0.8 ha is irrigated vegetables, 1.0 ha is coffee, 3.4 ha is grazing land, 0.8 ha wetland, 0.6 ha forestry and orchards, and 0.7 ha buildings and roads. Elevation ranges from 580 to 660 m above sea level.

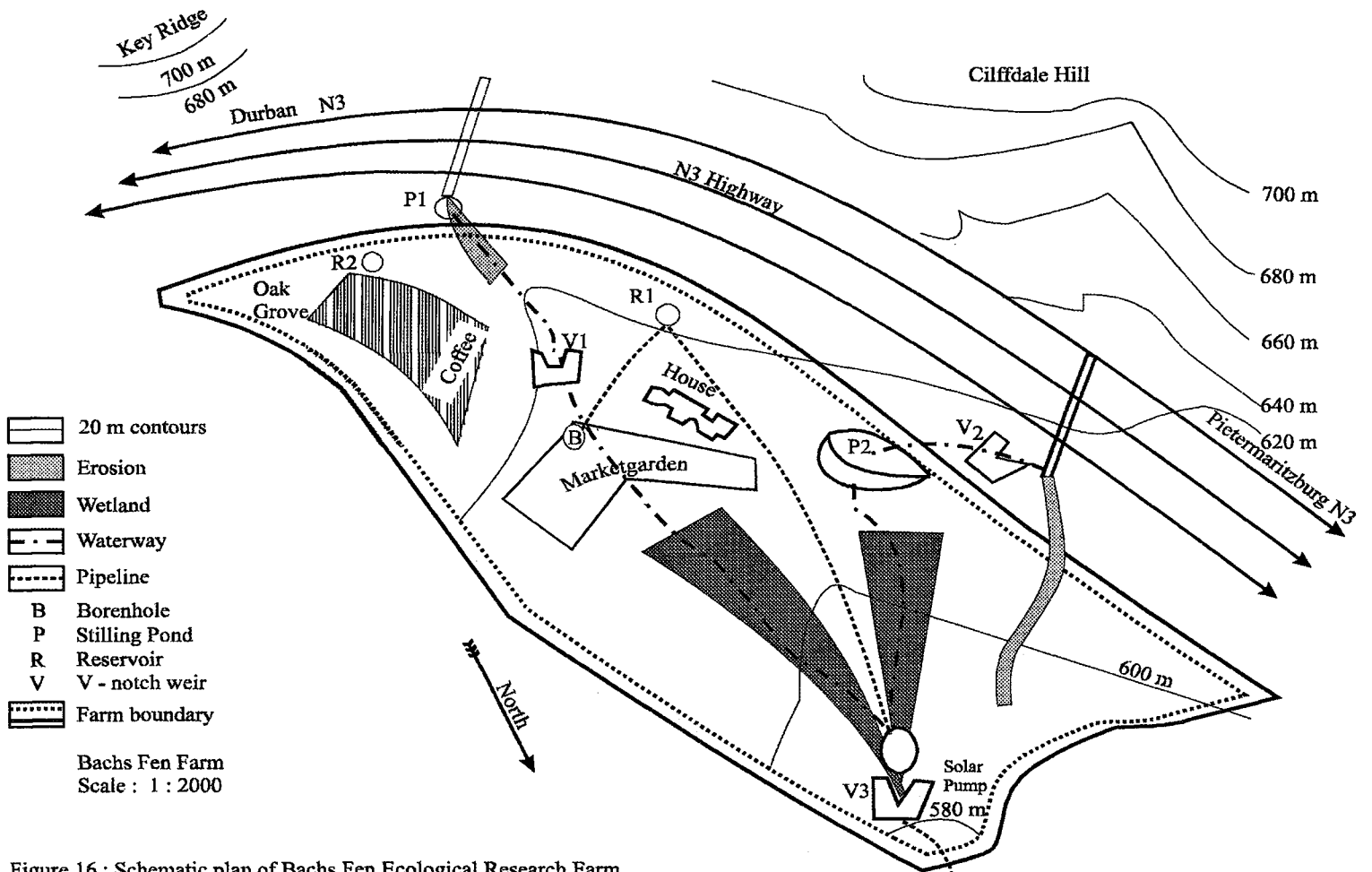



Figure 16 : Schematic plan of Bachs Fen Ecological Research Farm

The long term mean annual rainfall for the area is 797 mm (determined by interpolation of long term measurements, provided by the Computing Centre for Water Research), falling mainly in the summer months. Average rainfall for Bachs Fen over the past five years (which were wetter than average) is 813 mm/yr (see Table 1), which is considerably lower than subtropical Durban. Rainfall varied from 543 mm in 1994/5, the last of a cycle of drought years, to 1136 mm in 1995/6. Only 221 mm fell during the main growing season from October 1994 to February 1995, not enough to grow even a successful maize crop. This compares with 786 mm for the same period the following year, which would be adequate for a high value crop such as potatoes without irrigation. This highlights the risk of production in the area without irrigation. Even limited strategic irrigation dramatically decreases the risk of crop failure. In the adjacent Cliffdale area, dry years result in an increase in borehole irrigation, which adversely affects the water table. Groundwater resources are not adequate for extensive irrigation.

**Table 1: Summary of rainfall data (mm) for Bachs Fen Farm 1994-1998**
(Note: Hydrological year starts in October, when the main summer rains start)

| Month | 1994/5 | 1995/6 | 1996/7 | 1997/8 | Mean |
|---|---|---|---|---|---|
| **October** | 59 | 110 | 93 | 120 | **95.5** |
| **November** | 28 | 88 | 70 | 184 | **92.5** |
| **December** | 48 | 258 | 79 | 73 | **114.5** |
| **January** | 25 | 160 | 129 | 44 | **89.5** |
| **February** | 61 | 170 | 59 | 202 | **123.0** |
| **March** | 183 | 122 | 9 | 55 | **92.3** |
| **April** | 60 | 7 | 75 | 47 | **47.3** |
| **May** | 9 | 22 | 21 | 55 | **26.8** |
| **June** | 52 | 14 | 48 | 0 | **28.5** |
| **July** | 3 | 175 | 40 | 6 | **56.0** |
| **August** | 0 | 0 | 21 | 51 | **18.0** |
| **September** | 15 | 10 | 69 | 24 | **29.5** |
| **Total** | **543** | **1136** | **713** | **861** | **813.3** |

Although the climate is cooler than Durban, with only occasional frost, summer temperatures often reach over 40°C. This results in extremely high evaporative demand. The proximity of the area to Durban has three major implications for farming in the area: first, land prices are high; second, market potential is good; third, productive agricultural land is becoming increasingly scarce, due to urban development. The area falls in the summer rainfall zone, with most rain in the months October to March. On average, very little rain is received in the months May, June, July and August. The heavy rains experienced in July 1996 were thus atypical, while those of December 1995 were less unusual.

Water supply and irrigation practices

Domestic water comes from a borehole, 25 m below ground, equipped with a three-phase electric submersible Mono (screw) pump. No water treatment is undertaken as water quality is excellent. Water gravitates from tanks to reticulation systems for all dwellings. All water for irrigation, stock water and the nursery is drawn from a second borehole, some 45 m below the

ground, similarly equipped. Water is pumped to a concrete reservoir, and then gravitates to the market garden. Sprinkler irrigation of the vegetables is regular, and coffee is watered strategically during fruit formation. Considerable water is now available through rainwater harvesting practices, using water from the wetland, but cannot be used until a pumping system has been installed. A solar pumping system will be installed when funds permit.

Constraints

The fact that Christina and I have off-farm employment means that our contribution to practical farm management is limited. The small size of the farm is also a constraint, making it difficult to justify tractors. Although tractors were used initially, when the we moved from a larger farm, once the coffee was established, we decided that they were no longer necessary. Although soil was initially compacted with a tendency towards capping, use of mulches and compost brought about a radical change to the soil within two years, so that it is now easy to dig by hand. The difference between soils under mulch and those exposed to the sun is striking, and this has been useful in helping visitors to discover the value of mulch in a hot climate such as ours.

Although we have had no problems with our boreholes, groundwater in the area is a major constraint (Backeberg *et al.*, 1996). In neighbouring Cliffdale, boreholes were mostly about 40 m below ground. However, during the drought of 1992-95, these dried up, and the depth at which viable boreholes could be operated dropped first to about 80 m and later to more than 120 m (pers. comm., R. Stone, Borehole contractor). As a result springs dried up and base flow decreased. Through most of South Africa, underground water is only sufficient for stock and domestic purposes (Backeberg *et al.*, 1996). It is essential to find better ways of managing surface water, as pointed out by many writers (Yeomans, 1954; Pereira, 1972; Backeberg *et al.*, 1996; Hatibu *et al.*, in press).

Given the above-described groundwater situation in South Africa in general and in Cliffdale in particular, we decided to reduce our dependence on boreholes at Bachs Fen. We observed that the hill (and the highway) above the farm shed a good deal of water, which caused major soil erosion problems, and the wetlands have been developed to catch and store as much water as possible, while minimising the destructive aspects through allowing turbid water to slow down and drop its load of suspended soil. The wetlands, swales and mulches reduce flood peaks and increase base-flow (dry-season flow), which is the objective of much hydrological management.

The approach to water management is: slow down, spread and sink. Slowing down, spreading and helping the water to infiltrate determined the choice of swale design. Given a small farming unit like Bachs Fen, economic viability requires the optimal use of all of the land. Water harvesting and water conservation makes it possible to manage surface water in such a way that our farm which previously could irrigate only 0.4 ha of land can expand the irrigable area to more than 1.0 ha, plus strategic irrigation of 1.0 ha of coffee. We have already doubled the area under full irrigation to 0.8 ha. This means that the farm potential changes from being a unit capable of supporting only a part-time farmer, to one which can support two full-time farmers at a reasonable rate of nett farm income.

Seeing the landscape within the context of urban development, McCarthy (1993) developed a conceptual plan for the Western Corridor between Durban and Pietermaritzburg. According to

his landscape analysis, the Key Ridge area southeast of the farm is the gateway to Durban from the west. He argued that the area should form a green belt in which landscape considerations should centre around preserving an open agricultural landscape with a strong emphasis on promoting natural biodiversity and community open space. The revised D'MOSS plan (Durban Metropolitan Open Space System) also notes the importance of this area (Mander, 1999), and proposes a series of links between the Mlazi River and Umgeni and Umhlatuzana River systems, including a link between Peacevale and Alverstone.

Soils

The coffee plantation soils (eastern part of the farm, see Figure 16) are characterised by an orthic A horizon with a lithocutanic B horizon, and with underlying saprolitic material. They are classified as Glenrosa 18, the Robmore form by the South African binomial system (MacVicar *et al.*, 1977) and are shallow soils (0.3 m) with a high clay content in the A horizon (15-35%). Both agriculture and forestry are considered to be suitable land uses for these soils, although they are not high potential soils, in that soil depth is a limiting factor, requiring careful management of irrigation. Correlating soils in the FAO classification are: Ochric, Eutric and Calcic Cambisols.

Soils in the vegetable cropping area of the farm (central area around waterways, Figure 16) are mainly fairly deep sandy loams, made up of alluvial deposits from the sandstone hills above the farm, while the adjacent wetland areas are hydromorphic soils with some concretions. These soils are deeper (0.4 -1.2 m) and are classified as Cartref 12, the Arrochar form with an orthic A horizon, a lithocutanic B horizon and an underlying E horizon. The clay content of the E horizon is low (6-15 %). Correlating soils in the FAO classification are not accommodated specifically, but include Gleyic luvisols (pers. comm. C. Bester, 1997).

## 5.2 Design objectives

The general design questions addressed on Bachs Fen Farm are those posed in Section 3.2:

a What strategies are available to help improve food security in a way which addresses aridity, poverty and restricted availability of land?

b Are there effective methods of producing good yields of crops without resorting to the levels of fertilisers, poisons and other technologies which have produced the environmental problems currently being experienced in Europe and America?

An additional specific design objective addressed on Bachs Fen Farm is:

c How can the farm become more useful for teaching?

These three questions relate back to the overall research question posed in Chapter 1, in that they inform the management of natural resources and farming systems.

## 5.3 Design methods

The main design method used for Bachs Fen was the Permaculture Design approach (see Section 3.2). Later, nutrient flows were analysed by Wisserhof (1995) using a linear programme developed by the Department of Ecological Agriculture at Wageningen Agricultural University, the FARM model (Witte *et al.*, 1995). Elements of wetland rehabilitation were based on advice from Jon Wyatt, based on the Rennies Wetland Research programme. Selection and placement of indigenous trees was based on the recommendations of Geoff Nichols, then of Durban Parks and Recreation Department. Rainwater harvesting design for the wetlands system was based on observation, reason and inspiration (see Sections 3.6 and 3.7). The swales are a feature of permaculture design and cut-off drains and stilling ponds draw on keyline principles (see Sections 3.2 and 3.3). Designing the farm as a teaching tool drew on growing understanding within NCMP of discovery learning and environmental education design (Section 3.4).

## 5.4 Designing an ecological farming system for Bachs Fen

After examining the general approach to ecological farm design (land use and farming practices), this section concentrates on analysing soil fertility, nutrient cycling and enterprise selection, on water conservation and on rainwater harvesting design.

### 5.4.1 Land use and farming practices

Bachs Fen farming systems have been designed to be mixed and as ecologically sound as possible. Land is cultivated and planted in small sections (usually about 10 m x 5 m), and is worked by hand. Chemical fertilisers and biocides are not used, with the exception of systemic tick treatment for the dairy herd, and occasional paint-on use of herbicide to help control invasive alien plants. A small dairy herd is maintained, which together with a small flock of free-range layer hens and some Angora rabbits for wool production, contribute most of the manure for compost production. Where farm-produced manure is insufficient, manure is imported, usually from nearby stables.

In addition to organic vegetables for sale and home consumption the market garden produces winter feed for the animals. Coffee trees (*Coffea arabica*) planted in 1992 are approaching maturity. A fodder bank is being developed using multipurpose tree species to produce high protein seeds, so that a drought feed reserve will be available for the cattle Many indigenous trees have been planted, some with medicinal uses, some to screen the national highway which forms the farm's southern boundary, and these increase biodiversity. Fruit trees and a small forest of Saw-tooth Oaks (*Quercus acutissima*) have also been planted. Wetlands form a source of craftwork material (mainly *Cyperus* and *Typha* species), as well as providing winter grazing with a range of nutritious sedges and grasses, and an important wildlife habitat.

The farm organism

As mentioned in Section 3.2, the nature of an ecological farm is that it is an integrated system. Nutrient cycling and water and soil conservation are designed into every aspect of the farm. Local craftswomen make use of the wetland reeds, as part of the Ntshongweni Catchment Management Programme. Trees, cattle and crops form a highly efficient nutrient cycling

system, requiring few purchased inputs. There is, however, a considerable management input required to keep the system functioning. It has been interesting to see how this requirement has reduced as the systems became more established. Good design pays off as systems grow into a more productive, sustainable pattern, and as one learns about the complexities of the local ecosystems..

The policy we adopted with regard to tree planting was that we would gradually reduce the number of exotic trees, but that we would plant at least three trees for each one cut down, as the farm required more tree cover, but with the emphasis more on indigenous trees to provide shade for the coffee and to screen the highway, rather than too many fast growing exotic species which use a great deal of water. After about six hundred indigenous trees had been planted, we cut down 150 *Eucalyptus* trees, some of which we sold, and some of which we cut into roofing timbers.

Although they are an exotic species, the line of *Sincarpia* trees along the southern (highway) boundary has been left for the time being, as the effect of reducing the noise from the freeway is significant. Indigenous trees have been planted in this area, which it is hoped will eventually form an even more effective visual and sound screen against the highway. The indigenous trees planted between the house and the highway, and between the two houses effectively form a permaculture wilderness zone (see 3.2 and Appendix 2) and have the effect of augmenting the wildlife habitat available on the farm. They provide a corridor which connects the wetlands to the north of the farm with the box culvert under the freeway to the south, thus forming a migration route for animals right through the farm from north to south.

A link from the box culvert to the Saw-tooth Oak Grove is currently being planned, which will effectively join the farm via a little used farm road, to the adjacent natural heritage site at High Meadows Farm, and thus to the Alverstone Environmental Reserve and across Roseway School to the Mhlatuzana River catchment. As mentioned earlier, such cross-links between river systems are recommended by Patrick (1998) in his study of Open Space Management in the area. The formation of the Peacevale Conservancy, which I convened with the help of Léonie Berkouwer, Jack Wortman and Russell Walford (now its Chairperson), marks a step towards a more integrated management by local farmers of the landscape of the Peacevale area, and constitutes a small local platform for negotiated resource management.

### 5.4.2 Soil fertility, nutrient cycling and enterprise selection

Soil nutrient status was tested in 1995, and was on the whole found to be reasonably good (see Table 2). Because of the great variability in soil nitrogen in tropical soils, and the difficulty in correlating soil nitrogen, nitrogen application and crop response, the Cedara Soil Advisory Service does not routinely test for soil nitrogen (Dr Neil Miles, Head, Cedara Soil Fertility Analysis Service, pers. comm., 1991). Available soil P was determined by the Olssen method, bases by atomic absorption spectrometry after extraction using the Hunter (ISFEI) method, pH in 1N KCl, oxidizable Carbon by the Walkley Black method.

Table 2 shows that P, K, Ca, Mg and Zn levels are adequate to high, especially the soil available P from in the Garden (west) and the coffee (159 and 135 mg/*l* P, respectively, by the Olssen method). The general P threshold for crops is 25 - 40 mg/*l*; K 120 -240 mg/*l*; Mg 100-300 mg/*l*; Ca 400-1200 mg/*l*; Zn 2-20 mg/*l*.

The results of the samples "pasture" and "fodder bank" reflect the soil status of areas of the farm which have not previously been cultivated, showing lower phosphate levels (4 and 9 mg/*l* P), reasonable potassium levels (133 and 359 mg/*l* K), and high organic matter for the pasture sample (6.3 % carbon). These results are very typical of undisturbed soils in the area. The highly dystrophic nature of soils means that phosphates are leached, and soils tend to be acidic, but in terms of field conditions in the rhizosphere, the acidity is buffered by high organic matter contents (6.3 % is high for the area). Once soils are cultivated, organic matter levels drop below 1 % carbon, and the buffering capacity declines. Thus acidity and low phosphate combine to exert a severe limiting effect on soil fertility. The relatively high clay content has the result that bases (especially potassium) are not generally limiting in the area.

The organic carbon levels of the two garden soils in 1995, while still lower than desirable on an organic farm, are better than many local soils, such as soils from the community gardens which have organic carbons ranging from 0.4 to 1.1 % carbon.

**Table 2: Results of soil analysis by Cedara Soil Advisory Service, Department of Agriculture, Pietermaritzburg for Bachs Fen Farm, February 1995.**

| Area sampled | Year | Density kg/l | Clay % | P mg/l | K mg/l | Ca mg/l | Mg mg/l | Zn mg/l | pH KCl | org C % |
|---|---|---|---|---|---|---|---|---|---|---|
| Garden (west) | 1995 | 1.28 | 21 | 159 | 301 | 823 | 188 | 11.0 | 6.4 | 1.9 |
| Garden (east) | 1995 | 1.15 | 32 | 55 | 149 | 743 | 160 | 6.0 | 5.5 | 2.0 |
| Coffee | 1995 | 1.04 | 42 | 135 | 579 | 755 | 187 | 15.6 | 4.8 | 2.3 |
| Pasture | 1995 | 0.95 | 50 | 4 | 133 | 791 | 348 | 6.3 | 5.2 | 6.3 |
| Fodder bank | 1995 | 0.97 | 48 | 9 | 359 | 556 | 268 | 2.4 | 4.9 | 2.3 |

Wisserhof modelled annual P and K balances (in kg/ha) for Bachs Fen, using the FARM model (Witte *et al.*, 1995). He predicts that given the farming system, phosphates will change from a depletion of 0.5 kg/ha in the past, to a depletion of 0.7 kg/ha currently and a projected depletion of 2.0 kg/ha. Both of these results are satisfactory. Regarding Potassium, Wisserhof's projections range from a depletion of 7.0 kg/ha K in the past, to a current depletion level of 9.0 kg/ha and a projected depletion level of 25.9 kg/ha K. This is largely due to nutrient export in the form of coffee beans, which should also provide the main source of income. In terms of nutrient cycles, this could become serious, and Potassium levels will be monitored regularly. If necessary, poultry manure may have to be imported, as has been done with the coffee terraces already.

As Wisserhof points out, the current weak point of the farm is the dairy management. Since the dairy is small, major efforts to develop a specialised market for unpasteurised milk have not been economically justified. The cows have been kept to provide milk for the farm families and a few loyal customers, and also to provide manure for composting for the market gardening activities. We have now sold our three cows, and intend to replace the herd with six high-producing in-calf heifers, now that the wetland rehabilitation process is complete. Hopefully, this will justify a more intensive marketing approach, and the farm now seems able to carry six cows and followers and a bull (total of sixteen mature livestock equivalents, including bull-calves raised for beef).

The Bachs Fen farming system is robust but not highly productive. However, the aim is not to prove that ecological agriculture can be highly productive, but to design and implement a simple and robust system, which works economically and can be used as a teaching resource as well. Vegetable production takes place without the use of poisons; appropriate varieties are selected, and garlic sprays are used prophylactically on sensitive crops. Farm animals contribute to soil fertility in the market garden, and in return, the market garden produces winter feed for the cattle and green feed for the small stock. A small amount of dairy feed is purchased, and where necessary, horse manure is bought in to balance the export of nutrients in the coffee subsystem. The system is kept simple so that the teaching aspects remain relevant to what is easily achievable by small scale farmers in the area. However, some high value crops such as strawberries, asparagus and a range of lettuce varieties are produced to capitalise on the local niche markets for these. Processing, packaging and distribution of the coffee are also done on the farm. Adding value by producing and processing such high-value crops is a strategy which is being used effectively by small scale farmers in Chile (Berdeguez, 1998), and it has great potential for small scale farmers in our peri-urban situation.

### 5.4.3 Water conservation design

Water conservation design makes use of swales and mulches.

Swales

In the vegetable garden area, two swales were constructed to catch all ran falling on the garden area. They were planted with vetiver to safeguard the crests of the swales against soil erosion after heavy rains. Water from the area above the garden was led to the waterway via a cut-off drain, also planted with vetiver grass. Plates 1 to 4 illustrate the construction and vegetation of the swales. Smaller swales were also constructed and planted with vetiver in the fodder bank area. Small dams serving the same function within the wetland were rehabilitated. Stilling ponds were constructed at the points of entry of runoff from the adjacent hills and highway to absorb some of the energy of the fast-flowing stormwater.

Mulching

Water conservation measures in the vegetable garden are designed to decrease runoff and erosion and to enable infiltration of all the rain falling on the vegetable garden. These consist of the swale system described above and the regular use of mulch on all cultivated beds. Vetiver grass is harvested from the crests of the swales, and when this is not sufficient, natural grasses are cut from the conservation areas (which also reduces fire hazards). Mulches are illustrated in Plates 5 and 6.

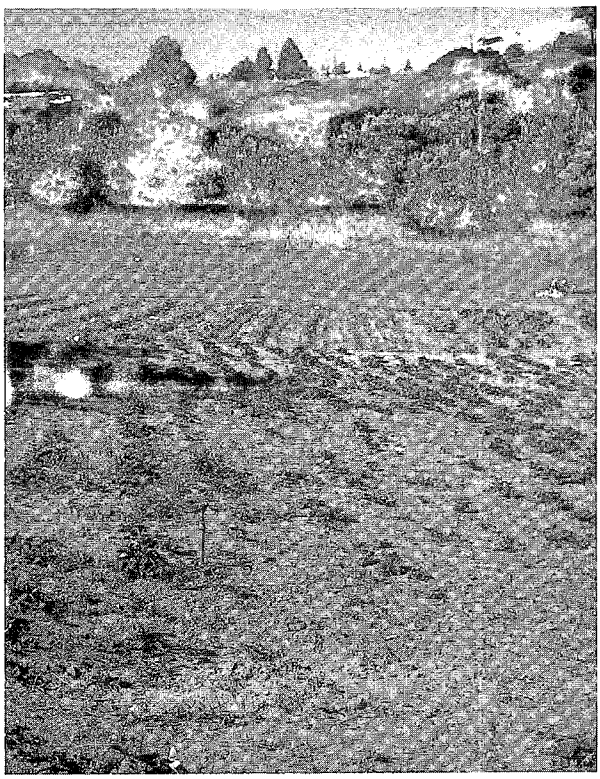


**Plate 1:** **Bachs Fen Farm before swale construction.**

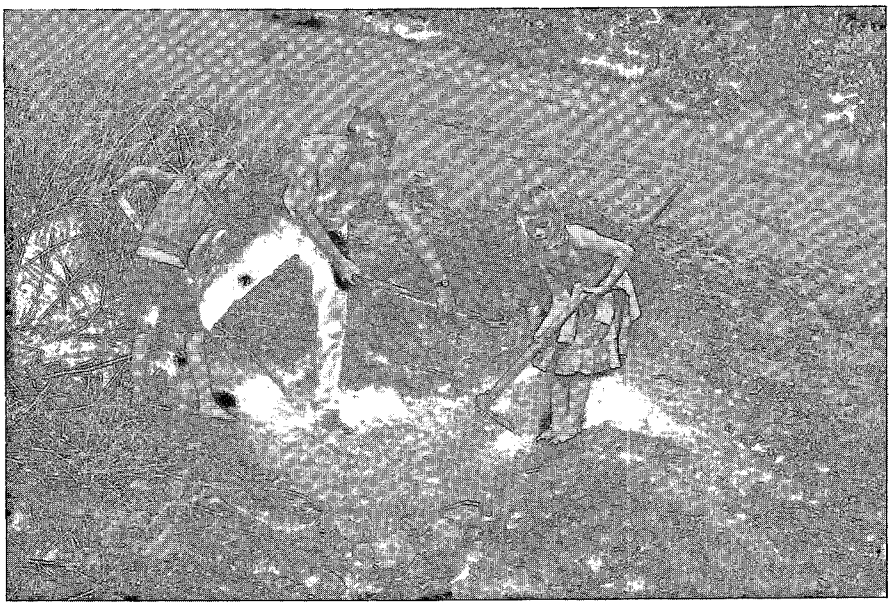


**Plate 2:** **Constructing a swale.**

**Plate 3:** **Engineering Phase complete.**

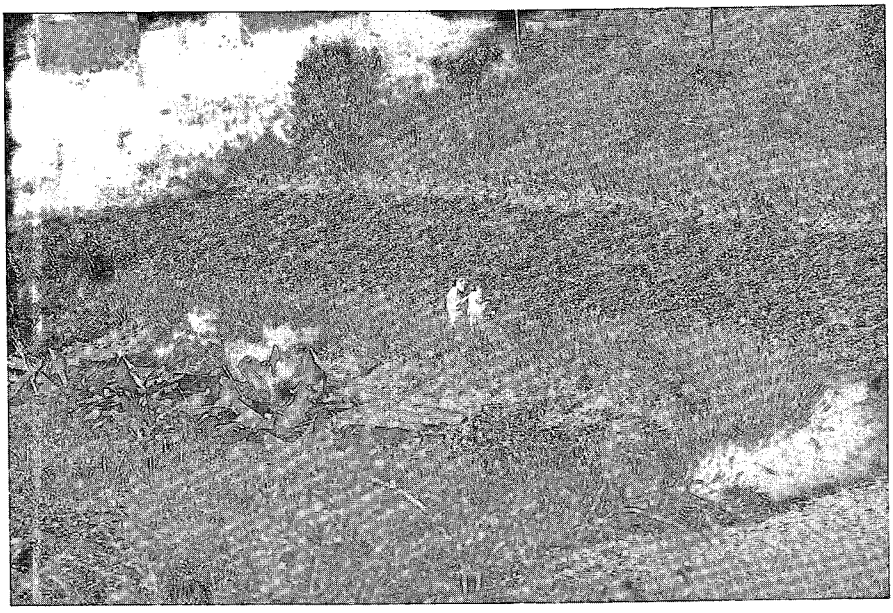


**Plate 4:** **Seven months later, vetiver stabilises the swales.**

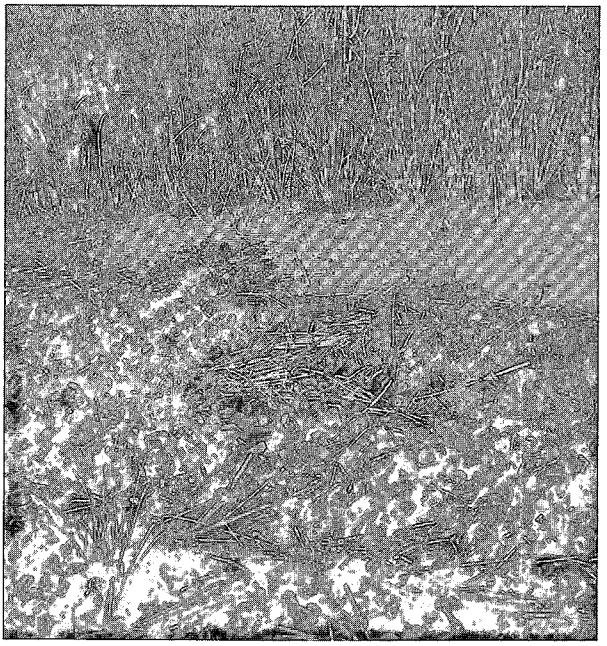


**Plate 5:** **The vetiver growing on the swales makes a good mulch, suppressing weeds and conserving water.**

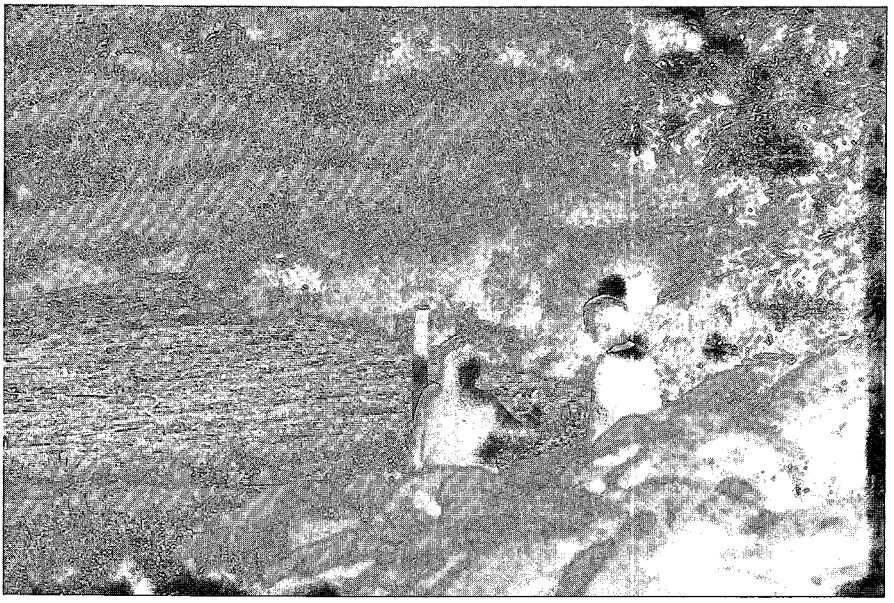


**Plate 6:** **A sheet of mulch covers the garden.**

### 5.4.4 The wetland rainwater harvesting system

Run-off generation

Rainwater run-off from a steep sandstone hill above the farm (with a total catchment area of approximately 0.293 $km^2$) enters the farm via two water culverts under the N3 national highway, and flows through approximately one hectare of wetlands on the farm. This water is complemented by the run-off from the national highway between the farm and the hill. Peak flow discharges onto the farm are rapid and relatively high due to the steepness of the hill and the impermeable surface of the highway. The response time of the peak discharge crossing the farm was modelled on a natural hillslope with the SCS model (Schulze *et al*, 1992) to be 0.5 hours after rain (Verburg, 1996). In practice, the wetlands, the swales and the mulches appear to have slowed this down to about 24 hours after gentle rainfall events, and even after storms, the peak discharge is considerably slowed, and the volumes of peaks are much reduced. Considerable quantities of water are stored in the wetland (Lorentz, 1998, 1999).

The two subcatchments above the farm, and the third subcatchment made up by the farm itself are shown in Figure 17. A transect, giving the range of altitude on the farm, is shown below this in Figure 18. Subcatchment 1 stretches from the highest point of the Key Ridge, south east of the farm, to the highest point of Cliffdale Hill above the farm, including the intermediate valley. The average slope is 46 %. The vegetation of the area is mainly *Eragrostis plana* (Mtshiki) and *Aristida junciformis* (Ngongoni) grass species, with some bushes. Soils are soft Glenrosa 18, the Robmore Form (MacVicar *et al.*, 1977). This is similar to the soils already described on Bachs Fen Farm, but with a high clay content in the A horizon (15-35 %), with a coarse texture. This area drains onto the farm through a box-culvert, and measures 375 m x 125 m (0.046875 $km^2$). The area of the impervious surface of the highway is another 0.005 $km^2$ (250 m x 20 m), giving a total area for subcatchment 1 of 0.051875 $km^2$. The highway drains onto the farm via concrete drains.

Subcatchment 2 is the area west of subcatchment 1, running from the top of Cliffdale Hill to a point west of the old farmhouse on Bachs Fen farm. Vegetation is similar to subcatchment 1, and slope is about 48 %. Soils are classified as Cartref 11, the Rutherglen form (MacVicar *et al.*, 1977). There is a rock factor of about 20 % on the top of the hill and the clay content of the E-horizon is 6-15 %, with fine grade sand. Water is piped under the highway from this area, which measures 150 m x 175 m (0.026250 $km^2$). The highway here again measures 250 m x 20 m (0.005 $km^2$), giving a total area of 0.031250 $km^2$.

Subcatchment 3 is the farm itself, with soils as described and an average slope of 18 %. The farm boundaries are the N3 highway to the south, and District Road 607 to the west, north and east. The farm area is 0.073 $km^2$, but approximately 0.013 $km^2$ of this area does not drain into v-notch 3. The total catchment area of the three subcatchments which does drain into v-notch 3 is thus 0.143125 $km^2$ (0.051875 + 0.031250 + 0.060 $km^2$).

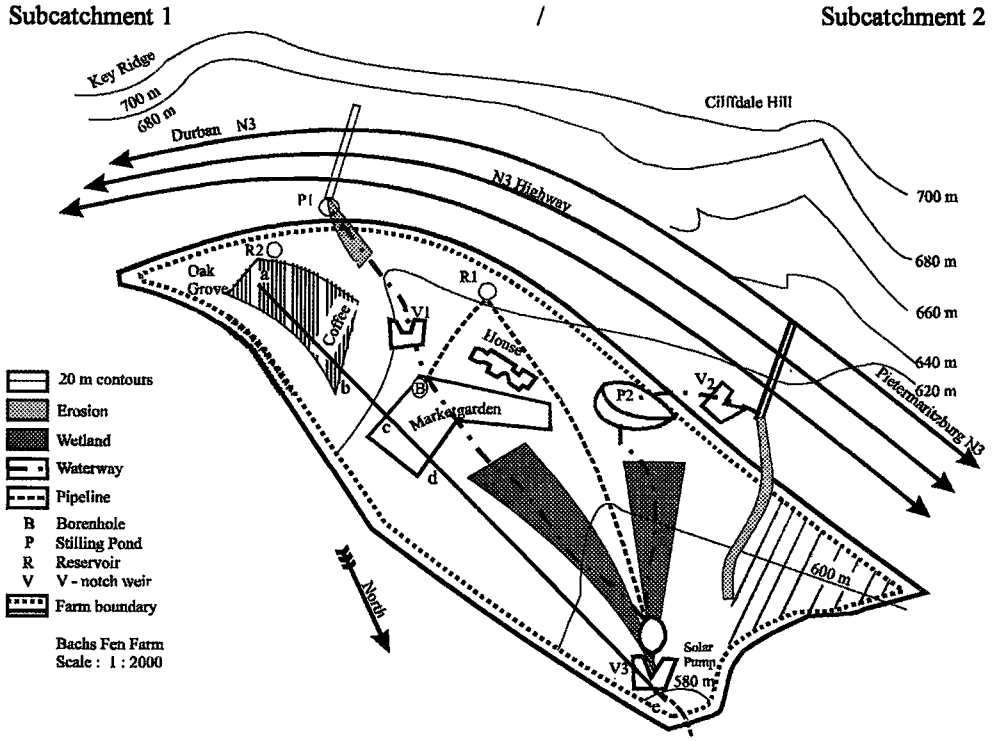



**Figure 17:Bachs Fen Farm and adjoining rainwater harvesting subcatchments. Water yields of subcatchments 1 & 2 above the farm measured at v-notches 1 and 2 (inflow); most of the farm makes up subcatchment 3 (excluding the western part, marked with hatching ///). Water leaving subcatchment 3 is measured at v-notch 3 (outflow).**

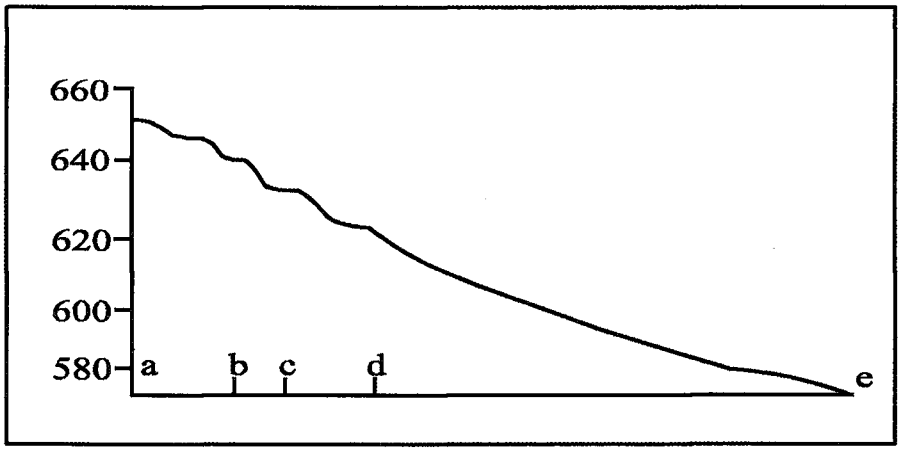



**Figure 18: Transect across Bachs Fen showing Dlamini's points a, b, c, d (1998) used for modelling runoff, and v-notch 3 (point e) showing heights in metres.**

Road engineering resulted in re-alignment of a water course running off the highway above v-notch 2, and caused a substantial erosion gully, and some scouring of the other water course above v-notch 1 after concentration of runoff. Remedial measures included the construction of a re-diversion furrow to bring the water back into the original waterway, and stilling ponds for both waterways, planting of vetiver grass to reduce the impact of runoff and construction of a cut-off furrow to channel all runoff above the vegetable area into the waterway.

Modelling runoff

Verburg (1996) was asked to estimate the water balance components in order to plan the wetland water harvesting system. Using the rough estimates available, he calculated that the mulches and compost already reduce evaporation by approximately 40%. He pointed to the need for further increases in water use efficiency, recommending that sprinklers be replaced by drip systems, and that reservoirs be covered where possible to reduce evaporation. This has not been done, as it was felt that the additional complexity and cost introduced would make the system less useful as a teaching resource. A photograph of water samples taken above the wetlands (at the site of v-notch 2) and below the wetlands (at v-notch 3) in 1996 after 13mm of rain (before weir construction, Plate 7) shows how turbid water is after flowing off the overgrazed hill above the farm, and the purifying effect of the rehabilitated wetland. Water quality tests indicate that even before the water passes through the wetlands, levels of lead and cadmium are similar to background environmental levels (Umgeni Water test results, 1997). The initial reedbeds in and above the stilling ponds appear to remove any toxic substances which might have been present.

The effects on water dynamics of swale construction were modelled by Dlamini (1998) using the Hills 9 model (Smith and Herbert, 1996). The transect through the farm follows Dlamini's study sites (a,b,c,d in Figures 17 and 18), and has been extended to show the elevation of v-notch 3 (e). Dlamini modelled four stochastically generated rainfall events. The first totalled 28mm of rain over four hours, reaching a peak intensity of 18mm/h. No run-off was generated on the farm transect during this event. Dlamini concludes that most of the rainfall replenished the soil moisture storage as the "event" occurred after a dry spell. The second event totalled 65mm over 5h, and generated surface flow for the no swales scenario, rising from 0 to 9.1mm in less than 2h. The slope with swales took 10 minutes longer to start yielding runoff, and the flow rates rose more gently and took longer to peak (at 4mm). The third rainfall event modelled was only 3.8mm, and generated no runoff, and the fourth was 10mm, producing runoff only on the slope with swales. Dlamini concludes this is probably because this slope was wetter than the plain slope, due to increased infiltration in the earlier events. Actual results of observations and measurements are presented later in this chapter.

Rainwater harvesting and water conservation measures are taken on the farm. Swales (level bunds) were constructed and planted with vetiver grass to slow down, spread and sink water falling on the vegetable garden (Plates 1 to 4). Mulches are extensively used (mainly derived from the vetiver planted on the swales) to decrease evaporation and inhibit weeds. Compost improves the soil moisture holding capacity and promotes nutrient cycling. Wetland areas are developed and carefully maintained to maximise flood attenuation and water storage. A lower dam has been constructed, and a solar pump (powered by electricity from photo-voltaic panels) will be installed to harvest the water from the wetlands, thus dramatically reducing borehole use for irrigation.

The two boreholes and two reservoirs were in existence when the farm was purchased in 1991. The swales were erected by hand after a simple survey using a dumpy level initially and a water-pipe level subsequently. The 0.4 ha area required two swales and a cut-off drain, which took about 60 man hours to construct, using picks and shovel. Planting of vetiver and watering it twice took a further 40 man hours, and required digging and transport from a neighbouring farm. Construction of the stilling ponds and channels was undertaken by the road engineers after my lawyer and I had persuaded them that the erosion was their responsibility. The work required a back-hoe for about four days, followed by about 10 cubic metres of gabion construction.

Most rain falls in the summer months (October to March, see Table 1), often in short, sharp thunder showers. Once the wetlands have become saturated, they consistently yield more than 20 *litres* per minute (November to April or May). The dry months are June and July, during which in some years there is no flow out of the wetlands. During this time, evaporative demand in the market garden is reduced, but irrigation is still required. The farm requires about 2.1 million *litres* of water for the 8 summer months, and about 0.3 million *litres* of water for the 4 winter months, giving a total of approximately 2.4 million *litres* per year to irrigate the 0.4 hectares of vegetables. My observations (only for ten months) during the year of 1996 yielded the data shown in Table 3, based on physical measurements of rainfall and flow at various times over ten months.

**Table 3 Rainfall and estimated flow & volume from Bachs Fen wetland, 1996***

| Month | (mm) Rainfall | (*litres* per minute) Estimated average flow | ($m^3$ per month) Estimated water volume |
|---|---|---|---|
| January | 160 | 40 | 2 000 |
| February | 170 | 30 | 1 500 |
| March | 122 | 30 | 1 500 |
| April | 7 | 20 | 1 000 |
| May | 22 | 15 | 750 |
| June | 14 | 0 | 0 |
| July | 175 | 15 | 750 |
| August | 0 | 0 | 0 |
| September | 10 | 0 | 0 |
| October | 93 | 5 | 250 |

* (not a full hydrological year: months 4 -12 of 1995/96 year, + month 1 of 1996/97 year)

Based on these data, it was estimated that the wetlands yielded about 10 000 cubic metres of water that year, or more than three times what Verburg (1996) calculated the garden required.

Measuring inflow and outflow for the farm rainwater harvesting system

Subsequently, Dr Simon Lorentz of the University of Natal's Agricultural Engineering Department (Agricultural Catchments Research Unit) designed a system of three weirs equipped with v-notches, differential pressure transducers, data-loggers and an automatic rain gauge for measuring the components of the water balance at Bachs Fen accurately (Plates 8, 9 and 10), based on preliminary estimates. The results obtained are discussed in the next section.

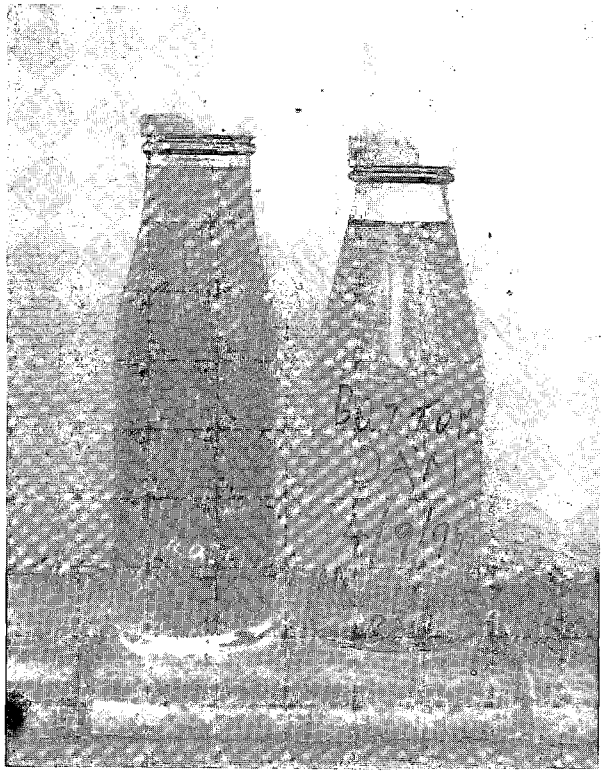


**Plate7:** **Water samples from above and below the wetlands show how turbid water (left) is purified as it passes through the wetlands (right).**

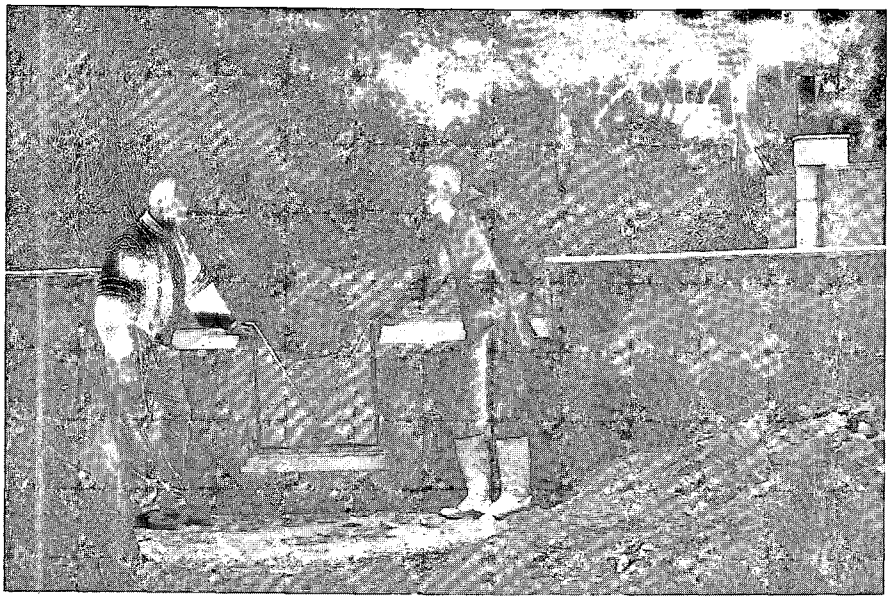


**Plate 8:** **Dr Nuhu Hatibu, editor of the study on African Rainwater Harvesting Systems (in press), examines v-notch 1 with Mabuye Ngubane.**

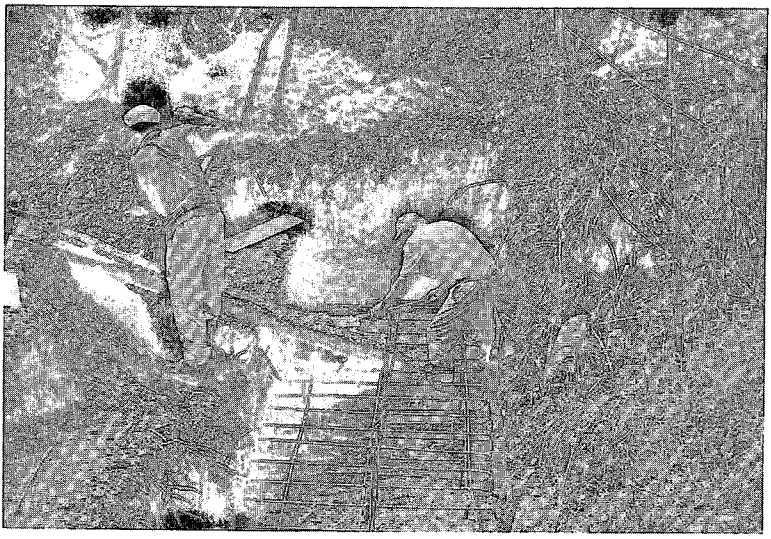


**Plate 9:** **Construction of v-notch 3: Bill York and his team at work.**

**Plate 10:** **Raymond Auerbach admires v-notch 3 below the wetlands (Cliffdale Hill in the background, with the Old Farmhouse which is to become an Educational Resource Centre below it).**

The v-notch measuring system was installed at the end of September 1998, and has been functioning since the beginning of the 1998/99 hydrological year (October 1998). Monthly flow data for October, November, December, 1998, and January and February, 1999, are presented in Appendix 3, and are summarised in Table 4 and Figure 19.

The three v-notch weirs are set up to record water flow every four minutes. In the three significant rainfall events of October 1998, the flow of water onto the farm from the neighbouring overgrazed hill and the highway totalled only 25 $m^3$, and lasted for only a few minutes on each occasion (see Appendix 3, October Flow data for v-notches 1 and 2). These were the first rains of the season, and much of the actual rainfall at this time would have soaked into the dry soil, and thus generated very little run-off. Prior to the rehabilitation and further development of the wetlands on Bachs Fen (1992 - 1995), all run-off ceased at the lower end of the farm within two hours of the cessation of even a heavy rainfall event. However, by 1996, the wetland maintained a flow through nine months of the year. It was, however, an unusually wet winter that year. The flow stopped entirely for some weeks during June, August, September and October.

By 1998, Table 4 shows that v-notch 3 (below the wetlands) is now reading a flow of water in the order of 10 $m^3$ (10 000 *litres*) per day, even at the beginning of the rainy season. September was hot and dry, with 24 mm of rain falling in seven events none of which totalled more than 6 mm. There was virtually no flow out of the wetland during September. Table 4 shows that a total of some 446 $m^3$ of water was available through the relatively dry month of October, even though the total monthly rainfall of 65 mm was well below the average (96 mm see Table 1). This quantity of water at the beginning of the season, significantly reduces the risk of crop failure, and also allows early planting, with probable benefits in terms of premium prices for crops which are mature earlier than those of rainfed farms which do not harvest rainwater. Subsequent monthly rainfalls (with means from Table 1 in brackets) were: November - 83 mm (93 mm); December - 94 mm (115 mm); January - 138 mm (90 mm); February - 191 mm (123 mm). The first part of the season was thus drier than usual, but the storms of early February led to wide-spread flood damage in the Durban area.

In terms of Verburg's estimate of crop water requirements at an average of 8 *l*/minute through the summer months, this converts to just over 80 000 *l*/week, or 80 $m^3$/week in order to irrigate 0.4 ha. In all weeks of the period except the first, this target is exceeded. In order to be sure of enough water for one hectare, however, 200 $m^3$ would be required. This total is reached by the end of the first week in November, and maintained throughout the period. Given the relatively low evapotranspirative demand during the early season, we as farmers are prepared to take the risk, and have already proceeded with plans to further enlarge the garden from the 0.8 ha to which we have already expanded, to a full one hectare.

**Table 4:** **Weekly rainfall, rain volume (over 6 ha), inflow, outflow and cumulative water balance for Bachs Fen Farm, October 1998 to February 1999.**

| Date | Weekly rainfall (mm) | Rain volume for 6 ha of farm ($m^3$) | Inflow v-notches 1 + 2 ($m^3$) | Outflow v-notch 3 ($m^3$) |
|---|---|---|---|---|
| 03/10 | 15 | 960 | 2 | 31 |
| 10/10 | 11 | 1800 | 0 | 117 |
| 17/10 | 30 | 1800 | 3 | 90 |
| 24/10 | 10 | 624 | 20 | 81 |
| 31/10 | 4 | 252 | 1 | 127 |
| 07/11 | 2 | 120 | 0 | 490 |
| 14/11 | 0 | 24 | 0 | 416 |
| 21/11 | 44 | 2652 | 281 | 545 |
| 28/11 | 24 | 1428 | 316 | 934 |
| 05/12 | 59 | 2952 | 59 | 4889 |
| 12/12 | 15 | 932 | 27 | 1003 |
| 19/12 | 2 | 120 | 0 | 634 |
| 26/12 | 18 | 1080 | 1 | 371 |
| 02/01 | 4 | 240 | 0 | 293 |
| 09/01 | 18 | 1080 | 30 | 204 |
| 16/01 | 94 | 5636 | 1460 | 4573 |
| 23/01 | 18 | 1104 | 92 | 756 |
| 30/01 | 7 | 432 | 3 | 305 |
| 06/02 | 158 | 9480 | 1910 | 15384 |
| 13/02 | 15 | 876 | 101 | 3276 |
| 20/02 | 18 | 1068 | 3 | 930 |
| 27/02 | 1 | 60 | 0 | 407 |
| **TOTAL** | **567** | **34726** | **4310** | **35859** |

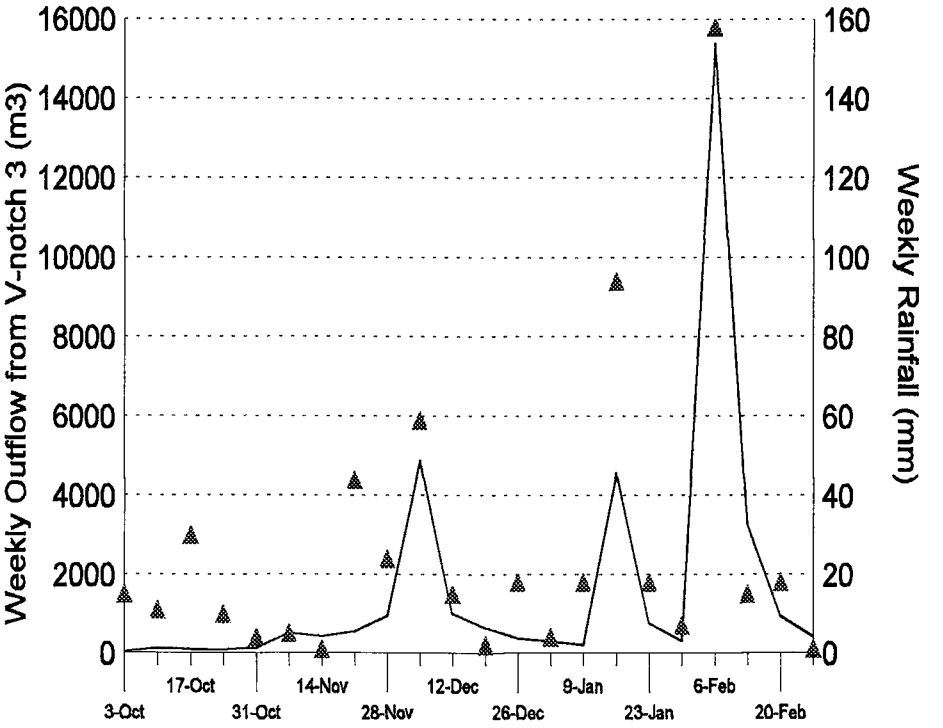



**Figure 19: Weekly rainfall and outflow from the wetland system on Bachs Fen Farm, October 1998 to February 1999**

Comparing the total volume of rain which fell on the six hectare area of the farm which makes up subcatchment 3, with the total volume of outflow from v-notch 3, as shown in Table 4, the similarity of the two totals is striking. However, the main difference in distribution, is that whereas 13 704 $m^3$ of the total volume of rain fell in the first 11 weeks, only 8 723 $m^3$ flowed out of v-notch 3 during this period. This represents at least 5 000 $m^3$ which is stored in the wetland, or contributing to evapotranspiration and deep percolation. The figures do even out in the second half of the period, largely due to the high volume of outflow generated by the 158 mm of rain in the week ending 6th February.

It is very likely that the inflow figures are underestimated for this event, as due to technical problems, the inflow data are not completely reliable. The amount of sediment which is washed off the hill into v-notches 1 and 2, means that the data loggers are sometimes covered with a thick coating of mud. If there are several rains overnight, the mud sometimes settles around

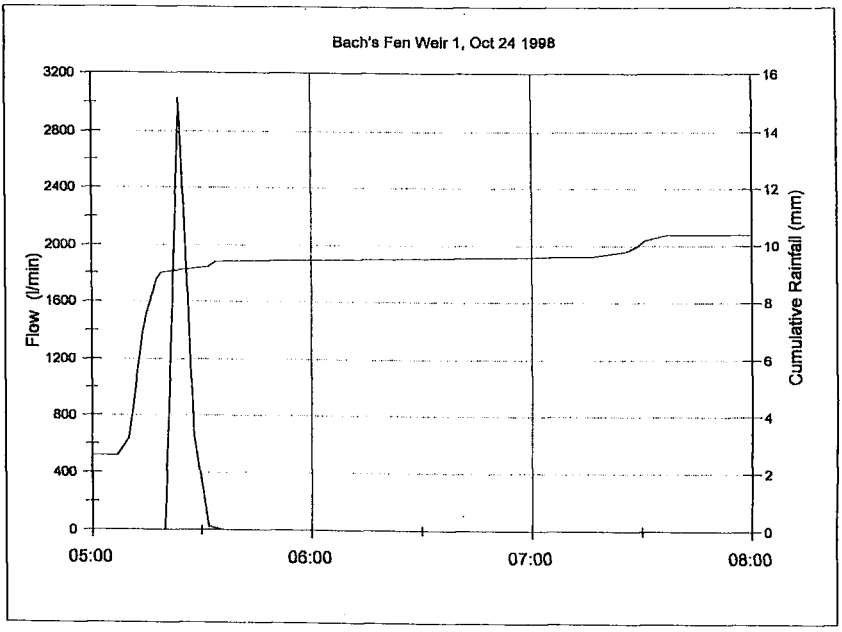
the inlet, and subsequent rainfall events are under-recorded. This problem (which is not experienced at v-notch 3) in itself confirms the tremendous erosive power of thunderstorms, and the beneficial effects of the wetland in dealing with the runoff from the hills and from the highway, as well as the rain which falls on the farm, without any significant turbidity occurring at v-notch 3. The relationship between rainfall and inflow is also closely linked to rainfall intensity, with heavy rain generating a higher proportion of runoff than gentle rain throughout a given period.

The relatively low proportion of water inflow (runoff from the hills and highway, v-notches 1 and 2: 4 310 $m^3$), to the water outflow (v-notch 3: 35 859 $m^3$), while it may be under-estimated, also serves to illustrate that rainwater harvesting using wetlands does not depend on having steep hills or a highway shedding water into the wetland. The bulk of the water which finds its way through the wetland originates from on-farm rainfall. If the hills and highway were not part of the system, some water would be lost, but so also would the water management problems which they bring with them.

To illustrate the performance of the wetlands, an example of a rainfall event on 24th October (see Appendix 3) is illustrated graphically in Figure 20. My field notebook shows that rain started at 05:15 pm; by 05:30, 6 mm of rain had fallen in a short, sharp storm. By 05:20 pm, weirs 1 and 2 began to flow, both dark brown in colour from suspended soil. By 17h25 they were flowing strongly, peaking at about 3000 and 1000 *litres* per minute (3 and 1 $m^3$/min) respectively, and by 17h40, most of the flow was over (Weir 1, Figure 20 a). Only at 18h20 did weir 3 record increased flow levels for about an hour, rising from the base flow figure of 11.1 to a peak of 53.7 *litres* per minute, or 0.0111 to 0.0537 $m^3$/min (Weir 3, Figure 20 b). The total volumes of water passing weirs 1 and 2 during this minor storm were 15 and 5 $m^3$ respectively, over a period of 16 minutes. Although the flow rate is high, the total volume is low because of the short duration of the flow. In comparison, weir 3 has a flow rate varying from 4 to 80 $m^3$ per day throughout October, although the rate is never more than 0.1 $m^3$/min.

This example shows that although high intensity rainfall will produce rapid and turbid run-off from overgrazed hills and roads, wetlands can be used to slow down the water run-off. This wetland also has significant storage capacity, especially in the early part of the season, as can be seen from Table 4. The estimates presented in Table 3 which were used to design the measuring system (v-notches 1, 2 and 3) appear to have given a reasonable indication of flow rates. However, heavy rains in February 1999 again caused major soil erosion at the point where water flows under the highway above weir 2, and this necessitated the construction of a concrete wall to ensure the diversion of the water back towards the original watercourse.

For October, 3871 $m^3$ of the total rainfall plus farm on-flow (4320 $m^3$) has percolated into the soil, evaporated, or been stored in the wetland. Future studies with potentiometers could help to determine the fate of this water, but Dlamini's predictions are that most of the water will have infiltrated where it fell. Thus these preliminary data suggest that combining mulches, swales and wetlands has practically turned out to be an efficient early season water harvesting system. The design appears to be functioning efficiently. Further long term measurements should quantify seasonal water yield of the wetlands.



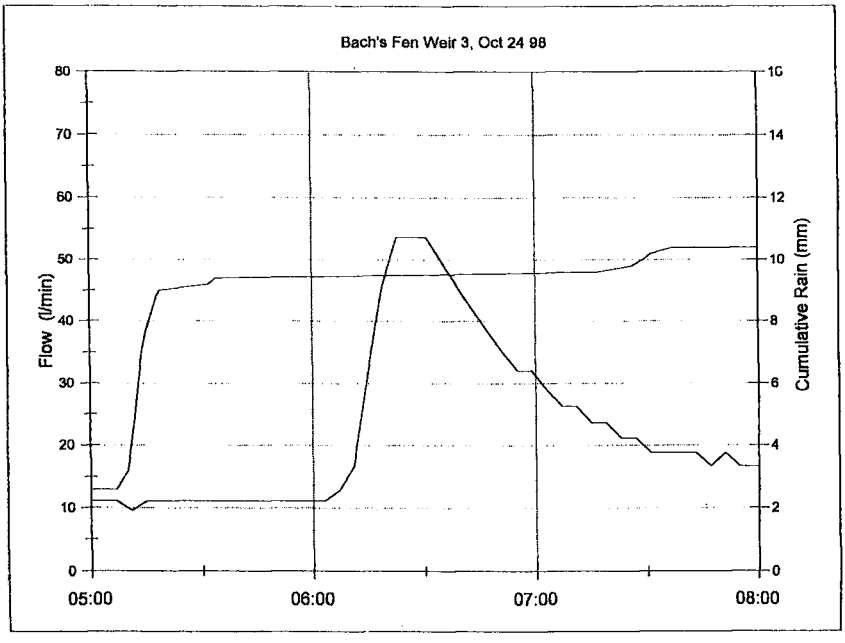




**Figure 20:** **October 24 runoff flow and cumulative rainfall for Bachs Fen Farm measured at Weirs 1, 2 & 3 before, during and after 6 mm of rain**

One of the major achievements of Bachs Fen Ecological Research Farm has been to convert a hazardous situation into productive use of natural resources, both for the local ecology and for crop production. According to Backeberg *et al.* (1996), 6 000 to 9 000 $m^3$ per year of water is required to irrigate one hectare of irrigated crops. This agrees fairly well with Verburg's estimate. Even if only a fraction of the estimated 50 000 $m^3$ flowing out of this one hectare wetland this year (and at least 20 000 $m^3$ even in a dry year, based on October outflows) is used for irrigation, the reduction in pressure on the water table (both through the use of boreholes and through increased groundwater recharge) will be dramatic. Benefits are thus fourfold: reduction of soil erosion hazards through use of wetlands, increase of biodiversity (including craftwork resources, cattle feed and wildlife habitat), decreased pressure on groundwater resources and increased irrigation potential.

Water conservation

Verburg (1996) estimated that when mulches are used, evaporation from market garden beds is reduced by 40 %. At this stage, it is not yet possible to quantify the performance of the mulches accurately. However, it has been observed frequently and remarked upon by visitors to Bachs Fen, that on an average hot summer's day, areas which are not mulched are dry and the soil is compacted, while areas covered by mulch are moist, and friable enough to insert a finger to a depth of at least 3 cm.

Dlamini's estimates of the effectiveness of the swales indicates that a further increase in effectiveness of water use has been brought about by the swales, but this has not yet been quantified. However, the combined effect of swales and mulch should at least result in crop water demand dropping from the middle limits of the normal range (7 500 $m^3$ per ha per year) to the lower limits of the range (6 000 $m^3$ per ha per year).

Economic analysis

In 1997/98, the value of vegetables produced on our 0.4 ha was approximately R39,000. The cost of pumping the 400 000 *litre* reservoir full was approximately R215. Total irrigation cost was about R54 per irrigation on 0.4 ha or about R5,000 per year against a gross income of R39,000, or 13 % of gross. Other overheads are wages (R17,000), seed and manure (R2,000), packaging and marketing (R7,000); total overheads R31,000, gross margin R8,000 on the 0.4 ha unit. Figures on the expanded acreage are likely to be at least double this amount.

Without irrigation, the land would produce approximately 5 tonnes of maize grain per ha x 0.4 = 2 t in a good year. This could yield a maximum gross margin of R1,000 at replacement value for own consumption after milling (Auerbach 1993 with updated input and return costs). An important factor, however, is that the water supply is finite, especially with regard to groundwater in our area. In neighbouring Cliffdale, as mentioned earlier, overuse of groundwater for irrigation of vegetables has lowered the water table so that the average depth of new boreholes increased from 40 m in 1990 to nearly 120 m in 1995. Table 5 presents a cost/ benefit analysis.

**Table 5: Cost/ benefit analysis of production with and without the rainwater harvesting system on Bachs Fen (US$ 1.00 = R6.06 on 5th May 1999)**

| | Conventional irrigation (7.5 million *litres*/ha/yr) on 0.4 ha | Irrigation w. swales and mulches (6 million *litres*/ha/yr) on 0.4 ha | Swales, mulches + extra water from rainwater harvesting (6 mill. *litres*/ha/yr) on 0.8 ha |
|---|---|---|---|
| No of 15 mm irrigations per year | 7 | 6 | 6 |
| Total irrigation cost (Cost of filling reservoir: R220 for borehole and R20 for solar pump for each filling) | R 5 800 | R 5 000 | R 4 000 |
| Total projected income | R39 000 | R39 000 | R78 000 |
| Cost excluding irrigation | R27 000 | R27 000 | R54 000 |
| Total costs | R31 800 | R31 000 | R58 000 |
| Gross margin | R 7 200 | R 8 000 | R20 000 |

Although twice as much water is needed for the doubled garden size, the lower cost of pumping means that the total irrigation costs are still lower for the larger garden. The gross margins are based on the historical figures given above, with simple marketing and no premium for the organic produce. Given a better organised marketing strategy (which could go together with the planned increase in dairy production) the economic multiplier effect of the increased irrigation potential should be significant.

Soil fertility and animal health

Soil fertility on Bachs Fen Farm appears to have been maintained on areas which were already fertile, and to have been improved on those areas which were infertile. Organic methods appear to be working well, although potassium nutrition will have to be watched. Animal health and welfare appear to be reasonable, but no alternative for poisonous tick-dips has yet been found. The natural biological control agent in South Africa is the Red Oxpecker, a bird which can eat many times its own weight in ticks daily. Unfortunately, Oxpecker populations have declined dramatically in recent years as a result of the widespread use of dips. It is hoped that the current trend towards pour-on systemic dips will result in increased populations of Oxpeckers, as manufacturers claim that these dips have a smaller impact. Discussions are underway with KwaZulu-Natal Conservation Services officials about a possible project which would construct an Oxpecker aviary, in which cattle would wait before and after milking, and where they could possibly even sleep at night. In this way, Oxpeckers would not be exposed to poisons on other farms, and dipping on Bachs Fen could stop. Proper fencing for improved management of free-range poultry is also planned, but the Angora rabbits wool-production has been discontinued, as it is extremely difficult to find a humane system for housing the rabbits in a socially acceptable way.

Teaching aspects of Bachs Fen

Approximately 120 groups of visitors have come to Bachs Fen Farm to see the farming system over the past five years. Groups range from eight year old schoolchildren, cubs or brownies, to high school students and university students. Third year soil management students from Geography Departments of several universities visit the farm as a regular practical, following a lecture on water management. Many others visit the farm as part of a visit to NCMP. Groups from provincial nature conservation, agriculture and education departments have visited, and many farmers and researchers have also come specifically to look at various aspects of the research underway at Bachs Fen. Bachs Fen was one of the stops for tour groups for the pre-symposium tour of the province organised with the recent International Farming Systems Symposium held in Pretoria. Visitors included scientists from Bangladesh, who found much in common with their problems.

Experience within NCMP with discovery learning suggests that if Bachs Fen is to play a major role in discovery learning, certain basic learning situations need to be provided. Since it is unreasonable to ask people to invest in a private farm for educational purposes, the farm will probably need to be set up as a research and educational trust. Once a suitable legal structure has been developed, a rainfall simulator, a number of soil profiles, demonstrations of mulching, swales and wetland management (together with displays of photographs and data) could be provided. Games such as those developed by Share-net (Taylor, 1997; mainly for children), and the Queensland Department of Primary Production (Hamilton, 1995; mainly for adults) could be acquired. These activities would require a venue, and the old farmhouse could possibly serve this purpose.

As a part of Durban's Western Green Belt Area, Bachs Fen is ideally situated geographically for the establishment of a Research and Training Trust, including demonstrations of rainwater harvesting and reedwork using wetlands, efficient use of water, stormwater management, management of "greywater" (water which has been used domestically and is mildly contaminated with pollutants such as soap). Probably the most effective would be to combine the ecotourism, organic food production and educational aspects of the farm. Discussions have commenced with Durban's Outer West Local Council and lawyers concerning the appropriate physical, legal and town planning structures.

**Plate 11:** **Mr Ngubane shows visitors from EZakhiweni the coffee, interplanted with sweet potatoes; agricultural officer Ndlovu (left) looks on.**

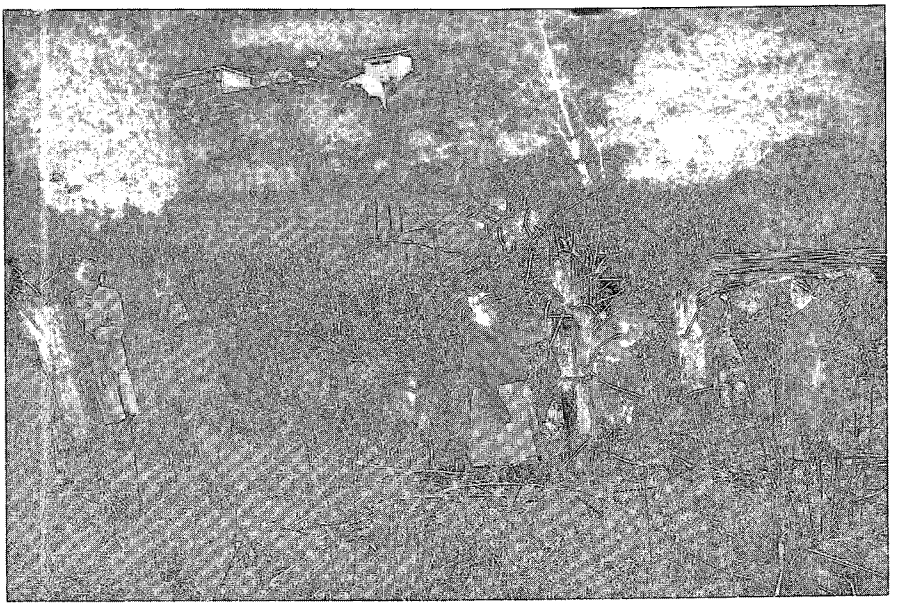


**Plate 12:** **Women from EZakhiweni craftgroup cut *ikhwane* on Bachs Fen wetlands.**

## 5.5 Conclusions and discussion

In terms of design objectives (a) strategies and (b) ecological production systems, we set out to discover the elements of a balanced small farm organism which would be suitable for small scale commercial farmers in the Mlazi River catchment area. The design has not yet reached these objectives from an economic point of view, but the nutrient cycles seem to be working effectively and the performance of the water harvesting and water conservation systems is highly satisfactory. The potential of the water harvesting system to allow the area under irrigation to be doubled means that the farm has the potential to become more profitable (if it is accompanied by improved management and marketing), and improved management of the coffee crop should enable this crop to deliver the yields and the returns originally forecast. The raising of stock numbers for the dairy (possible because of effective pasture and wetland conservation management) should also increase incomes, and overall, improved performance should make the difference between a farm which supports half a farmer, and one which supports two full-time farmers.

In terms of design objective (c), the potential of the farm to become a more effective teaching venue will depend upon an appropriate legal structure being developed, upon a teaching venue being established on the farm, and upon suitable discovery learning activities being set up, and discovery learning being facilitated by an innovative educator. The farm can serve as an example of a small scale ecological farm, and can contribute much to the debate about what such a farm could or should look like.

# Chapter 6: SMALL SCALE AGRICULTURE AND CRAFTWORK

## 6.1 Introduction and analysis of EZakhiweni social, political and farming systems

Poverty is a major constraint to small scale agriculture in South Africa, along with aridity, and poor access to land. Rainfed production is therefore seen as very risky. Rural poverty results in little money being available for inputs, relatively few skilled people (especially with management skills) remaining in rural areas and a profound lack of confidence on the part of many rural women concerning their capacity to change their lives for the better. This in turn results in food insecurity, as reported in Section 4.3, and consequently "food insecurity and drought" is now seen as one of the top priorities for agricultural research (Department of Agriculture, 1998). Few rural families have access to more than one hectare of land, and for this reason, NCMP has concentrated on community vegetable gardens as a strategy for addressing food insecurity, and the development of craftwork groups as a strategy for generating income and learning about collective natural resource management. This chapter describes the work of NCMP and various cooperating groups in establishing eighteen community gardens and three craftgroups. As can be seen in Figure 15, most of the gardens and craftgroups were started in 1998, and this has resulted in considerable work pressure for NCMP staff.

Community gardens and craftgroups are not new approaches in addressing poverty, and the role of leadership becomes particularly apparent in comparing the progress of areas with leaders who are open to participation, both from community members and outside agencies, and those with a more restrictive approach towards exercising power in their areas. Poverty is not only a physical phenomenon, but is also manifested in terms of living in a small world. Unselfish leadership requires self confidence and a devotion to principles greater than one's own physical well-being, or personal power. Helping people in resource poor areas to become more self-confident is a challenge which FSG faces regularly. The process requires a delicate balance between respect for existing local leaders and structures, advocacy in helping marginalised groups (mainly women) to be heard, and a commitment to justice which has to be seen through the way staff themselves behave. Courtesy, accountability, reliability and integrity are qualities which characterise a leader, but above all a leader should be able to develop a worthwhile vision for the future, and involve those who are to share the vision in developing strategies and taking action to realise the vision.

A detailed analysis of social, political and farming systems will show that power relations play a significant role in the Ntshongweni area. This has had a major impact on what was achieved in the area, and on the necessary conditions for community participation in Landcare and integrated catchment management. The gardens which NCMP has helped to develop are mainly (though not exclusively) concentrated in the Ntshongweni-Mpumalanga area, and Table 6 gives an overview of garden distribution. Of the eighteen gardens and five craftgroups which NCMP is involved with, three gardens and one craftgroup (those which have been running the longest) will be discussed in detail in this chapter.

**Table 6: Distribution of NCMP community gardens and craftgroups, 1998**

| Location | Gardens | Members | Total area | Craftgroups | Members |
|---|---|---|---|---|---|
| Ntshongweni | 5 | 112 | ± 6.5 ha | 4 | 52 |
| Mpumalanga | 8 | 120 | ± 6.2 ha | 0 | 0 |
| Salem | 2 | 26 | ± 1.7 ha | 0 | 0 |
| Entembeni | 1 | 15 | ± 1.8 ha | 1 | 16 |
| Willowfountain | 1 | 22 | ± 2.4 ha | 0 | 0 |
| Tafuleni | 1 | 18 | ± 1.8 ha | 0 | 0 |
| **TOTAL** | **18** | **313** | **± 20.4 ha** | **5** | **68** |

The following account draws on a report on a two week stay at EZakhiweni, Ntshongweni, during April 1995 by Kees Wisserhof, Wageningen University MSc student in the Department of Ecological Agriculture. Wisserhof was very well accepted by local people, and stayed for most of the period with Mr R Sibisi, then Chair of the Ntshongweni Development Forum, and a prominent local Inkatha Freedom Party politician. The report was written at the end of 1995, and provides a useful picture of conditions at that time, shortly before the first local government elections of 1996. Technical and cultural details have been added to give more background to the account, but the situation described is generally a picture of the community in 1995.

The people

Seven categories of people were distinguished by Wisserhof: women with urban employment, other women, men with urban employment, jobless men, retired men, schoolgoing children, children who do not attend school. All older people (except for those who are widowed) seem to be in stable relationships, and consider themselves married. Among the women most are not employed in the formal sector, while most of the men are employed. Retired people form a substantial group. Almost all children go to school, for which the parents pay R5 to R15 per year, plus some extras for special activities.

Formally employed women are only in the area at night, on weekends and on holidays. Most of them work as domestic servants, earning R200-R400 per month. They leave Ntshongweni early in the morning and return in the evening to prepare dinner for the household. Over weekends they carry out household tasks, such as washing and cleaning. They also work in the homegarden, where one is present; only one of the employed women (Mrs Sibisi) is a member of the community garden, and she works there with her children over the weekends. Employed women are relatively few in number.

Women without formal employment have more time available. Most have a homegarden, and also a plot in the community garden. They usually work there about three days a week,

generally spending about 6 hours in the garden on those days, usually not during the weekends. Those who do not have a plot in the community garden (usually because they do not like gardening) sometimes help others who have a plot, usually relatives. If the women still have young children being breast-fed, these require much attention. However, from an early age children seem to entertain themselves quite well together. Women prepare meals every day. They sometimes collect firewood, which takes about two hours. This varies with the number of people in the household. Some families have electricity, but only a few of these families use electricity for cooking, as it is expensive. Some women also do not like an electrical heat source for cooking. Apart from cooking, some wood is always needed in the winter for heating. Older women (over 60) receive a government pension of R390 per month. Their activities are similar to those of the unemployed younger women.

Men with urban employment leave Ntshongweni early in the morning (about 5.30 am) by bus to go to work. Most employment is in the nearby Hammarsdale Industrial Area, in Pinetown or in Durban; a few men travel further afield. Work is mainly unskilled work in factories, offices or construction. They earn on average R1200-R1500 per month. They return home at about 7 pm. Some men stay in the city where they are employed, and only come home at weekends and on holidays. Apart from the money that they earn with their work the men do not have a substantial input to the work of the household. If at home, they sit, walk around or sleep. At weekends, they smoke marijuana, drink a lot and often get drunk (especially on Friday afternoons). Wisserhof notes that there are exceptions, and remarks that he did occasionally see men helping their wives in the garden.

Unemployed men spend much time in bed, smoke marijuana, drink a lot and are sometimes drunk for the whole day. They either spend the money that their wives earn or are supported by relatives. They do not help in household activities. Wisserhof concludes that they have an inferiority complex. He notes, however, that there are more exceptions in this group; a fair number of the unemployed men do try actively to find employment, many of them finding short-term employment. Among this group, some are prepared to do gardening or other strenuous work. Some are involved in herding cattle.

The retired men (over 65 years old) obtain a government pension of R390 per month. They collect this pension from the Roman Catholic Church payout point. They do not do much in the household, as this is seen as the woman's role; often there are adult children who help as well. Wisserhof remarks that their life is pretty easy. They spend their time looking after their cattle, if they have any, and hunting with their dogs in the neighbouring bush for buck and rabbits. Weekends are sometimes used to visit children in the neighbourhood. Some spend a great deal of their money drinking.

Children who go to school generally don't need much attention from their parents. In the morning the older girls help in preparing breakfast and at 7.45 am all go to school. In southern and eastern Ntshongweni there are three schools: Lalelani (lower primary), Charles Memorial (higher primary), and Woza Moya High School. The Lalelani and Woza Moya schools are at EZakhiweni, the Charles Memorial school is in the southern part of Ntshongweni. After school, the older girls help to prepare lunch for the family. The children have homework, but Wisserhof did not see anybody working on it in the time he was there. Older boys play soccer in the afternoon; the older girls spend more time on household

activities, such as cleaning and washing. In the evening they also help with supper preparation. Younger children spend most of their time playing all kinds of games with one another, and entertain themselves well. In the evening everyone is at home, except for some older boys who practise a sport such as karate. At weekends and sometimes in the afternoon younger children help their mothers in the community garden or herd cattle. The youth do not like rural life. Most have the ambition to go somewhere else, mainly to a city, to earn more money. Becoming a military policeman is the dream of many boys.

Children who do not go to school are mostly very young. The ones who are still breast-fed spend much time with their mothers, the others entertain themselves. They stay close to their homestead. Sometimes children stay at the home of extended family members, or family friends. Some older children do not go to school, but this is rare. Some of them herd cattle every day.

Eating habits

Breakfast is usually at 7.30 am, lunch at 2.30 pm and dinner at 7.30 pm. Breakfast consists of maize porridge or bread. Lunch and dinner are the major meals, although schoolchildren who study far from home take bread for lunch. Both meals consist of meat (when it is available) and a starch source, normally with vegetables. Meat is mainly beef and chicken, sometimes fish, goat or goose. Many people do not eat pork for religious or cultural reasons. Maize meal is the main starch, although rice is more commonly eaten now, especially in the wealthier households. Dry beans are sometimes mixed in with maize, combining the maize carbohydrate with protein from the bean to make the highly nutritious *isitampa*. Vegetables can be the nutritious wild spinach (*Amaranthus spp*) which grows as a weed, or garden vegetables. Sometimes fruit is eaten for dessert (apples, bananas, grapes, etc.). Coffee (or tea) with milk and sugar is consumed at all meals.

Infrastructure

Transport is a problem in Ntshongweni. Mini-bus taxis and a regular bus service go to nearby Mpumalanga, and very few buses go direct to Pinetown or Durban. This increases the cost of transport, as two journeys (and two queues) are involved. The recent electrification of the area has had some impact; a recent study looked at changes in a deep rural area following electrification, and compared these with changes in peri-urban areas including Ntshongweni (Auerbach, 1998). Impacts of electrification seem to be restricted mostly to the more wealthy sectors of society, even though the settlement at Ntshongweni is dense enough for the cheaper "ready-board" system to have been installed. Here, the cost of installation is minimal, and the house does not have to be electrically wired by a licensed electrician. An electrical board is supplied to which appliances may be connected. In Ntshongweni, as in many other places, electricity is used mainly for low-demand purposes such as lighting, television and sometimes refrigeration. Electrical space and water heating, and cooking, are generally too expensive for resource-poor households and so wood remains the main source of heat energy, supplemented by electricity and paraffin.

At the time Wisserhof stayed in Ntshongweni, water was supplied at communal taps, which are situated within three to eight kilometres of most homes. Since then, water has been reticulated to all households, and those who can afford it have been connected directly. Water was, and often still is, stored in drums or tanks outside the house. Some homesteads

supplement their water supplies with water caught from the roof. The poorer households still obtain water from the communal taps (the charge is R5 per family per month). An important source of income for poorer people has been lost, as they used to be paid for carrying water to the wealthier homes (Auerbach, 1998). There is no sewerage system in the area. Pit-latrines are constructed behind the houses, at the back of the homestead yard. Garbage is dumped in the backyard and burned.

Most food is purchased at the local Qobozela Store. The price of maize meal ranges from R58 (Impala) to R85 (Nyala) for a 50 kg bag (1995 prices). Poorer families buy in smaller quantities, with a price of R2-R4 per kg, depending on quantity and brand. Dry beans cost about R5.60 per kg. The Mayat Store to the Northwest has a larger variety of goods on offer. Altogether there are five stores in the Ntshongweni area. Vegetables are purchased in Mpumalanga, Hammarsdale or Pinetown. There is a strong demand for vegetables, and the possibility of establishing a market has been discussed in some of the planning workshops.

Social relations

People live together as extended families, and most have local relatives. If necessary, the relatives support one another financially. The system is traditionally patriarchal, with the man "in charge" of the household. He takes the main decisions about expenditure, but the women are actively involved, especially where the man is away. Although tribal law puts women on the same level as children, the new constitution guarantees equality before the law. Women are increasingly assertive, and in many cases make major financial decisions, especially about agriculture. Increasingly, Zulu women are reluctant to marry, as many (especially more highly qualified women) see marriage as an arrangement whereby the man is more easily able to exploit the woman. Many women see few advantages in marriage, but on the whole in EZakhiweni the situation is more traditional.

Within EZakhiweni and even the broader Ntshongweni area, most people know one another. People share their lives to a great extent, more so because much of life is lived out of doors. Men meet one another when going to work, and sometimes visit in the evenings or at weekends. Women meet during the day when working in the garden, fetching water or firewood (less so now), or during visits. Children play together. Older boys and girls should not be seen together regularly. Having an affair has to be secret, otherwise the boy has to pay a fine to the girl's family. In some families the practice of examining girls to ensure that they are virgins has been revived. When two persons wish to marry, many exchanges between the two families take place. Formerly, these involved the boy's family giving goats and cattle, but now this is often converted to money (at lower values than the current value of goats and cattle). The family of the girl provides everything for the wedding ceremony, and the basic assets for the new household. In many cases, if the girl is still a virgin when marrying, the boy's family has to pay a real cow to the mother of the girl.

Politics

Politics in KwaZulu-Natal over the past twenty years has seen on-going and increasingly bitter rivalry between the African National Congress (ANC) and the Inkatha Freedom Party (IFP). While the ANC was banned, several groups, notably the United Democratic Front, arose and were, in their turn, banned by the *Apartheid* authorities. The Inkatha movement started as a Zulu cultural movement. As the Inkatha Freedom Party, it became a national political party some years ago, but most of its support still comes from those who consider themselves Zulu first. The ANC tends to have a broader solidarity between black South Africans as its base. Both parties are officially open to all, and do in fact have members of all races in their organisations.

Within EZakhiweni, most people support the IFP, while in most other parts of Ntshongweni, most people support the ANC. This formed the basis of much of the conflict over the past two decades. After the Ntshongweni Peace Accord of 1989, the violence abated, but there are still major tensions in the area. Mr Sibisi was the local IFP candidate during the Local Government elections of 1996, but the ANC candidate, Mr Fanie Moya, was elected. This result was repeated in many peri-urban areas, where the ANC made significant inroads into IFP majorities. This can be seen as part of the urbanisation process, which sees many people identifying more with national political and economic issues, rather than the more provincial traditional Zulu perspective. However, many of those involved in agriculture in the province are by their very nature, more traditional in their approach, and the FSG has a policy of strict neutrality politically. However, our Mission states that we work with and for resource poor farmers, especially women, and our democratic approach is not always appreciated by the more traditional patriarchs in some areas.

Wisserhof reports that most people are not very interested in politics; they see politicians as generally corrupt and self-serving, and politics as a relatively non-productive process at best, or as the vehicle of violence at worst. Nevertheless, in 1995 Wisserhof reported that all the people he had spoken to had registered for the local elections. Wisserhof remarks, "The only local person at EZakhiweni who is involved in politics is Mr Sibisi. He has been elected by the people as their representative in the democratically chosen Development Committee, giving him credit for the coming of electricity and water. Quite a number of people do not like him, however, regarding him as a power hungry person. ..... Some see him as capable of throwing people off their land and therefore as a factor of instability in their life. Ntshongweni is planned to be part of the Durban Metropolitan Area". In fact, other people are involved in politics in the area, as will become apparent.

Agriculture

Agriculture is practised by women. There seems to be a cultural bias against agriculture from the men. They believe that there is no money in agriculture, and that the work is too strenuous. Some fields have anti-erosion contour banks. In all agriculture, fencing is a primary necessity, as cows and goats walk around freely, and can thus destroy crops. Cattle owners do not take responsibility for their cattle and the children who herd the cattle do not effectively keep them out of the gardens. Lack of water is considered by everyone as the main constraint to agriculture in the area.

The community garden

A group of 18 women from EZakhiweni used the community garden during 1995. That year, some women from other parts of Ntshongweni applied for plots. The women elected a committee for the garden, which was then called Hlanganani Garden. The Chairlady was Mrs Ndimande, the Vice-Chair was Mrs Gumede, and Mrs Mgwabe was the Secretary. Due to the violence in the 1980's, the garden had not been managed well, and in the early 1990's the violence was followed by drought. In 1986, the agricultural officer (at that time Mr Nkabinde) left the place because of the violence. He used to give valuable advice on which varieties to use, when to plant, etc. It is only with the late autumn rains of 1995 that the women have started to cultivate their plots intensively. This is partly because of good autumn rains, but is also only possible because the garden has been refenced, with material from the Department of Agriculture and assistance from NCMP.

Most of the women are very eager to increase production from the garden, and are trying to find ways to do this, such as composting removed weeds, and asking for specific information from NCMP staff. Their influence on the Department of Agriculture is limited, and they do not have much confidence in the service provided. The garden is divided into plots; each women has about 600 $m^2$ made up of ten subplots of about 17 m x 4 m. In the lowest part of the garden, two small dams have been made to use as a water source, but these dry out in winter. (These dams were enlarged during 1996 by gardeners, supported by a Department of Agriculture drought-relief grant, requested by Thami Mthembu. The dams were also connected by a furrow to the nearby road, so that water could be harvested from the road). Agricultural practices include cutting long weeds with a bushknife, cultivating the soil with a hand hoe (sometimes, if weeds are short, it is not necessary to cut the weeds first). Land preparation takes one to two days per subplot, depending on the amount of weeds and the skill and strength of the woman. Sometimes children (not one's own) are hired for this job, and paid R6 per subplot. Primary cultivation is followed by seedbed preparation (also with a hand hoe, about 2 woman hours per subplot), usually accompanied by incorporation of well-rotted cow manure from the cattle pens where the cattle sleep at night. Those who do not have cattle often use manure from families who have cattle - there does not seem to be a shortage of manure, although the quantities used are not very high (equivalent to about 1 - 2 t/ha). Seedbed preparation is often done using small ridges to improve water supply to the plant and to protect them from wind.

Weeding is also by hand hoe, usually twice for each crop, about three and six weeks after planting, and usually takes about 1.5 - 2 woman hours per subplot. The women know that seed-bearing weeds give problems later, and encourage one another to remove them from their fields. Harvesting takes relatively little time (0.5 - 1 hour per subplot, depending on crop). Crops grown include onions, tomatoes, green beans, dry beans, pumpkins and peas. Insect pests and diseases do occur in the garden, and include stalkborer (*Busseola fusca*), topgrub (*Heliothis spp*) and cutworm (*Agrotis spp*), and a range of rusts, blights and mildews, with *Diplodia* rots as one of the dominant disease problems.

Most homesteads have a homegarden, ranging in size from 30 - 300 $m^2$ where sweetcorn, sweet potatoes, chilies, beans, and some other vegetables may be grown. Some gardens have fruit trees (peach, pawpaw, mango and citrus) and a few have ornamental flowers or shrubs. Many home gardens are fenced with a hedge of Lantana (*Lantana camarensis*), a thorny plant

which effectively keeps out goats, but which is also a declared noxious weed, which conservationists are trying to eradicate. In some parts of Ntshongweni, especially those areas which were abandoned during the violence, dense stands of Lantana make the area almost impenetrable. Some homesteads are now fenced with a range of conventional and unconventional fencing materials.

Livestock

Cattle are seen as a form of savings; they make up a "hedge against inflation", fulfill a range of social functions and are an indicator of personal wealth. There is little commercial trade in cattle and goats, although they are often the subject of complex inter- and intra-family exchanges, often related to marriage through *Lobola* (the bridal dowry). A full-grown cow usually costs about R2500. In the whole of Ntshongweni, there are about 1200 cattle, according to Mr Mthethwa, the dip-tank assistant. The EZakhiweni area is a relatively newly settled area with only about 90 cattle altogether. Cattle graze in the daytime on the commons, which are largely *Eragrostis and Aristida*- dominated natural grasslands. Most households also have some goats, some have geese, and almost all have some chickens. Cattle drink in the Mlazi River or at a small dam near the gardens which was dug for the purpose, and also supplies water to the cattle dip nearby. At night cattle stay in the *isibaya* (cattle pen) in the homesteads. Traditionally, these have a spiritual significance: one goes to there *(esibayeni)* to speak to the spirits of one's ancestors. If the family moves, elaborate rituals are required to ensure that the spirits of the ancestors accompany the family.

Cows are not usually milked now, although traditionally they were milked once a day, at midday. Cattle do not receive supplementary feed in winter, and often lose condition. In dry winters, or during and after poor seasons, many cattle die of starvation or diseases, mainly *Babesiosis bigemina* and *Anaplasmosis*, both protozoal diseases carried by ticks. Cattle are dipped every Friday at Ntshongweni. Although it is compulsory to dip cattle (a service which has been free for black farmers, but for which they will have to pay in the near future), some cattle are not dipped. This seems to be related to earlier stock reduction schemes, which were administered by dip-tank assistants and stock inspectors. These schemes tried to reduce the impact of livestock on soil degradation, but were highly unpopular, as they were implemented together with *Apartheid* legislation such as the Consolidation of Land Act, and the Group Areas Act, which deprived black people of their land, or shifted them out of so-called "black spots". Many subsequent efforts to improve livestock management have suffered through being identified with these earlier heavy-handed approaches. In order to work towards a new cooperative approach, animal extension officers are now called "animal health officers" rather than stock inspectors.

Part of the area is owned by the state (just before the 1994 elections the KwaZulu Government transferred much tribal and trust land to the *Ngonyama Trust*, nominally controlled by the Zulu King on behalf of the people). Most of EZakhiweni falls under the Trust, except for an area towards the east owned privately by Mr Ngcobo. Further to the east and north, in the other parts of Ntshongweni, most of the land is privately owned. The EZakhiweni area is more rural than much of the surrounding area, and partly for this reason is more traditional than the rest of Ntshongweni.

EZakhiweni, Magaba and Zimeleni gardens

Of the three gardens described in detail in this chapter, EZakhiweni is an old garden, but it was expanded and refenced in 1995; Magaba Garden was started in 1995, although it moved to a larger site at the end of 1998; planning for Zimeleni Garden started in 1996, but the garden was officially opened early in 1997, and many of the lessons learned from the other two gardens and at Bachs Fen were applied in the way it was designed with participants, and in its actual development. This has been the pattern for the other new gardens. All of the new gardens have developed (or are developing) rainwater harvesting designs. A theoretical prototype for community gardens has been developed out of this experience, and is presented in Section 6.5, as it will be used to contribute towards a framework for community participation in South Africa. The development of the EZakhiweni Craftwork Group is also described together with the EZakhiweni garden, as the two are closely linked, and involve many of the same people.

The research question identified in Chapter One arose out of the participatory design process described in this chapter, in particular with the EZakhiweni community at Ntshongweni, over five years of working with a range of interest groups on subjects as diverse as water supply, integrated development planning, housing, conservation, the role of the church and the ethics of rural development. Technical questions addressed in Chapter Five give some technical answers to the question, but this chapter focuses on social processes, on social learning, on working with communities, and the successes and failures experienced. There is at least as much to learn from the failures and difficulties as from the successes. One of the lessons is that "community participation" does not always mean agreeing with the researcher!

## 6.2 Design objectives

The general research question formulated in Chapter One was: "How can diverse communities often characterised by conflict, be helped to come together to learn about natural resources and systems, and to manage them collectively in a way which is productive and responsible?" Two design questions arose in Chapter Three. These were:

a What strategies are available to help improve food security in a way which addresses aridity, poverty and restricted availability of land?

b Are there effective methods of producing good yields of crops without resorting to the levels of fertilisers, poisons and other technologies which have produced the environmental problems currently being experienced in Europe?

These questions form the design objectives for this chapter. The conclusions from Chapter 5 indicate that rainwater harvesting, water conservation and nutrient cycling are effective, low external input methods of producing good yields of crops in an ecologically sound way. However, Chapter 5 also illustrates that this requires fairly high levels of understanding of the ecosystem and also good management. Sections 3.5 and 3.6 reported on processes of social learning and discovery learning as important precursors of collective action, or sometimes in fact being the result of these processes.

In trying to apply the technical lessons from Bachs Fen to small scale farming and food gardening in the Ntshongweni area, these aspects are important to understanding how community gardens can contribute to food security. The outline of the social and political system given in Section 6.1 shows how poverty and local power relations have shaped society at Ntshongweni, and in particular in the EZakhiweni area. Addressing food security is a first step towards small scale agricultural production which can be made by those women who are prepared to work together in the context of a community garden.

Landcare

Moving from short term food security strategies to longer term sustainable small scale farming systems is a step which requires that resource poor farmers invest some of their scarce resources in providing for the future. While this is difficult, it is a key strategic consideration, and some assistance from government is appropriate here. It is, however, a step which is already being made by many emerging small scale black farmers, with the support of the national and provincial Departments of Agriculture (Department of Agriculture, 1998). The success of the Department's Landcare programme will be determined largely by whether the programme is able to support farmers (large or small scale) in investing in strategies which enhance the long term sustainability of their farms.

Reporting on the Australian Landcare movement, Campbell (1994), Australia's first National Landcare Facilitator, emphasises that high profile commitment of political leaders and availability of resources ("top-down" initiatives) must go together with grass roots activism ("bottom-up" community driven processes). In his contribution to the book "Facilitating Sustainable Agriculture" (Röling & Wagemakers, 1998), he agrees with Röling & Jiggins (1998) that the key to Landcare is "to develop processes for establishing agency at levels of social aggregation appropriate to each environmental issue", and that "this involves creating shared perceptions of reality, highlighting inter-dependence among participating actors, developing processes for collective decision-making and conflict resolution, and integrating structures for rationalizing access to resources". He also states that effective facilitation is a critical process in establishing and sustaining platforms for resource use negotiation.

The decision within NCMP was to work with resource poor women in Ntshongweni, in spite of the difficulties and limitations this involved, as part of our attempt to "establish agency" at this highly appropriate level of social aggregation, to help rural women at grass roots level to develop an understanding of their ecosystems, so that they can use them productively and sustainably. Having made this decision, work with community gardens and craftgroups was the appropriate, indeed, probably the only, available avenue for helping local people to "learn about natural resources and systems and their collective management" (see Figure 3). Subsequently, eighteen community gardens and five craftwork groups have been started, and most of these have resulted in relatively rich and positive learning experiences.

The gardens and craftgroups aim to help communities move towards a sustainable future. To do this, a balance between production, food security and conservation of natural resources is required (see Figure 2). Conway's trade-offs between productivity, equity, stability and sustainability discussed in Chapter One were a major design consideration. Short term solutions based on introduction of technology can create dependency, and require finance, management and adequate water to reduce the risk of crop failure. Ecological agriculture also

requires development of management skills, but water harvesting, water conservation and nutrient cycling can reduce the risks associated with erratic rainfall and expensive production inputs. Thus, our design objectives aimed to optimise production, equity, conservation and sustainability in a balanced way. Some visitors have commented that we could have produced more with more fertilisers or chemicals; others have pointed to the unproductive garden plots and complained about inefficient land use; yet others feel their should be more indigenous plants, and that mulching and composting should be enforced.

Prescribing to Ntshongweni community gardeners how they should produce would presume that there are experts who have all the answers. As has become clear from the changes in approach to agriculture in Europe, experts have a way of changing their opinions over time. If farmers engage in discovery learning, they become experts on their local system, and are able to adapt to market and policy demands. Our challenge is to facilitate this process of discovery learning, and in doing this to help local leaders to develop a long-term vision for local development, and to motivate local people to work towards realising the vision.

## 6.3 Design methods

Technical aspects of designing ecological production systems have been described in the previous chapter. Social processes were discussed in Chapter 3, in the first section and the last four sections. In working with the formation of community gardens, we responded to needs expressed. We also used participatory rural appraisals, vision building exercises and a participatory landuse planning approach in order to help local people to analyse their situation, and decide on their own development objectives, as mentioned in Section 2.3.

In terms of designing community vegetable gardens, a theoretical prototype garden was developed during 1998, based on our experience with EZakhiweni, Magaba and Zimeleni gardens, and our needs analysis carried out in October 1997 (Mthembu and Auerbach, 1997). The prototype draws on the prototyping approach of Goewie, Oomen, Vereijken and their associates, as described in Section 3.4, ecological farm design principles of Mollison (Section 3.2), and rainwater harvesting and water conservation approaches described in Section 3.3.

The craftgroups started with the existing skills of the local women, and then exposed them to other production techniques, to markets and marketing requirements, and thus towards an appreciation of what products, techniques, designs, and quality levels could successfully generate income for the women. The emphasis has been on crafts which use wetland reeds, and through learning about the reeds and their wetland habitat, their have been many opportunities for learning about wetland management. All of these methods emphasised discovery learning about agriculture, craftwork, personal development and economics.

## 6.4 Designing community vegetable gardens and craftgroups

Given the background of poverty, and the recent history of violence described in Sections 4.5.2 and 6.1, it was clearly important to take great care to involve local leaders, while trying to develop a more accountable approach to development and resource management. Difficulties and tensions were compounded by the Local Government Elections, which took place in KwaZulu-Natal in 1996 (local government elections in the rest of the country were earlier, but chaotic logistics, inaccessibility of some areas, and hostility from some of the more conservative areas necessitated the postponement of the elections in this province). Both Mr Sibisi and Mr Zwane intended to stand for the elections, but Mr Zwane did not secure the ANC nomination for Ntshongweni, as he no longer lived in the area. Mr Fanie Moya, a young student of the University of Natal's School for Rural Community Development, secured the nomination. He stood against Mr Sibisi, the IFP candidate, and won the election. He has been very supportive of agricultural development in the area, and through him FSG has been asked to help communities spend funding allocated by the Durban Outer West Local Council (on which he now serves) on garden development.

The IFP lost ground dramatically in urban and peri-urban areas in the Local Government elections, and this gave rise to rising intolerance of outsiders in areas where they had retained control. EZakhiweni, being a small area of predominantly IFP supporters, remained under the influence of Mr Sibisi. This context changed the initial positive development of EZakhiweni gardens to a more problematic situation, and also affected the craftgroup development negatively, while it allowed Magaba and Zimeleni Gardens to develop under relatively untroubled circumstances.

### 6.4.1 Agricultural and craftgroup development at EZakhiweni

As mentioned in Section 2.2, the initial request from Mrs Ndimande was for help in fencing the gardens. Thereafter, farming systems were analysed during the PRA, and compared with the systems at Bachs Fen and at the commercial market garden of the Sookoo family in Cliffdale (Auerbach, 1998). At the end of 1994, a workshop was held in order to gather together what was known from various disciplines concerning the Ntshongweni area. After this, we started working with the gardeners at EZakhiweni, and analysing their farming systems with them, eventually planning how they would proceed with implementing the vision which they had developed. The process is described in Appendix 4 (extracts from Auerbach 1996) and is summarised in Figure 21 below.

Initially, I visited EZakhiweni Gardens every week, to learn about the garden, and to help where I could (see Box 6). Later, I was joined by Thami Mthembu (NCMP Agricultural Facilitator), Sifiso Ntinga (NCMP Development Facilitator) and Barry Patrick (NCMP Ecologist). As the NCMP activities expanded, work pressure increased. There were many requests for help with new projects, yet those which had already been started still asked for our support.

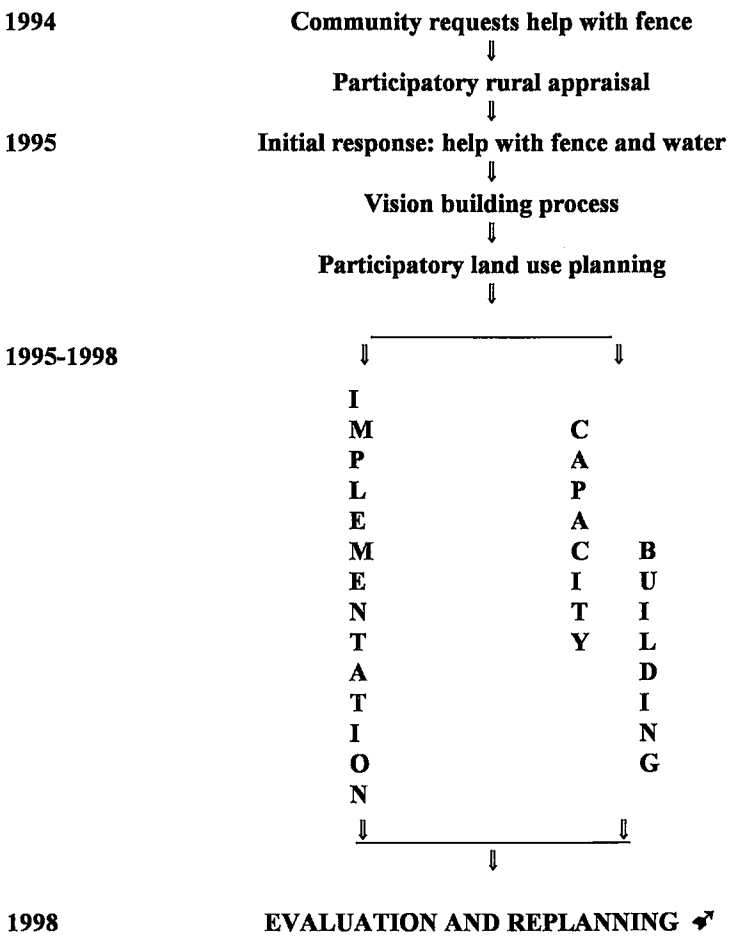



**Figure 21: Planning process at Ntshongweni (EZakhiweni Garden)**

Thami in particular, was put under considerable strain during 1997/98, as he was starting many new gardens in the Mpumalanga area, and therefore had little time available to spend with Ntshongweni gardeners; Sakhile, who had helped with Zimeleni garden development as an NCMP intern, had by this time been appointed as Agricultural Facilitator for the upper catchment, and was working with the Entembeni and Tafuleni communities. These problems are reflected in the evaluations, which were carried out in October 1998 (Appendix 5), and they raise the questions: "How much help should be given in this process? Where does facilitation end, and spoonfeeding begin? Which interventions encourage sustainable development, and which encourage dependency?".

**Box 6 Extracts from early Field Reports of visits to EZakhiweni Gardens**

FIELD VISIT AFTER MIDNET MEETING, Friday 20th May 1994
Discussed with gardeners what they want with the land and what help they need. They said that fencing is the great need. They have asked KwaZulu Department of Agriculture (KDA) many times for help, but have had none. They rarely see KDA at the gardens. They agreed to participate in the PRA exercise tomorrow.

21st May 1994 HISTORY
The old garden is called Hlanganani Garden; the proposed new enlarged garden will be EZakhiweni. This is the local name for this part of Ntshongweni. It means "At the place which has been built" and indicates that the area was recently settled (hence relatively new "building"). Previously there was an agricultural officer resident at the gardens (Nkabinde from 1982 to 1987, Mpisane before that). They organised transport of seeds and fertilizer and helped the committee to decide what should be planted. Many people saved their own seeds and used manure to fertilize their plots. Where fertilizer was used it was usually 2.3.2 (22) and LAN. Maize was planted in September/October in the fields and there was always a problem in getting the government tractor to plough in time. Weeding was generally carried out at the two leaf stage only. Oxen were often used to plough as were mules, especially in the garden.

Once the tribal authority has instructed the tribal police to inform livestock owners that cattle must be removed from the fields the cattle are kept out of the fields. However, there is still a problem with damage from goats which are not always properly supervised, and fields do need to be net fenced. The parasitic plant *isona* is found on the poorer fields. *Ibhece* melons are commonly planted. The dung beetle (*ithukhu*) is active in the fields. Gardeners acknowledge that trees are useful, especially to provide shade for young children. They mentioned the *umgano* tree as a good shade provider. The local name for red-soil is *isibomvu* and sandy grey-soil is called *inhlabathi*. Mrs Mbehle used to grow seedlings for the gardeners. The main problems identified were water and fencing.

!4th January, 1995.
After visiting Mrs Gumede (and her donkey-ploughing team) with Prof Röling, Raymond took him to see MaShelembe at the garden. A useful discussion recapped some of the problems in the gardens. Raymond agreed to set up a meeting with the KDA staff from Inchanga (Ms Khumalo, Mr Ndlovu, Mr Gumede; meeting subsequently arranged for Wednesday 8th February at 9 am). MaShelembe made it very clear that gardeners were fed up with a string of broken promises, which were all that they had had from KDA for the last 8 years (since Mr Nkabinde left).

Mr Sibisi lives at EZakhiweni, and at the time chaired the Ntshongweni Development Forum. He attended many of the planning meetings at EZakhiweni, as can be seen from extracts from my early Field Reports in Box 7 Many of the difficulties encountered, especially at the EZakhiweni garden were related to polarisation, and to the increasingly marginal position of the IFP in peri-urban areas of KwaZulu-Natal. Although he participated in the planning processes described in Figure 21, he became increasingly negative towards the programme thereafter. A further complicating factor was the request of the Durban Outer West Local Council for NCMP to assist three councillors in spending R67 000 in each of their wards. Because of the way the money was offered and delays in actually paying it out, there was much dissatisfaction among community members. Some of this anger was turned onto Thami, who found himself in a very difficult situation for several months.

The difficulties associated with EZakhiweni gardens should not be over-emphasised, as the other seventeen gardens which NCMP has been working with have been far more positive in terms of progress and acceptance of ecologically sound approaches. Most of the difficulties associated with EZakhiweni can be ascribed to the special circumstances of the area, including political sensitivities, power relations and poverty, but these conditions are prevalent in many parts of South Africa.

Boxes 6 and 7 trace the early history of NCMP involvement with EZakhiweni Garden. MaShelembe Ndimande comes through as a strong leader of an impoverished community. The frustration of the community with the poor level of services provided by the (then) KwaZulu Department of Agriculture (KDA) is clear from both Mrs Ndimande (Box 6) and Mr Sibisi (Box 7). Having NCMP as an outside influence to hold the KDA accountable seems to have been an important factor in securing fencing materials, assistance with fencing and ploughing the garden, and in the replacement of Mrs Mlaba, an Agricultural Assistant who had done nothing for the community for six years (but was still paid throughout this time) with Mr Biyela, who was at least there, even though he did not come from the area, and had no agricultural training or skills. The influence of NCMP was not, however, great enough to get Mrs Ndimande appointed as Agricultural Assistant. In spite of our pointing out on several occasions that she was a natural local leader with considerable gardening experience, KDA responded that policy forbade the appointment of new Agricultural Assistants at that time, and staff from other areas who were not being fully made use of should be transferred instead.

**Box 7: Power relations at EZakhiweni Garden**

8th February 1995 (meeting with KwaZulu Department of Agriulture staff)
10.40 am. At this point Mr Sibisi from the Ntshongweni Development Committee arrived with Delia, a social worker from the Christelike Maatskapelike Raad, and two other social workers, who are working with local sewing groups. They were introduced and gardeners were invited to become involved with sewing. Mrs Khumalo and Mr Ndlovu from KwaZulu Department of Agriculture (KDA) arrived at 11.05 am and Mr Sibisi proceeded to upbraid them for their lack of involvement over the past eight years. Mr Ndlovu pointed out that violence had affected the local community until 1990, but agreed that there was a need to increase KDA involvement. He explained that all funds used by KDA had to be requested two years in advance because of government budgeting procedures, but undertook to investigate whether fencing material for the new garden could be made available. Raymond asked if the KDA house and office could be used for the project. Mr. Ndlovu suggested an official request should be made, which he believed would be looked upon favourably but commented that the house and office had been vandalised and that it was likely to take a long time for Kwa-Zulu Department of Works to repair this damage.

Raymond asked whether there was a local agricultural assistant and was informed that a Mrs Mlaba had been appointed some years before and was still officially employed. Discussion revealed that she had not been active and had been seeking a transfer to Mahlabatini where she had built a house after the start of the violence. Mrs Khumalo undertook to ensure that Mrs Mlaba is at the next meeting. (Raymond and KDA staff visited her after the meeting and discovered that she had blood pressure problems. She claimed to be actively assisting the gardeners from time to time.)

8th March 1995
Raymond asked whether there any problems with the Development Committee as Mr Sibisi had seemed to be fairly hostile at the previous meeting. The gardeners assured him that there were no problems and Raymond asked them to ensure that there was good communication between the Garden Committee and the Development Committee. Raymond is happy to attend a Development Committee meeting if invited to do so. However at present he is involved because he has been invited by the Garden Committee to assist with garden development. The gardeners agreed to clarify the situation.

29th March 1995
Mr Sibisi from the Ntshongweni Development Committee was at Lalelani school when Raymond arrived and they discussed Raymond's work at Ntshongweni. Raymond asked to be invited to a Development Committee meeting so he could report on the work at the community gardens. Raymond asked Mr Sibisi why the Development Liaison Forum had not met for two months and Mr Sibisi expressed his dissatisfaction with the Forum. Raymond asked whether he could attend a Development Committee meeting, and Mr Sibisi said he would discuss this with the committee. He asked Raymond to drop off regular reports about his work at his house if he could not speak to him personally, told him that he was standing for local government as IFP candidate and expects to be elected.

Mr Sibisi's belligerent approach was already clear early in 1995 (see Box 7). Initially, his anger was directed at KDA, and was fairly understandable, if not very constructive. His opinion and his approach were similar to Mrs Ndimande's in this matter. Their strong objections had the positive effect of calling KDA to account for lack of effective assistance in the area. Mr Sibisi, Mrs Ndimande and I worked well as a team at first. The participatory rural appraisal and participatory land use planning exercises were well attended, and there was good communication between us. Mr Sibisi even agreed to host visiting Dutch student Kees Wisserhof at his home, to help him analyse Ntshongweni Farming Systems. However, once the process of constitution development started, it became increasingly clear that the gardeners did not want him to interfere in the garden development. They selected Thami Mthembu as their candidate for the NCMP position of Agricultural Facilitator, and he was subsequently appointed. As a member of the local community, he knew Mr Sibisi well.

Thami subsequently had a very difficult time trying to maintain impartiality, with ANC supporters initially complaining that he was only helping EZakhiweni, which is an IFP area. Once other gardens had been started, Mr Sibisi complained that Thami was bringing ANC influences into the area. Thami himself had previously been a member of the IFP as a youngster, but had resigned some years earlier. He had subsequently been physically assaulted by members of the IFP. The ANC had then invited him to join, but he had refused, saying that he had no interest in politics. His frustration with the way politics is dragged into everything which happens at Ntshongweni was shared by the gardeners.

During April, it was agreed that a Community Planning meeting was needed (the participatory land use planning process, see Figure 21) and Mr Sibisi, Chairman of the Development Committee, agreed with the Garden Committee that Sunday 14th May would be an appropriate date for this. However, on the scheduled date, the *Amazulu* group (IFP supporters) had disrupted the meeting and made it impossible to continue the planning process. Although Mr Sibisi had attended the meeting when it was eventually held in the following month, and had been positive about most of the ideas expressed, he was against tree planting, and was deeply suspicious of the process to develop a constitution for an enlarged EZakhiweni Farmers Association. He still agreed that the Participatory Landuse Planning process should go ahead.

The women were unanimous at that stage in wanting to keep Mr Sibisi out of the Farmers Association. At the end of the meeting reviewing the disruption of the planning meeting (26th July, 1995), it was evident that the strain was beginning to tell on Mrs Ndimande, and she threatened to resign, as she felt that people were not serious enough about working together constructively. She pointed to poor participation in activities, and the low level of payment of subscriptions. Subsequently, after the constitution had been developed and adopted by the members of the new EZakhiweni Farmers Association, the committee was elected. Two men (Mr Gasa and Mr Mthethwa, both livestock owners) felt that while it was acceptable for a woman to chair a garden committee, it was inappropriate for a woman to lead a farmers association. One of them offered himself as a candidate. I was not present at that meeting, feeling that there should be no external pressure concerning elections. However, Thami simply asked the meeting whether this was so. In so doing, he gave the women space to respond, and they were overwhelmingly of the opinion that Mrs Ndimande was the one who had done most of the work to get the garden and the fields fenced and productive, and that she

should chair the association. However, rather diplomatically, they co-opted the two men onto the committee, assuring them that they agreed that liaison with livestock owners was very important.

After this point, the garden developed well over the next two years, with good development of the demonstration area, and a lot of participation in garden development. Towards the end of 1997, however, activities declined. This was partly due to the women being busy with fieldcrops, partly that some were involved in craftwork, but also, apparently, because Mr Sibisi and Mr Mthethwa were not happy with the way the garden and Farmers Association were developing. Events surrounding the craftwork exhibition in October 1997 will be described after a summary of the garden's achievements.

What was achieved technically?

When I first visited the garden in March 1994, it was completely derelict, fences were broken and only a very small area had been planted. All the crops on this area had been destroyed by goats. The two small dams were empty and there was no agricultural officer.

By October 1996, the garden had been doubled in size to three hectares, and had a membership of 30. It was securely fenced, crops were planted on most of the enclosed area, the new area was protected from erosion with two swales and no livestock damage was evident. The two dams had each been enlarged to three times their previous capacity and a water main had been laid to the garden. One tap was later installed for the use of gardeners. A demonstration fruit tree garden had been planted with deciduous fruit trees, tissue-cultured coffee (*Coffea robusta*), and a range of live-hedge plants and soil-improving legumes. The 15 ha field above the community garden and demonstration area had been fenced by the members of the newly formed EZakhiweni Farmers Association, and beans, maize, sweet potatoes and cabbages had been planted. Plans were in place for the planting of live hedges around the perimeter fence, and swales were to be constructed below each fieldplot, with fruit trees planted above the swale.

By October 1998, much of this progress had disappeared. Although about 50 % of the garden was planted to vegetable crops, no water conservation measures were being used. The dams were empty, the crops were being scorched by the sun. No mulch or other water conservation strategies were being used. The fields had not been ploughed for summer crops, and cattle were roaming freely. The fences in the demonstration area were broken down, and fruit trees had been damaged by cattle. There was still some on-going contribution to food security at a household level.

What was achieved socially?

According to the evaluation held on 5th October (see Appendix 5), the FSG contribution was not much use at all. Very little was given to the community by FSG. The achievements made in the first three years were totally discounted by Mr Sibisi and two of the women present. Even in the group work the women had many complaints, although some positive remarks were also made. Mr Mthethwa, the new EZakhiweni Farmers Association chairperson, and Mr Sibisi were very hostile. Mrs Ndimande was very subdued.

There had been two Agricultural Shows, one of which had been held at EZakhiweni (at Lalelani School in 1996), the other in Mpumalanga in 1998. These had attracted a lot of

interest. There had also been experience of PRA processes, visits to several farms and projects and many farmers were members of the new KwaZulu-Natal Agricultural Union. The process of drafting the constitution did help local people to understand how organisations and committees function.

The community had experienced that it is possible to work together collectively for commonly agreed goals (the first swales, initial mulching, the two dams and the fencing of the fields, Plates 13-21). For a while, they had maintained the demonstration garden and planted two potato crops collectively to boost the community garden general funds. Initially, the women had been able to resist political interference, and to concentrate on working together as farmers. The community had been able to state clearly that they refused to be dictated to by outside organisations, whether non-government (such as FSG) or government (such as the Department of Agriculture).

On the negative side, the attempt of Mrs Ndimande to encourage people to develop the gardens had not produced a sustainable, ecologically sound production system, as at Zimeleni (Plate 22). The position of local women had been undermined by her removal from office. The denial of the positive aspects of the earlier community efforts was not contradicted by any of the women, and their tacit agreement with the opinions of the woman and two men who dominated the evaluation process means that they agreed with what was said, or were not prepared to be seen to disagree publicly. It seems likely that people did not feel free to disagree. Society was less democratic and open than it had been during 1996 and 1997.

The platform which had been created did still function, in that the farmers did meet with other farmers in the new Ntshongweni Farmers Association (formed in 1998 as a joint NCMP/ Department of Agriculture initiative), and some degree of access to resources had been achieved in that money from the Outer West Local Council had brought benefits to the farmers (in the form of irrigation pipes, watering cans and garden tools).

What was achieved in terms of local leadership?

The leadership positions of Mr Sibisi and Mr Mthethwa had been strengthened, but anyone with an independent viewpoint would have understood the coercive basis of Mr Sibisi's leadership. The possibility of leading the community into a wider world through a process of developing towards a selfless leadership based upon serving the needs of local people has not been realised. Local leaders stated that they did not accept President Mandela as the President of Ntshongweni (Mr Sibisi, during a 1996 planning session), that they did not accept the Mayor of Durban's Outer West as the Mayor of Ntshongweni (Mr Ndimande, during the 1997 craft exhibition) and that anyone with ANC affiliations was not welcome in the area (Mr Sibisi during the 1998 evaluation).

Thus the community is likely to continue in much the same way as Wisserhof described in terms of a social system which is characterised by poverty and a fatalistic acceptance that not much will change. As Mr Sibisi did not win a place in the local government elections of 1996, the position of the area seems to be more marginal, as IFP resources are dwindling and local leadership spurns any resources originating from the ANC.

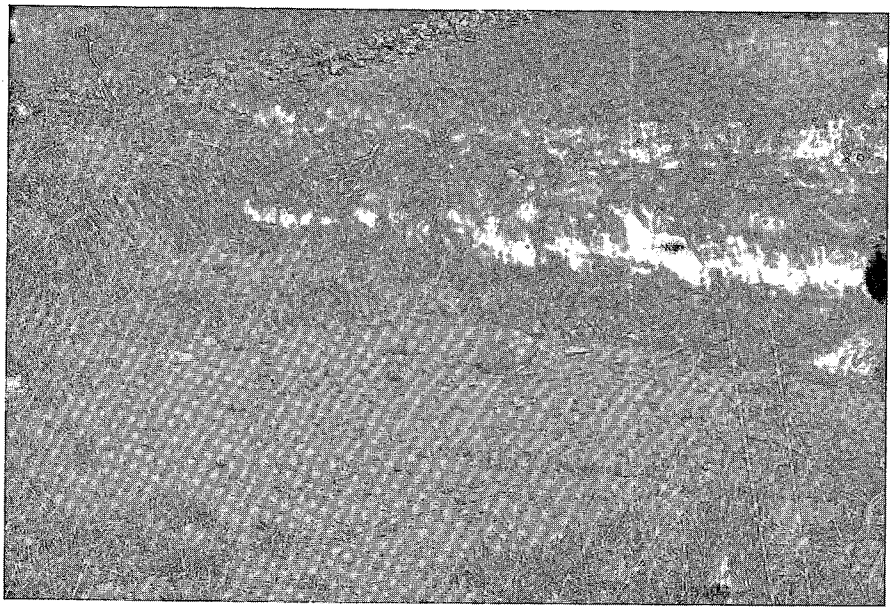


**Plate 13:** **A view of the empty dam and damaged crops at EZakhiweni gardens in September 1995**

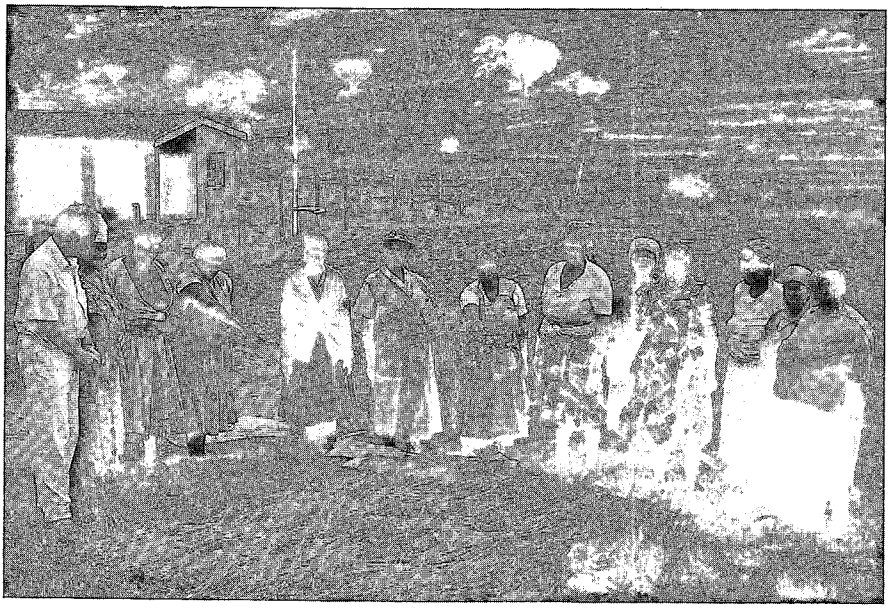


**Plate 14:** **Gardeners discuss a sheet mulching demonstration**

**Plate 15:** **Construction of a demonstration swale at EZakhiweni Garden, 1995**

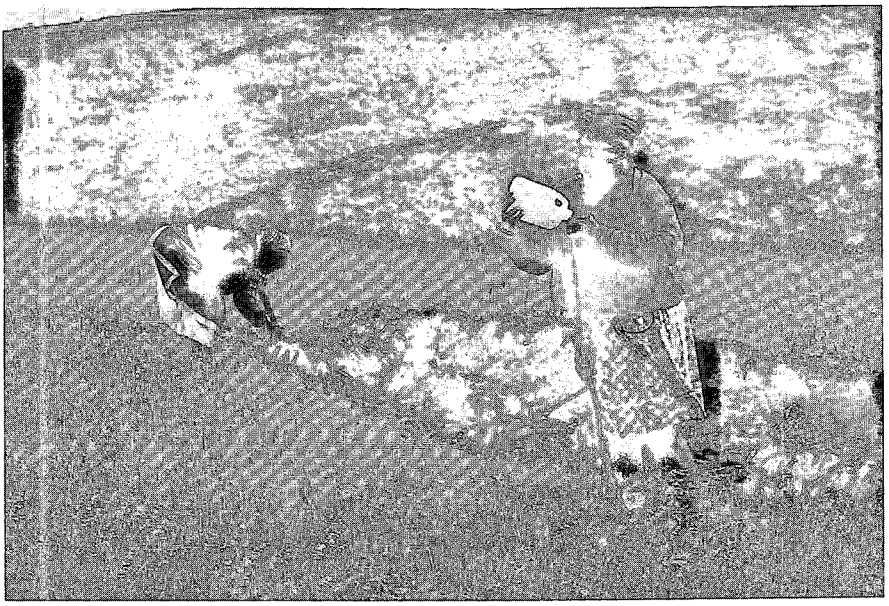


**Plate 16:** **EZakhiweni members learn to use a water-pipe level, and use it to construct swales wherever there is a history of erosion**

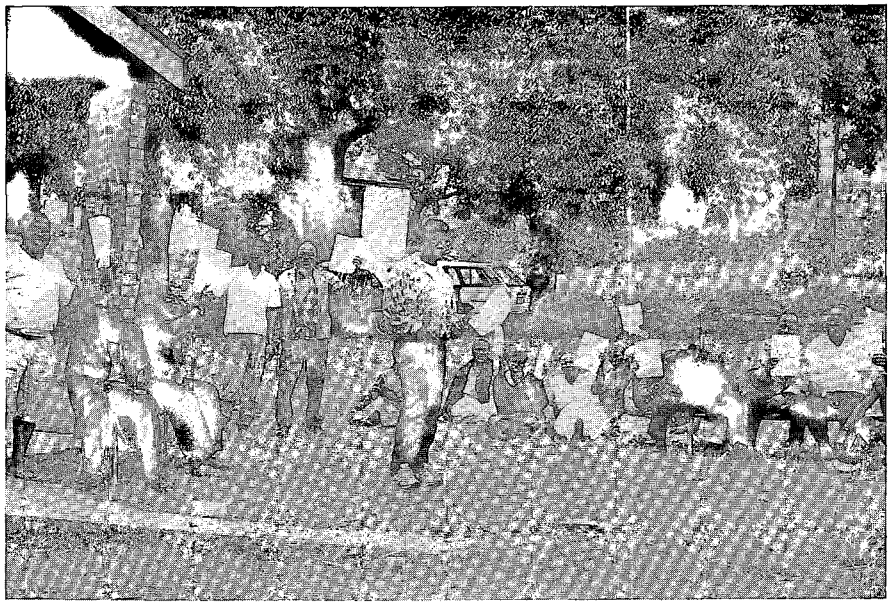


**Plate 17:** **The EZakhiweni Farmers Association adopts its constitution after a year of discussion and development, near the end of 1996**

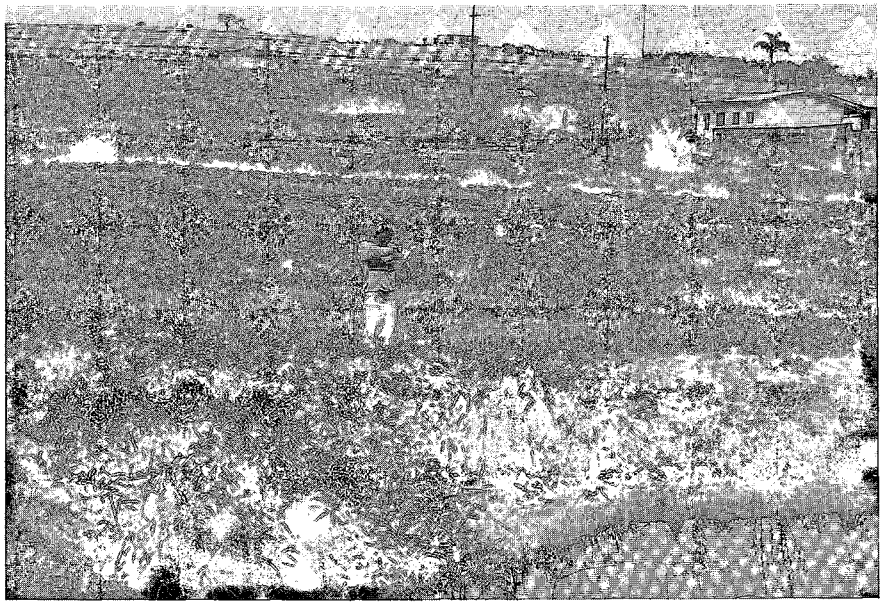


**Plate 18:** **Thami Mthembu next to the enlarged dam at the waterlogged site where he has planted a range of craftwork reeds. Crops are growing in the garden, with arable land in the background. Woza Moya High School is on the right, with the new toilet block**

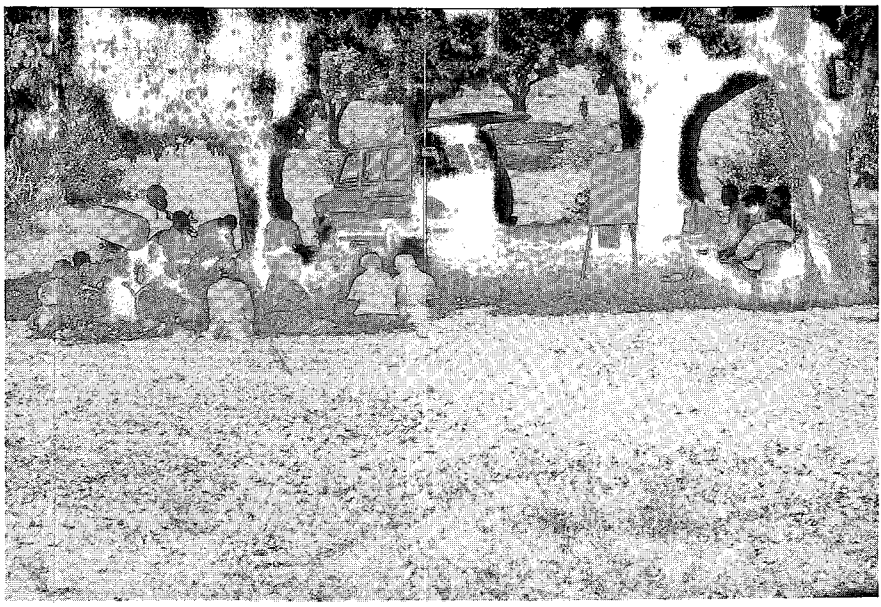


**Plate 19:** **EZakhiweni Garden evaluation**

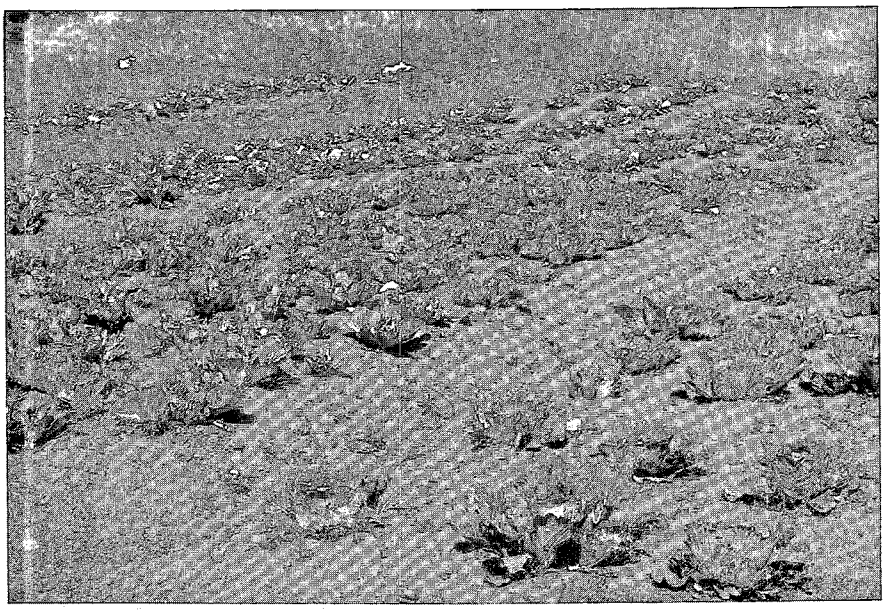


**Plate 20:** **Crops are growing, but there are no signs of water conservation or ecological agriculture to be seen. Short term food security**

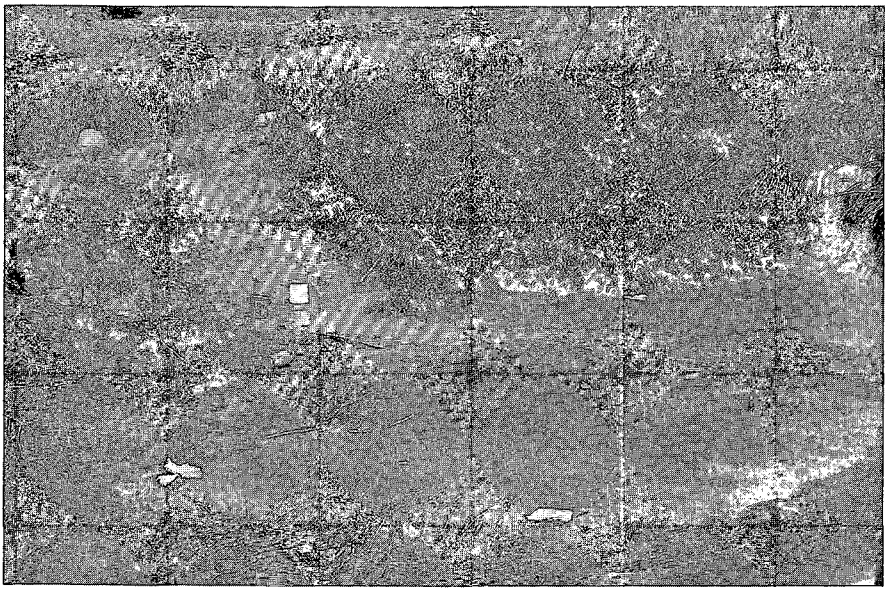


**Plate 21:** **October 1998: The dam is larger than five years ago, but just as empty; there are more crops in the background, and reeds are growing (left)**

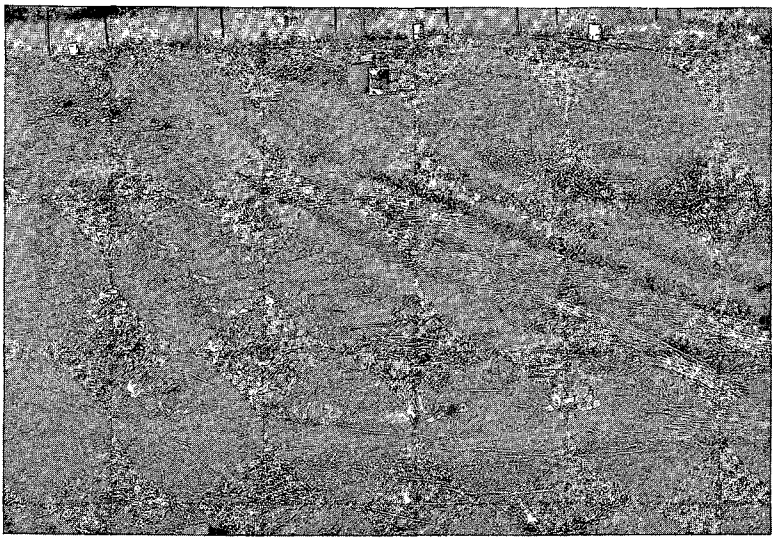


**Plate 22:** **Zimeleni garden shortly after it had been fenced (July 1998). Mulch, liquid manure and compost are used by most gardeners. They have committed themselves to water conservation, and are developing a rainwater harvesting structure. The garden was expanded in 1999.**

EZakhiweni Craftworkers Group

After Cross & Clarke (in Auerbach, 1994) had identified the importance of natural resources in the survival strategies of women at Ntshongweni, NCMP began to look for those people involved in craft production. Thami was able to assist the women in harvesting reeds for their work, and they used the agricultural officer's office and store room to produce and store craftwork, as long as NCMP had the use of this office. Once Zenzele Gumede had joined NCMP as craftwork facilitator, he took over the work with the craft group, and, with Lynn Stefano, was able to organise several marketing and training opportunities (Plate 23). The women regularly harvested reeds on Bachs Fen Ecological Research Farm, and on several other sites. Thami helped them to plant provenance trials of the craftwork reeds *ikhwane* and *iduma* (*Cyperus spp.*) and *incema* (*Juncis krausii*) in the wetland area at EZakhiweni Garden, and these, although limited in extent, have shown local women that it is possible to produce material by managing wetland areas. A management strategy which protects the hydrological and erosion control values of their wetland, protects the ecological values and allows plant harvesting for community development is recommended for the Wakkerstroom wetlands by Kotze, Breen & Klug (1994), and, as for Bachs Fen wetlands (Chapter 5), this strategy has been recommended for the wetlands being developed at EZakhiweni.

The Craftwork Exhibiton held in October 1997 at EZakhiweni was an important step in craftwork development. As it was a fairly major event aimed at launching the area as part of a possible ecotourist route, NCMP took on a major role in funding and organising the event. Dr Hadebe, the Mayor of Durban's Outer West Local Council (and one of the peacemakers in the Mpumalanga Peace Accord process of 1990, together with Mr Mlaba of the IFP), opened the event, and several speakers were invited to speak on craft and development (Plate 24). Although every effort had been made to invite local leaders from various political parties, Mr Sibisi claimed that he had not been invited, as did the IFP Youth Leader, Mr Ndimande, who insisted on being given a chance to speak. With his pistol on his hip, he addressed the gathering, upbraiding NCMP for not involving local political leaders, and complaining that the Mayor should not be present without IFP permission, as he was a member of the ANC and EZakhiweni is an IFP area.

An aspect of craftwork development which has been more positive, is the way in which locally established craftsmen and women (notably the well known potter, Andrew Walford) have been prepared to help Ntshongweni craftspeople to improve the quality of their work, and to publicise and market a range of handcraft. Although the levels of income are still modest, it would appear that some of the craftspeople are able to support themselves entirely from craftwork already, and that several thousand rands worth of craftwork has been sold through NCMP-related marketing efforts, including sales at the craft exhibition, and later at Roseway Waldorf School, Pietermaritzburg's Tatham Art Gallery and at various venues in Durban. Equally clear, however, is the fact that the local craftspeople are not yet in a position to take on the marketing themselves. For some considerable time they are likely to need assistance with marketing and organisational aspects, and this represents a significant level of investment of public money.

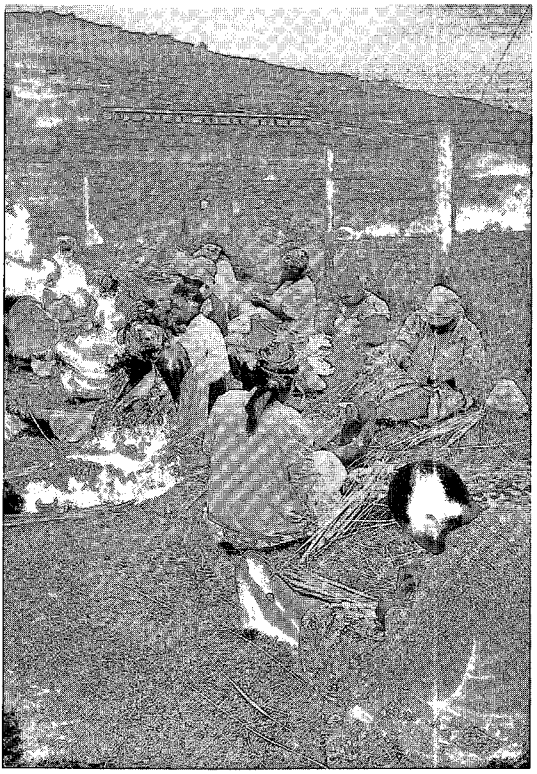


**Plate 23:** **EZakhiweni craftswomen at work, with the garden and Lalelani School in the background.**

**Plate 24:** **Mrs Cele, Lynn Stefano and Zenzele collect the special *Cyperus* reeds from Bachs Fen Farm wetlands in order to teach local women how to produce the now rare *Isithebe* reedwork.**

What was achieved technically?

Craftworkers attended several training courses which enabled them to improve the quality of their work. Beauty Ngcongo from northern KwaZulu-Natal ran a week-long course on basket-making, and the craftworkers attended several exhibitions in Durban and Pietermaritzburg which gave them a broader perspective on market opportunities and quality requirements. A range of new techniques including the use of *Lala* palm and *Ncema* reed were introduced to them. Some aspects of marketing were learned, and connections with several commercial outlets were established. In short, the 26 members had begun to produce commercially, and in selling over R1 000 worth of goods at the craft exhibition in 1997, and about the same amount at other smaller venues during 1998, they were beginning to generate finances which were a significant part of their household income (estimated monthly income for resource poor households was R250 per month, see Cross & Clarke in Section 4.5.2).

What was achieved socially?

Women experienced their own ability to generate cash income through using traditional skills and local natural resources. They learned that managing resources is not necessarily outside their control, and the production of craftwork reeds at EZakhiweni, although very small scale, was an important first step in collective management of natural resources. Collective marketing has started, although the women are very reluctant to take the initiative, and Zenzele (NCMP craftwork facilitator) has taken on much of the organisation of this process. He encourages local people to manage the marketing process, to try to prevent them becoming dependent on him, and this has led to him being accused of evading his responsibilities to help them to make money, so progress towards helping them to develop their own market outlets has been very slow. An example was the insistence of the craftgroup that Zenzele should go to Durban to buy *Lala* palm for them, since he and Lynn Stefano from NCMP had been responsible for introducing Beauty Ngcongo and her *Lala* palm skills.

The real cost of a special trip to Durban by professional project staff to purchase small quantities of craft materials highlights the difficulties of establishing economically viable craft industries unless they are based on locally available natural resources and on people who are convinced that the opportunity value of using their time for craftwork production is higher than its value for other activities. At present, this is only so in a very limited number of cases.

What was achieved in terms of local leadership?

At this stage, local women have seen that they can produce products which people are prepared to come from outside to buy. Previously they had only sold their work locally at very low prices (the average *cansi* or sleeping mat used to take 40 hours to produce, and was sold locally for R45; with improved production techniques using a wooden frame, and with the incorporation of coloured patterns in the mats, some women now make *cansis* of high quality in half the time and sell them for R75. On an individual level, a few talented craftswomen are producing high quality work and making money from this, but this has not yet translated into local, economically viable organisations capable of sustaining themselves.

### 6.4.2 Magaba Community Garden

The development of Magaba Garden can be traced by referring to the evaluation report in Appendix 5. The history, involvement of Christelike Maatschappelike Raad (CMR), land tenure difficulties, problems with poultry, problems associated with Thami's involvement in Mpumalanga, and access to the new site have much in common with the discussion of EZakhiweni development. However, once the small site had been secured, local leadership through Mrs Cebekhulu (Chair of the Garden Committee) was effective, and the garden will move to a larger site nearby during 1999. As the evaluation points out, gardeners have asked that the new site should be planned to maximise rainwater harvesting opportunities. They have undertaken to use mulch extensively, now that they will be further away from the disturbing influences of marauding poultry, and hope to be able to produce compost in larger quantities. Mrs Cebekhulu spoke passionately at the function where tools bought from Durban Outer West Local Council funds for members of the community gardens were handed over, about the improvement in the quality of local life which the garden had brought about.

What was achieved technically?

The small garden site was productively managed in spite of difficulties. The membership was initially 12, and the site about 0.3 ha, but membership has increased to 30 and the new site is nearly 2 ha. The new site has now been ploughed and fenced, and a rainwater harvesting design is being implemented. The gardeners are committed to the use of mulch and compost, but in practice this has not happened on a large scale. Vegetables have been produced consistently throughout the past four years, and the expansion of the garden means that a far larger quantity of vegetables can now be expected. The garden is contributing effectively to improved food security at household level.

What was achieved socially?

Mrs Cebekulu and her committee have shown consistent leadership, although Mrs Cebekulu has been far more active than the others. She has grown in stature and is accepted as a local spokesperson. The committee and all the gardeners have learned about running an organisation, and are positive about their experience. They have been able to bring pressure to bear to improve the accountability of both NCMP staff and Department of Agriculture staff, and they have done this in a very balanced way, ensuring that shortcomings in performance were understood by management, while giving credit for good work done. The process of developing a constitution and arranging to lease land, and also of recognising that the initial offer of land was not worth accepting, has had the effect of encouraging the members and convincing them that change is possible, and that collective action can bring about lasting improvement in food security, social cohesion and natural resource management.

What was achieved in terms of local leadership?

Mrs Cebekulu has been able to experience a wider world, having attended the launch of the provincial farmers association, opened by President Mandela. She was also elected Treasurer of the new Ntshongweni Farmers Association, and visited FSG projects at Stoffelton, where she met farmers and attended a permaculture course. Members of the garden felt that they shared much with her when she returned from these activities, and that they also experienced something of the wider world. Planners have consulted the gardeners about what sort of development options they would like to see in the future in their area, and members of the community participated in planning workshops for the Outer West Local Council's Integrated

Development Plan. The community looks towards a future with increasing participation and interacts democratically with the local councillor, Mr Moyo. They are not afraid to criticise him, the NCMP or the Department of Agriculture, but they are also balanced in giving praise and support to what they perceive as positive contributions from whatever source. They respect the vision provided by Mrs Cebekulu, and continue to contribute to developing and realising the vision, which they see as their joint vision for the future.

### 6.4.3 Zimeleni Community Garden

Once again, the history of Zimeleni Garden can be gleaned from the evaluation report in Appendix 5. Here again, political tensions played a part, as did personal tensions between Thami and Local Councillor Fanie Moya. During the development of Zimeleni Garden, Sakhile Ngcobo joined us as an Agricultural Intern after he had spent a six-month internship on Bachs Fen Ecological Research Farm. His input into setting up practical compost and mulching procedures was significant, and underlined the need for facilitators who themselves have practical knowledge and experience. Again, the evaluation report in Appendix 5 gives more detail of how the garden developed and problems which arose.

The official opening function gave rise to financial difficulties, and as we had been involved in the planning, the Chairlady, Mrs Meyiwa, approached us for help in repaying a small loan which they had taken out. After much discussion, NCMP did eventually make a contribution towards repaying this loan, as we felt that we did share responsibility, in that we encouraged the gardeners to hold an opening function. The NCMP contribution was about 50 % of the cost of the event.

What was achieved technically?

There is a garden where there was no garden before, and it is producing food. It has recently been expanded to accommodate four additional members, bringing membership up to 16 and the area of the garden to 1.6 ha. Mulches and compost were used initially, and are now again being used. Reticulated water connections will be in place during 1999 for emergency use, but water from the nearby spring will also be used. Water is efficiently used, and gardeners are aware of the connection between the use of mulch and compost and the decreased water demand. Gardeners learned how to apply permaculture methods and they understand basic soil fertility and water conservation practices through the course which Sakhile presented. They have learned about sweet potato cultivation using improved varieties. They have several natural pest control strategies which appear effective, and they are now able to access good quality seedlings. Household food security has been much enhanced and some money has been earned through the sale of surplus vegetables. They have secure tenure on the garden with no lease payable, thanks to the positive relationship which has been built up with the landowner, Mr Meyiwa, largely through his wife who chairs the garden committee.

What was achieved socially?

The collective action which resulted in the establishment of the garden has been an affirmative experience for all those involved. Prolonged negotiations over an appropriate site eventually resulted in the offer of the current site by Mr Meyiwa. The site did not meet Department of Agriculture criteria, as it was not close to a water source, but with help from NCMP and an aware membership, a water conservation strategy was developed and the Department of Agriculture agreed to assist with fencing the garden. Thami's input on mulching

demonstrations, and Sakhile's practical and enthusiastic approach to discovery learning with pest control, permaculture design, composting and rainwater harvesting meant that gardeners gained an understanding of ecological farming systems through a process of experiential learning. The enthusiasm and positive sparkle of these gardeners makes a welcome change from the negativity of some of the neighbouring EZakhiweni gardeners. The garden has become an example in the area of an ecologically and socially sustainable production system, and the visitors to the garden have made the gardeners doubly proud of their achievements. There is a sense of solidarity among the gardeners. Some members of the garden are also involved in craft production, and are working with Zenzele in a local Zimeleni craftgroup.

What was achieved in terms of local leadership?
The unselfish basis of Mr Meyiwa's loan of the site to the gardeners, and the leadership given by Mrs Meyiwa meant that the basis of this garden was far more sound than that of either of the others described above. The land was there to be used, even though Mr Meyiwa is using all of his other land productively. Provided it was being well used, he was prepared to make it available to the community. Mrs Meyiwa and her committee were also prepared to work and to keep up with an ecologically sound approach, partly because they knew that the site required careful water conservation. Nevertheless, some of the practices, especially mulching, had declined in efficiency partly because Sakhile was working in the upper catchment and Thami was busy at Mpumalanga, and partly because of a fairly wet season. However, during the evaluation gardeners became more aware of the longer term effects of ecological methods, and they have since then shown a renewed commitment to on-going soil improvement, based on a deeper understanding of local ecosystems. Mrs Meyiwa has proved to be a selfless leader who has put effort into helping her fellow gardeners to learn about gardening. This willingness to share knowledge has been an important factor in the success of the garden. The characteristics of a good leader described in Section 3.8 included both interdependence and this willingness to share, to move away from an opinionated defence of a small world, and open oneself to new ideas. The Zimeleni gardeners have done this, and now the world is coming to them. They have also been supported by their local councillor, who has made efforts to secure financial assistance from the Durban Outer West Council for agricultural development, and who has been supportive throughout of garden development for the whole of Ntshongweni.

## 6.5 Conclusions and discussion

Taking the second research question (b) first, we can conclude that there are effective methods of producing good crop yields organically. This can be verified by visiting Zimeleni Garden. Regarding question (a), the innovations demonstrated (rainwater harvesting, water conservation and composting) were not uniformly adopted. Mulching seems to be accepted as a good innovation, according to the evaluation comments, but has not been extensively adopted. Rainwater harvesting still seems to be a novel concept. It will be important to organise a process of discovery learning so that gardeners can experience for themselves the benefits of rainwater harvesting through a structured process of discovery learning. The experience of Hamilton (1995) in Queensland, using a rainfall simulator and other learning tools could be adapted for this purpose. Regarding compost, most gardeners accept that manure is an important source of nutrients; many are not convinced that the composting

process adds value. Again, a process of discovery learning could help this process along.

With regard to the general research question "How can diverse communities often characterised by conflict, be helped to come together to learn about natural resources and systems, and to manage them collectively in a way which is productive and responsible?" the experience with the three community gardens shows that a process of needs analysis can focus community attention on meeting needs. If additional resources (such as fencing material and irrigation infrastructure) are available, this can have a great stimulating effect on resource-poor communities. However, where local leadership is not strong enough to overcome partisan political biases, efforts have not proven long-lived. Collective action appears to need responsive, open-minded leadership in order to maintain enthusiasm. Campbell's comments about the critical importance of facilitating the process of collective resource management, quoted in Section 6.2, is given further depth when he says "There is no such thing as a neutral, detached, value-free facilitator. It is ridiculous to pretend otherwise. One must make one's values explicit. Anything less undermines the chances of facilitating meaningful dialogue amongst participants, let alone subsequent changes on the ground" (1998). In terms of the NCMP approach to ICM, we have made explicit our values, as expressed in the University of Natal mission, the FSG Mission Statement and the NCMP goals and objectives, as expressed in the preface to this thesis.

Although these values and the approach to democratic processes and discovery learning which result from applying them, are not popular with some local leaders, they do make a significant statement about the conditions which we consider acceptable. The idea that facilitators should be colourless and value-free is similar to the belief that a scientist should be objective. Both are illusions, and in both cases the values and agendas should be made explicit, rather than hidden. Facilitators and scientists can, however, be expected to strive towards selfless leadership, and to contribute to the development of a vision for the future.

In reflecting on the relatively positive experiences at Zimeleni compared with the more negative results at EZakhiweni, the role of Mrs Meyiwa as Chairperson is a vital factor. Not only is she a strong leader, committed to local development, but she was also supported by her husband, Mr Meyiwa, who is a landowner, and locally respected (and powerful) figure. Whereas Mrs Ndimande had to work against the dominant power relations, Mrs Meyiwa had powerful support.

The imminence of the 1999 general elections has been an important factor in increasing political tensions in the area towards the end of 1998, and this has had a major effect on the NCMP, as on many other development initiatives.

Gender and power

During 1998 Mr Sibisi and Mr Mthethwa persuaded the women to change some details of the constitution including a clause stating that they would work closely with FSG. They were also not happy with the clause which allowed the Association to expel members and to deprive them of rights to use land in the arable field. Mr Mthetwa then replaced Mrs Ndimande as Chair. The NCMP was excluded from this process, and from this point on, those members remaining active in the garden became increasingly hostile towards Thami and the NCMP in general. It is worth noting that Wisserhof had observed (see Politics in Section 6.1) that

"Some see Mr Sibisi as capable of throwing people off their land and therefore as a factor of instability in their life". In the evaluation (Appendix 5), Mr Sibisi claimed to be the Landlord of the fields. I questioned whether this was so, but no one contradicted his claim. I conclude that he has this power *de facto*, even if he does not have it *de jure*. In terms of local leadership, it appears that the local community accepts that Mr Sibisi is their leader, and they are prepared to do what he says should be done.

In spite of identifying issues and taking a stand on electing Mrs Ndimande as their Chairperson, the women at EZakhiweni Garden allowed the constitution to be changed and allowed Mr Mthethwa to take over the decision-making position. Whether this was the direct result of intimidation is difficult to determine. However, the disruption of the meeting of 20/8/1995 by the IFP *Amazulu* group was definitely an intimidatory tactic.

The election of Mrs Ndimande was a key milestone in the design process. The constitution was an unexceptional document, which was only accepted in mid 1996, after more than a year of quietly working through how the association wanted to operate, how it would encourage productive use of land and what procedures it would adopt. Nevertheless, it appears that the democratic process, resulting in a woman being in charge of an organisation which had the power to make decisions about land allocation, was more than Mr Sibisi was prepared to tolerate. While Mr Zwane had bowed to the democratic process, whereby Mr Moya was nominated and subsequently elected as Local Councillor, Mr Sibisi's position as leader in the EZakhiweni area continues. As the events surrounding the craftwork exhibition and the Local Council financial grant illustrate, the local IFP leaders are not prepared to tolerate any interference from outside, even if it is in the form of support for the struggle of resource poor women to access resources for economic development and improved food security.

In Section 3.9 it was pointed out that the real government of society is carried out by the operation of the ordinary standards of behaviour and conduct of the people themselves, who decide what is acceptable. In the three cases presented, what society accepts turns out to be very different. Initially, EZakhiweni society was open to new ideas and prepared to work at making a new start with local agricultural development. An injection of resources and enthusiasm appeared to be all that was needed. However, as locally powerful people began to feel threatened by inflows of assistance from unwelcome quarters, and by the erosion of their traditional power base, the world became small again, as it had been in the last four years of the 1980's when political violence had wracked the area. Local leadership was taken back by those who had previously wielded it, and they were unwilling or unable to see the larger picture. The result was the failure to live in a wider world, and the reinforcement of poverty.

At Zimeleni on the other hand, the world became more open. Unselfish leadership provided people with access to skills and resources, people responded by seizing the opportunities offered to them with both hands, and resources began to work for the people. Mrs Meyiwa is a leader who obeys the need she sees in front of her, and the result is abundance in the garden and in the hearts of people.

In the first case, the fence (of the demonstration garden) was torn down to prevent people from thinking that other people may help them, in the second case the fence (of the community garden) was carefully taken down to expand the size of the garden, and expand the size of the

world. Of course, many factors play into the success story of Zimeleni, and many other factors affect the negative aspects of EZakhiweni. However, the facts indicate that inspired leadership is the major difference in the equation, which allowed Zimeleni to progress even though the garden had received only a small fraction of the resources (time, equipment and financial support) which EZakhieni had had.

Towards a prototype community garden

The method for developing a theoretical prototype described by Goewie (1995, see Section 3.4) uses five steps: identify constraints (constructing a hierarchy of farm objectives with the farmer); transform into quantifiable parameters and define; propose methods; prototype framework; draw up action plan. This is the process followed by NCMP, as shown in Figure 21. The PRA and the Vision Building processes correspond to the first step, the Participatory Land Use Planning process quantifies parameters, proposes methods, builds a prototype framework and draws up an action plan.

Based on NCMP experience to date, the general characteristics of an ecologically sound prototype community garden would appear to include at least the following:

- commitment from gardeners to an action plan which includes production, equity and conservation perspectives (in other words, the creation of an appropriate "soft system" for managing a human process of resource use negotiation);
- a strategy for rainwater harvesting and water conservation which includes designing, constructing and maintaining appropriate structures (this should be developed as a joint process between experienced resource persons and local people with local knowledge of resources and rainfall and runoff patterns);
- provision of plants capable of generating biomass for mulch (such as vetiver on swales, employed on Bachs Fen Farm, or protected patches of thatch grass, the reject grass not useful for thatching being available for mulch), as this material is often not easily available to gardeners, and it often requires an outside facilitator to help gardeners discover the importance of providing such material as part of the longer term strategic plan for the garden;
- a soil fertility strategy based on available inputs (in some urban cases this will not include adequate manure, and here urban authorities could cooperate in an urban composting programme, as they are already doing at Enyosini School), but including steps aimed at improving the water holding capacity of the soil and the nutrient cycles within the garden and broader community;
- a marketing strategy based again on a joint analysis of demand, crop suitability and economics of production by gardeners and outsiders.

The process adopted by the Regional Technical Working Group of the South West Region of the Department of Agriculture, under chairmanship of Dr Fred Kars is an example of a suitable planning process to establish gardens along these lines. The Department helps gardeners to develop their action plan, and then develops business plans and irrigation plans for the garden, using interactive planning processes between their specialist staff and gardeners. The weak point of the process is the lack of social scientists in the department, and the technical orientation of agricultural officer training. The influence of Departmental Home Economists

on this process could be positive, but in general their role is limited to working with sewing clubs and food processing. A greater integration of home economists in the garden planning process could lead to garden designs which are more suited to the needs of the household, and more amenable to possibilities of adding value through processing at the homestead or cooperatively.

However, the need for social scientists to analyse the relationship between the normative values of the local society and agricultural policy, so that the governing variables are understood in the development of strategic plans for community gardens is a very important missing link. If changes of these governing variables cannot be brought about in a society such as the EZakhiweni community, then it is unlikely that policy, however well-meaning, and resources, however abundant, will lead to rural women in KwaZulu-Natal being able to take collective action to manage resources sustainably.

## Chapter 7: SCHOOL ENVIRONMENTAL ACTION CLUBS

### 7.1 Introduction

"We believe that children have a very important role to play in the process of ICM. Looking at the catchment as an organism, one can liken the river to its blood circulatory system. The wetlands act as kidneys, purifying the water. Waste sites play the important part of the excretory system, and need to be carefully managed. Forests should be the lungs. Well-run factories are like the liver, processing and detoxifying products and substances. Local people form the eyes, observing what is happening. Local organisations are the limbs, getting the work done. The catchment agency becomes the brain, processing information and devising strategic plans. But at the heart of it all are the children. They epitomise the spirit of catchment management. If you speak to farmers and businessmen about costly conservation practices, their eyes tend to glaze over rapidly. If their children ask "Dad, why is the water full of stream life above our farm/ factory, but stone dead below it?" the effect can be to swing a resource manager into action, building a future that his/her children can enjoy. It is because children are of the future, and conservation looks to the future that environmental education can galvanise local action like no other investment" (Auerbach, 1997).

The School Environmental Action Clubs are part of a strategy designed to build an environmental ethic: involving Mpumalanga and Ntshongweni community leaders, teachers and the youth in environmental activities, and then spreading out to other areas (Cliffdale, Alverstone, Hopewell, Entembeni, Tafuleni, Nels Rust). If participatory catchment management is to have a future, young people need to become involved in caring for the catchment. Already, NCMP has twenty school enviroclubs functioning, and interest appears to be growing steadily. Both boys and girls have joined the clubs, and the integration of community vegetable gardens with school gardens and enviroclubs has had a significant impact on the attitudes of students towards agriculture. The old adage that "The hand that rocks the cradle rules the world" has certainly had its echo in Mpumalanga: the children see respected local women (and also some men) producing beautiful crops, and all of a sudden, the school vegetable garden is not a place of punishment, where one is sent to pull up weeds, but a place of celebration, where nurturing, care and creativity dwell. This was the conclusion of Mrs Ngcobo, Headmistress of the Enyosini School, at our recent Enviroclub Evaluation. She also reports that vandalism has decreased significantly since the communities have been using the school premises for vegetable production.

### 7.2 Design objective

The general research question formulated in Chapter One was: "How can diverse communities often characterised by conflict, be helped to come together to learn about natural resources and systems, and to manage them collectively in a way which is productive and responsible?" The design objective which this chapter addresses is:

d Can School Environmental Action Clubs effectively involve school children in caring for their local environment?

## 7.3 Design methods

The key to good School Enviroclubs is the same as the key to good community vegetable gardens. It is local leadership. Without a teacher who can inspire students, Enviroclubs do not seem to take off (van Mansvelt, 1990). Our strategy was therefore to concentrate on supporting teachers, helping them to develop teaching materials themselves which they could use in a practical teaching situation (Taylor, 1997).

In terms of support, as mentioned in Section 3.7, facilitating a process of hands-on development of learning resources is the most important aspect of NCMP's role in helping teachers to find appropriate ways to motivate students. Supporting teachers in exploring the process of discovery learning is also an aspect which received attention in the design process. In this we used the participatory action research approach. Facilitating a process of discovery learning is the basis of effective environmental education. In particular, the rural schools need extra attention, as poverty is prevalent, resources are few and good teachers are reluctant to accept posts away from the convenience of the city (Chambers, 1983).

The main interventions from NCMP were based on providing an overall strategic framework for the enviroclubs, which included teachers' workshops (together with Share-net), providing schools with an "envirokit" (a large toolbox with tools, resource books, "River Action" water testing kits), helping teachers to develop School Environmental Policies (together with the Department of Education), and an annual competition with attractive prizes. T-shirts, caps and badges also help make discovery learning a lot of fun. From the teacher's point of view, one of the critical issues is linking the teaching curriculum with enviroclub activities. Much of the workshop activity examines this aspect of turning textbook theory into experiences which help students to discover how the world works, and what they can do to help.

## 7.4 Design process

From the beginning of the NCMP, the need for environmental education was seen as an objective. The process of general education design, based on our information and communication activities will be described in Chapter 8, though some of the more specifically educational outcomes are discussed in the next section. This will avoid duplication, as the processes of developing institutions, bringing people together, supporting local leadership and platform building are much inter-related, but have more to do with the subcatchment committees. This section will thus concentrate on the school design process.

After a discussion with students during the initial setting up of EZakhiweni community garden, MaShelembe Ndimande and I visited the Principal of Woza Moya High School on 15th March 1995, and discussed the possibility of joint projects such as tree planting, and of ways in which the rubbish which blows onto the garden from the school could be better managed. Subsequently, I was asked first to address the school about the NCMP, and later to help with teaching of Standard Seven Geography, which deals with the water cycle, map reading and geomorphology. During February 1996, we held a workshop in Mpumalanga. On the basis of input from this workshop, the NCMP developed a strategy for the clubs, which is presented in Box 8.

The strategy has helped to give a structural outline to teachers around which they can organise administrative and curriculum-related activities. However, discovery learning is a step-by-step process, and our Environmental Educators respond to the situations they meet by trying to support hands-on experimentation and innovation. After all, innovation is an emergent property of soft systems (Bawden, 1995).

**Box 8: Strategy for development of School Environmental Action Clubs**

To date, 20 clubs have been started, most of them in or near the Mpumalanga Township.

What do the environmental clubs do?
Activities include: Gardens; recycling; clearing invasive alien plants; planting trees; rainwater harvesting by constructing swales and erosion control structures; clean-up days; recycling; monitoring water quality using water testing kits; trips and interpretive trails; sanitation information campaign in Mpumalanga; annual school competition; developing local environmental action plans.

How does the Ntshongweni Catchment Management Programme (NCMP) help?
**Phase one: Capacity building** - minimum of 10 members per club: Wildlife Society membership costs R70 (this entitles schools to booklets and magazines). Clubs keep any additional money and administer it. We give the club Sharenet booklets, a record log-book for plants, birds and animals spotted in the area & reporting sheets for activities.
We help to develop an **school environmental policy and action plan** with the club, emphasising discovery learning processes which link activities to the curriculum.

**Phase two: Action phase** - complete one activity in each of the following categories:
1 Clean-up and recycling.
2 Indigenous tree planting.
3 School gardening.
4 Water harvesting and soil erosion control.
5 Alien plant control.
**NCMP supplies a lockable toolbox with appropriate equipment.**

**Phase three:** Assessment phase - once all 5 activities have been successfully undertaken, participating members will be presented with NCMP membership buttons and the club will be accredited as Champions of the Environment. Evaluations of activities happen annually before the end of the school year for the annual school competition.

**OUTLINE FOR OUR INTERVENTION AT SCHOOLS BASED ON FIVE VISITS**
1 Introduction. Visit school with catchment model: The story of the Mlazi River.
2 Arrange hands-on activities at a stream or river (Share-net: Pondlife booklet).
3 Session on Environmental Action Clubs, how they work, how to participate.
4 Develop School Environmental Policy.
5 Develop Environmental Action Plan for the club: targets and activities.

During June and July 1996, I carried out a survey in the standard seven class to establish a baseline profile concerning students' knowledge about the catchment. I had already given a general talk to the whole school on the NCMP, and students had understood much of what had been said. Their knowledge about rivers and dams was very localised. Most of them knew of the Mlazi River, and of the Ntshongweni Dam and Hammarsdale Dam, and that all of these were fairly polluted. A few knew of the Midmar Dam on the Mgeni River, and most felt this was not polluted. Few people knew of any other dams, but the perception that Hammarsdale industries are polluting the Sterkspruit (known locally as the *Mncadodo* Stream) was fairly general. Only two students came from families using water from the rivers; the rest were all already benefiting from the newly installed water reticulation systems. Many complained about the intermittent water supply.

Experiential learning

The teacher workshops drew on the methods described in Section 3.7, attempting to help teachers develop teaching resources which were appropriate to their circumstances. A range of innovative ideas were workshopped. Initially, many teachers were fairly resistant to participating in activities such as simulation games, and we adopted a flexible approach, respecting the right of those who felt that it was "undignified" to play games to watch the others, and then to comment on what they observed. It appears that for many teachers, teaching remains the province of the "expert" who imparts knowledge to the "student".

Processes such as discovery learning initially appeared very threatening, and even dubious, as they appeared not to draw on knowledge written in a prescribed book, covering a defined syllabus. Making the links between the curriculum and club activities remains a difficult process, especially for teachers used to following the syllabus closely through a prescribed textbook.

The difficulties of introducing a process such as Outcomes Based Education with teachers who have had their learning and teaching experience in a rote-learning environment are considerable. Nevertheless, after initial inhibitions were overcome, teachers became markedly more enthusiastic. The first Mpumalanga workshop early in 1997 was by far the most difficult, and with time participation improved considerably. This was also due to many other initiatives which were underway, such as changes in the Department of Education.

The first Mpumalanga workshop

The first Mpumalanga workshop took place in February 1996, before the appointment of our Environmental Educator. Colleagues from Share-net and Umgeni Water External Education Department helped me to present a range of possibilities to teachers and youth leaders from Mpumalanga and to carry out a needs analysis (Box 9). The initial response to suggestions that a range of extra-mural activities could be undertaken was negative. Teachers mentioned that parents might accuse them of exploiting child labour, and pointed out that political sensitivities in the area made it difficult to start any activities. The community was polarised, and if people from one side were involved in an activity, the other side would automatically refuse to support, and sometimes actively sabotage, the initiative.

**Box 9: First Mpumalanga Environmental Workshop**

**The workshop highlighted the following environmental problems:**

* Blocked sewers are not dealt with.
* It is felt that there is inadequate infrastructure, the pipes are too small and taps leak.
* Lack of knowledge as to how to use the sanitation system properly.
* Poor communication between local authorities and communities. It is felt that the Public Works Department does not respond therefore people lose hope.
* Confusion as to whether people should pay for community services.
* Littering.
* Soil erosion in the Georgedale area.
* Lack of space and facilities for recreational purposes.
* Schools are without fencing and caretakers.
* Waste is disposed of in undesignated areas.
* The staff of local industries are not aware of the problems in the community.

**The following educational problems were also raised by teachers:**

* The school curriculum needs to be changed to incorporate more hands on experience. "We, the teachers, must shift our focus; we must not wait for government."

* Principals need to become aware of the need for teachers to take children out into the community for hands on experience and learning.

Box 9 reflects the results of the needs analysis, which listed many of the shortcomings in physical infrastructure at the schools and also in the township. Share-net and Umgeni Water provided some resources, and NCMP subsidised an initial package of resources for each school. Teachers also experimented with these resources, and were encouraged to develop modifications to make resources more appropriate to their local situations. At the end of the workshop, the Mpumalanga Environmental Forum was constituted.

Two clean-up days at Hammarsdale Dam

In November 1995, NCMP organised the first Hammarsdale Dam clean up, attended by about forty school children, and a dozen unemployed local young people. This was followed up by a second clean up day in March 1996. The second day was far more ambitious, including transport of children, equipment and quite significant sponsorships from some of the Hammarsdale industries. Press coverage drew attention to the sewerage problems which had been reported for more than a year with no response from authorities, and joint statements by Umgeni Water and NCMP were effective in mobilising some resources (approximately R4 million initially, and subsequently R8 million, from the Joint Services Board) which have resulted in the overhaul of the sewerage system.

Children were given Mpumalanga Environmental Forum T-shirts, with water-birds, wetlands and the slogan "Let's make Hammarsdale beautiful" which one of the young men involved in the planning had suggested. The idea of the School Environmental Action Clubs was discussed over lunch, and considerable enthusiasm was evident from some teachers, although others were clearly unimpressed that they were expected to do some physical work, and set an example to the children. Again, they felt it was undignified, and one teacher even stole some of the equipment, reportedly claiming that he was entitled to it in payment for his work.

On the whole, the two clean up days launched the Mpumalanga Environmental Forum (MEF), and gave some credibility to the School Enviroclubs. Although the ME did not really take off as an independent organisation until 1999, it continued to function as a low-key organisation around which the Enviroclubs and other local environmental activities were organised. The appointment of various committees did not result in local people starting up activities independently of NCMP, except for the activities connected with recycling at the schools, which had already been started by Mr Ndokweni of the Health Department in 1996.

The second Mpumalanga workshop

A second workshop was held in October 1996, which built on the problems identified, and arranged for ME members to meet with senior Durban Water and Waste officials and the Deputy Mayor Matthews Meyiwa of Durban's Outer West Local Council. This resulted in good communication about environmental problems, and the Deputy Mayor became an important source of contact with the Outer west Local Council. Subsequently, NCMP developed a proposal and an architectural design for an Environmental Education Resource Centre for Mpumalanga, which it was hoped would be built above the proposed Mpumalanga Town Park. This plan was presented to the Outer West Local Council during 1997, and initially the Mayor asked us to await a decision from the full Council. Subsequently, he gave the proposals his support, and officially launched the Mpumalanga Environmental Forum.

During 1997, Sifiso Ntinga begun to inform Mpumalanga councillors and others systematically about the work of NCMP. He arranged meetings with individual councillors, presented them with copies of the pamphlet "Do you care about your catchment", and had several meetings with Durban Outer West Local Council Mayor, Dr Hadebe (one of the architects of the 1990 Mpumalanga Peace Accord), and Deputy Mayor, Matthews Meyiwa. This led to an invitation for Sifiso and me to address the Council about the NCMP, and through this contact, a relationship with the council developed. We worked together on issues such as the Mpumalanga Dump, which local people had complained about, and built links between councillors and members of existing (white) conservancies.

One of the teachers, Cindy Gwala, started an Urban Conservancy in the Valley View area of Mpumalanga, involving local children in care for their local environment, supported by Jenny Dean with her knowledge of organising conservancies. At this time, my own activism was also a factor in encouraging local people to get involved in environmental conservation and discouraging industrialists from polluting the environment. Through our network of contacts, we reported several polluters, and this led to several warnings from Department of Water Affairs and Forestry inspectors. One prosecution which resulted from our activities is still in court. The appearance of several newspaper articles reporting on our work, and later of our newsletter, raised public awareness about the environment, in particular about sewerage

pollution of the Mophela River at Mpumalanga, and this, together with scientific back-up from Umgeni Water, led to about R16 million being allocated to replace the sewerage reticulation system. Officials from the Sanitation Department of Durban Waste and Water (who took over from Umgeni after Mpumalanga became part of the Durban Metropolitan Area) asked us to help mount an education campaign in the schools, as part of the problem related to blockages of sewerage pipes, through the use of cloth off-cuts from Hammarsdale textile industries being used instead of toilet paper, and subsequently blocking toilets.

At this point, Nomusa Zwane was appointed as Environmental Education Facilitator, and she, being a teacher with experience of involving children in river clean up programmes, was able to motivate teachers, and bring specific ideas about applying enviroclub activities to learning about various parts of the curriculum. Having mixed age groups in the clubs makes it more difficult to cater for a specific aspect of the curriculum of one subject at a time, but theme activities allowed teachers to bring in a range of activities.

The first teachers' workshop

In September 1997, the first Environmental kits were presented to schools publicly, and early in 1998 a workshop was held which helped to focus the attention of teachers onto practical environmental activities. This workshop concentrated on the practical activities which teachers could undertake, and put them in touch with recycling companies, Durban Waste & Water's Sanitation Section, the Health Department and nurseries who were prepared to supply plants and trees. The workshop explored resources available, and worked with teachers at understanding how to use some of the available resources. Teachers were very much more positive in their participation at this workshop, and left with a firm commitment to develop environmental action plans for the clubs.

One of the important aspects of the workshop was showing teachers how to use the "River Action" kits which were included in the school Envirokits. These were developed by Share-net, Umgeni Water and the KwaZulu-Natal Conservation Services to teach young people about water quality. They include testing facilities for nitrate, phosphate, pH and an *E. coli* culture medium which is incubated by students, as well as a simple biomonitoring card which helps students get a rough idea of stream life related to water quality. These have been a very successful tool in many anti-pollution campaigns, as children have become very concerned about water quality in their local rivers, and have involved many other people in subsequent clean up campaigns. The involvement of the Mpumalanga College of Education, and the election of Mr Shangase as Chair of the Mpumalanga Environmental Forum, meant that we could also start working with student teachers, and we arranged several activities including the demonstration of the use of water test kits (together with Umgeni water External Education Section). This workshop is illustrated in Plates 25 and 26.

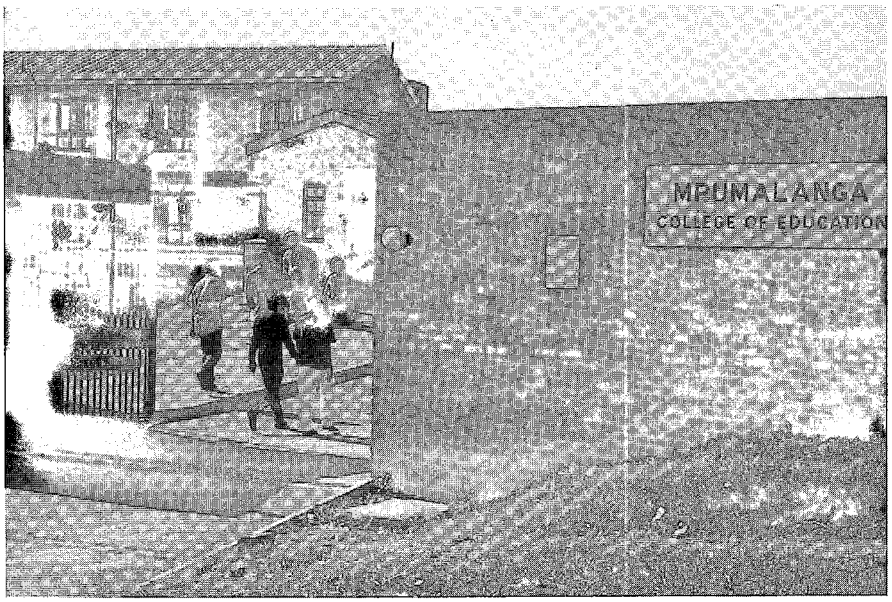



**Plate 25:** **The Mpumalanga College of Education, an important partner in environmental education.**

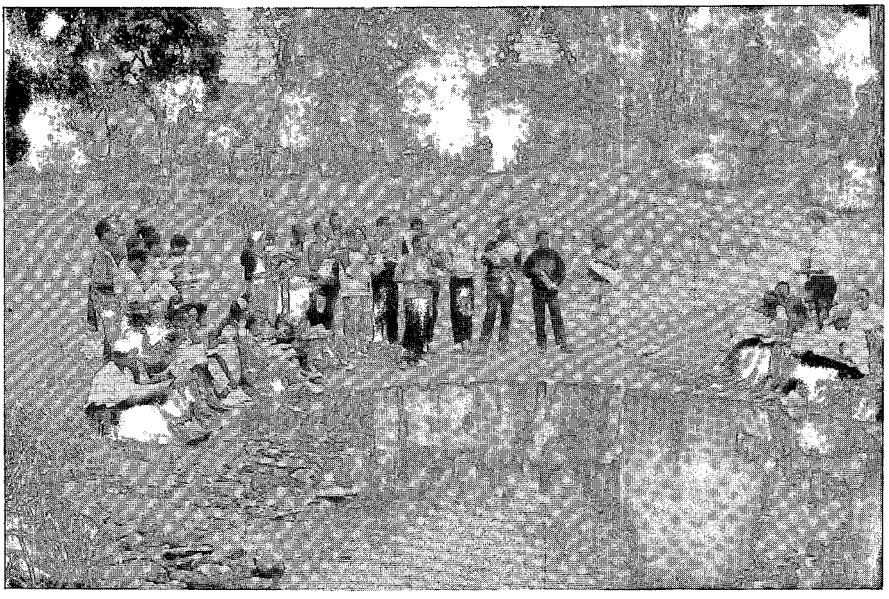


**Plate 26:** **Trainee teachers from the college learn about water quality testing from Umgeni Water External education Section staff.**

Attempts to establish partnerships

Environmental education requires partnerships, and those with Share-net and Umgeni Water have been important to the programme. The partnership with the Department of Education has also made a great difference, both in terms of cooperation from the Mpumalanga Circuit Office, which informed teachers about workshops, and gave them permission to attend, but also the partnership with the Durban Environmental Education Centre, and its staff. In particular the Centre Manager, Jeff Keegan helped us to run the second teacher workshop. Cooperation with the Hammarsdale Industrial Conservancy was also a very positive development after it had been established.

Partnerships with the Department of Health were not so successful, in spite of many attempts. Initially, their school recycling programme and competition appeared to be an ideal opportunity for a joint competition, where we would emphasise the agricultural activities, and they would carry on with recycling and other health-related aspects. However, in spite of a Departmental willingness to work together and a personal commitment from the person involved, he did not attend any planning meetings during 1997, and then arranged his own competition anyway. During 1998, he again expressed a wish to work with us, and then, having once again failed to meet with us, even after we arranged to come to his office, he arranged a competition for the school gardens, which he had not even been involved in setting up! This caused some confusion amongst the teachers, who initially thought that he was working with us, but in the end, we had to hold a second competition a month later, with a proper evaluation process. This was not a major problem, but it illustrates the difficulties of establishing effective partnerships!

The second teachers' workshop

The second teacher workshop was held in July 1998, and concentrated on development of school environmental education policies for each school. The teachers met at the factory of the South African Nylon Spinners in Hammarsdale, and lunches were provided by members of the Hammarsdale Industrial Conservancy, which we had helped to form. This also marked a major milestone in terms of building partnerships, as teachers had not previously had much contact with the industrialists, although the parents of many children at Mpumalanga schools work at Hammarsdale factories. Jeff Keegan from the Department of Education and Jenny Dean facilitated the workshop. Many opportunities for mutually beneficial activities have now been opened up, including the employment of some local women on a programme to beautify the area, and to control invasive alien plants (an initiative which grew out of the Working for Water programme activities, see Chapter 8).

The workshop used an outline school environmental policy prepared by Share-net, which helped the teachers to work through a number of aspects of the school environment. They drafted the policy at the workshop, but were encouraged to develop the policy with colleagues after they were back at their schools. Our environmental educator, Nomusa Zwane saw to the follow-up after the workshop, and made it clear that the policies and their implementation would form a major part of the evaluation of the school enviroclubs in the competition to be held at the end of the year. When we did subsequently visit schools and discuss the policies, about 60 % had been very thoroughly worked through. The workshop also resulted in the linking of black schools from resource poor communities to the Environmental Education Centre in Durban, which none of them had had contact with previously.

The first School Environmental Action Club competition

During October 1998, the older enviroclubs were evaluated by a team of three judges. The criteria for evaluation were the quality of the policy (20 %), the degree to which the policy had been implemented (20 %), tidiness (10 %), weed control (10 %), gardening (10 %), tree planting (10 %), recycling (10 %) and water conservation (10 %). Most of the older clubs scored sixty to ninety-five percent, while approximately half of the newer clubs scored fifty to sixty percent, and the other half scored ten to thirty percent. It was interesting that Woza Moya High School, next to EZakhiweni garden, scored the lowest, together with two nearby schools. Almost nothing had been done, and schools remained littered, vandalised, with broken windows and desks and an air of total dereliction. The contrast between these schools and the schools which had made an effort was quite remarkable.

The presentation of prizes was a very festive occasion, in spite of it being the second competition in the month. The two best schools were so close in score, and both so excellent that we awarded them joint first prize. Deputy Mayor Meyiwa attended, and spoke warmly of the importance of the environment, and the prizes (garden tools) were awarded to some very excited children, who had really worked hard to earn them (see Plates 25 to 30).

Teacher's evaluation

Although no formal evaluation process has been carried out with the teachers, a number of remarks made by teachers have given some indication of strong and weak points of the programme. The remarks made by Mrs Ngcobo, quoted in the Introduction, were part of a presentation she made on behalf of the School Environmental Action Club for a national competition which the school subsequently won. She had been selected as a finalist, and had borrowed our map of the catchment, and some photographs and newsletters. She told us that her presentation emphasised that the school was not an isolated school garden and club, but that it was a part of the Mlazi River catchment, that it participated in environmental and educational networks, and that teaching staff saw themselves as part of an education process which would help young children become responsible citizens, able to innovate and discover for themselves what was needed for the future of their country and their world.

This ties in with what was said in Section 3.7 concerning the value of education and of discovery learning. Several teachers commented how the activities have been able to broaden and enrich their teaching programmes in biology, geography, mathematics, physics and agriculture. Other activities also play their part in improving the quality of education in depressed areas such as Mpumalanga Township and Ntshongweni, as many initiatives are currently underway as part of the nation-building process being experienced in the "new South Africa". We are one part of this process, and we watch how schools which make a decision to start with any aspect of discovery learning seem to blossom, and suddenly become a part of building the future, rather than remaining victims of the past. Both Röling (1988) and Taylor (1998) have referred to the importance of "doing with" rather than "doing to" or "doing for" others. Plates 27 to 32 show some of the enviroclub activities, including gardens, recycling, rainwater harvesting and its use, and the competition's prize-giving.

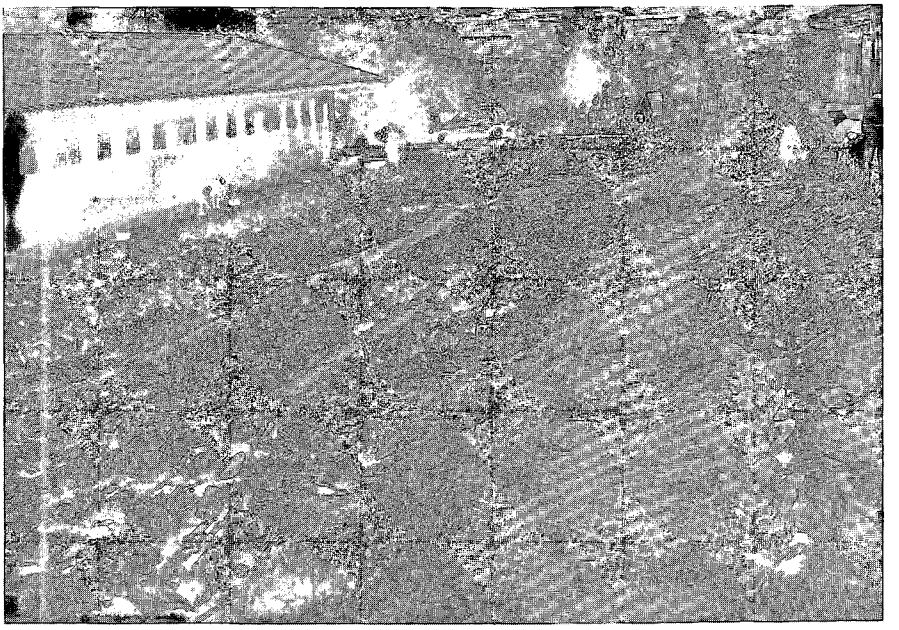


**Plate 27:** **Vukuzipathe School uses all available space productively; beds are mulched and compost is made at the school.**

**Plate 28:** **Recycling is one of the activities of the School Environmental Action Clubs which teaches children about the value of finite resources.**

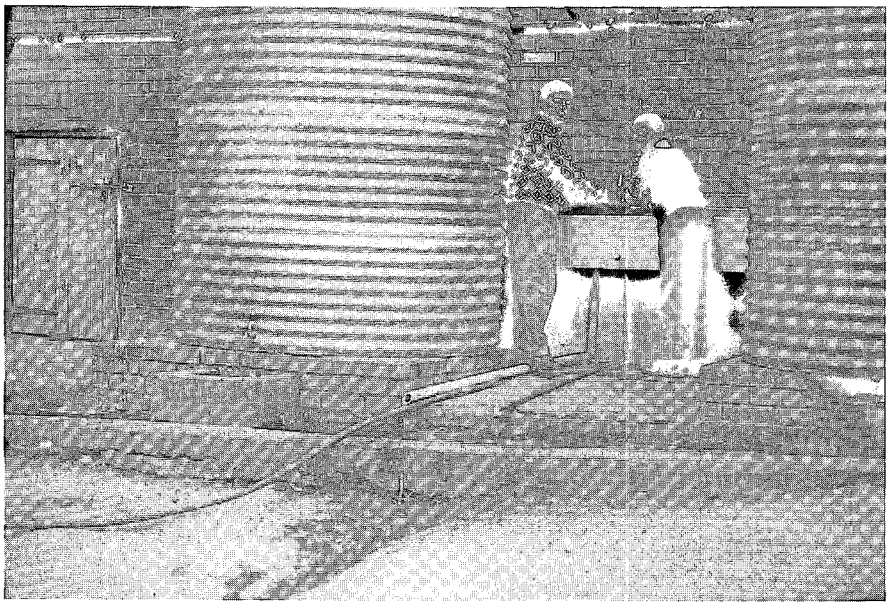


**Plate 29:** **Cliffdale School catches water from the roofs in tanks, so that water is available in this dry area for drinking and for keeping clean.**

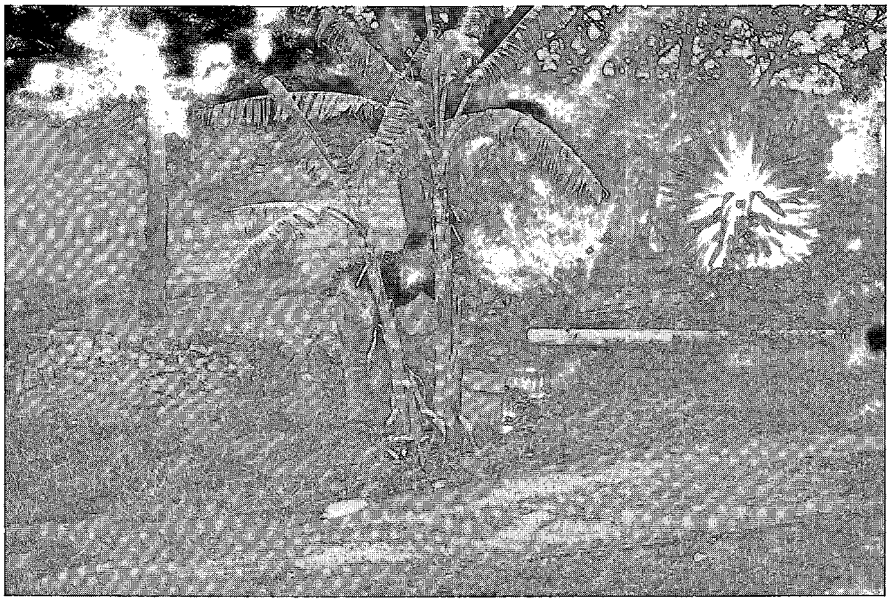


**Plate 30:** **Even the waste water is used! Water is piped to the school garden, where it works again to produce vegetables for the school.**

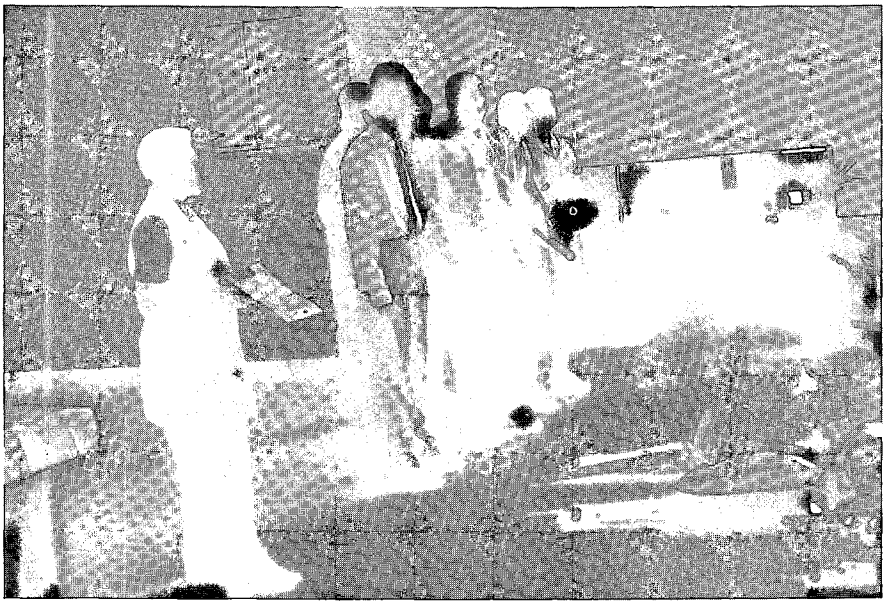


**Plate 31:** **The winning schools receive their prizes at the first School Environmental Club Competition. Nomusa Zwane, NCMP Environmental Education Facilitator, congratulates recipients at the Mpumalanga Hall, 1998.**

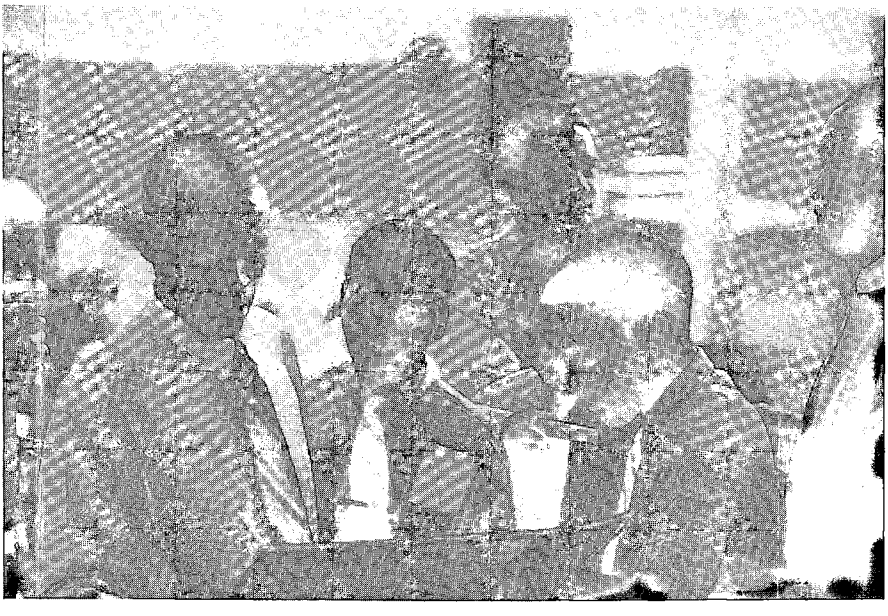


**Plate 32:** **Students from one of the winning schools examine Share-net Educational material on display at the prize-giving. These activities put students in touch with the wider world, through their environment.**

The rapid progress made by some of the schools which joined the Enviroclub programme recently has been quite remarkable. An example of innovation at one of the schools shows how the ideas are being applied: Teachers noticed that the bank was being washed away, and instructed children to bring the heavy duty plastic bags in which a particular brand of maize meal is packed, from home when these were empty. The bags were filled with soil and stacked carefully to form a reinforcement, which was to be covered with soil and planted with grass. Other schools were designing water conservation structures to lead water from the school roofs to school gardens, as can be seen in Plates 29 and 30 (the system at Cliffdale School). Teachers have commented that where parents are prepared to help in the development of school facilities, many things become possible which cannot be done if the school relies only on the resources of the Department of Education. In some schools, a "culture of entitlement" sees parents refusing to contribute time or money to school development, and demanding more resources from the department.

Local leadership can sometimes transform this negativity into a positive energy, by agreeing that once parents have achieved certain goals, the department should be lobbied to supplement the efforts of the parents. Plate 33 shows a discussion between senior staff from the provincial department of agriculture and a local Headmistress, concerning the cooperative efforts by the two departments. Facilitating such contacts is the essence of building platforms to manage resources collectively. The willingness of teachers to take on the extra load of inter-acting with the community, and allowing school resources to be used in this case, is in stark contrast with many other teachers who have very little contact with the community and complain about vandalism and negativity from parents.

Facilitating discovery learning about catchment management starts with helping people to realise what a catchment is. The physical model at a scale of 1:50 000 built by Margaret Dedekind of Pietermaritzburg, allows people to identify the area where they live, and to see its relationship to the Mlazi River and other resources in the catchment (Plate 34). When the model is placed in the middle of a school playground, very little interference is necessary. On most occasions, we allow at least half an hour, during which time the buzz of discussion does not abate. For most children, it is the first time that they have been able to get a picture of how their area fits into the Durban-Pietermaritzburg functional region. Adults show just as much interest at farmers meetings. Once people have had a good look, we usually spend some time describing in detail the journey of the Mlazi River, using a range of approaches, depending on the age of the audience. The little ones have "The story of the Mlazi River" followed by "The story of Ruby Raindrop", both teaching stories developed by Jenny Dean, our conservancies consultant. "Ruby Raindrop" is a discovery learning activity, which investigates what water is, and an activity such as placing a drop of water on a leaf brings forth much wonder and excitement from the children. Feeling water, playing with water, admiring the beauty of water, are important aspects of participating in catchment management.

**Plate 33:** **Dr Dludla Regional Director, South East, KwaZulu-Natal Department of Agriculture, discusses the community garden at Enyosini School with Headmistress Mrs Ngcobo, local agricultural officers and NCMP staff, and pledges support for this new partnership; another platform for managing and learning about resources comes into being.**

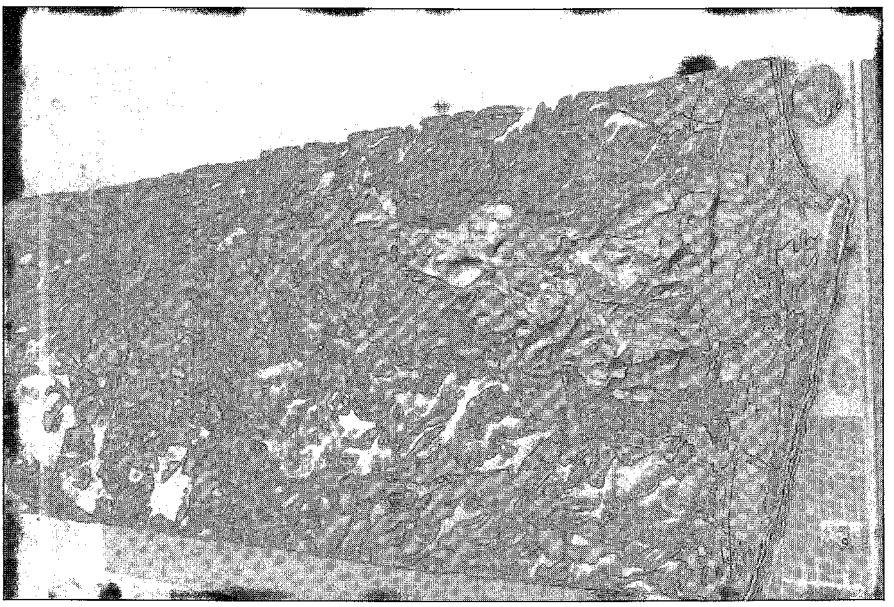


**Plate 34:** **Physical model of the Mlazi River catchment (green area) at a scale of 1:50 000. The white area is the neighbouring Mhlatuzana-Mbilo catchment. Land use is shown (sugar cane is yellow, forestry dark green).**

Problem schools

As with the gardens, it is important to look carefully at the enviroclubs which have not been very successful. Three of these were in the Ntshongweni area and two in Mpumalanga Township. The Woza Moya High School was mentioned in Chapter 6. It is the school where I helped with Geography lessons during 1995, and is adjacent to the EZakhiweni Gardens. One of the reasons for visiting the school in the first place was the problem of wind-blown litter from the school. In spite of tree planting activities organised by NCMP, a trip for some students to Ntshongweni Dam to participate in a Leadership week-end organised by Spirit of Adventure, a group operating at the dam which organises leadership activities for students, attempts to get students involved in the community garden, suggestions about recycling activities and many other supportive activities, the club simply did not take off. The school remains full of litter. Together with Mr Sibisi, Thami approached Umgeni Water for funding for a toilet block for this and other schools, as the existing facilities were very primitive. Thanks to the efforts of Mr Sibisi and Mr Zwane, the block was subsequently constructed, the school was fenced securely and a new classroom block was also built. Apart from this infrastructural development, nothing seems to be happening at the school.

Students arrive late for school, and often leave early. Broken desks are stacked behind the classrooms. Windows are broken. Teachers and the principal are often not at school, and there seems to be little interest in creative approaches to education. Reading Wisserhof's description of life in the area, one gets a picture of poverty and hopelessness (see Section 6.1). Once again, this seems to correlate with local leadership. When we tried to involve the school with the garden, we simply did not receive a reply to our suggestions. At several of the Mpumalanga schools where Enviroclubs have either not started, or have started but done very little, (more especially the high schools), when we visit most of the teachers are sitting in the staff room, with children unsupervised in the classrooms.

Most schools in the area have students arriving late, close early on Fridays, tell students to stay at home for the last three weeks of the second and fourth term while tests and examinations are being marked, and only to come to school on the last day to collect their reports. The problem schools have little if anything on the walls of the classrooms. The Charles Memorial School, also at Ntshongweni, was having a party on the day of the competition evaluation during school hours, and only three teachers were present. This school had initially seemed very positive and well-run, and the principal was very supportive of the idea of the Enviroclub. Since we were not able to carry out the evaluation (in spite of having made arrangements well in advance), I cannot offer an explanation for the decline in discipline and the overall dirty conditions at the school, other than to link the poor management to poor leadership. Nearby Ntshongweni School had also shown a decline from a relatively well-run, disciplined school, to one where the well-established garden had almost ceased to exist.

When we visited to evaluate one of the Mpumalanga schools for the first enviroclub competition (see previous section), teachers would not even accompany us. The evaluation was on a Friday, and one of the toilets was gushing water; I asked the teacher whether this would be repaired, and she said that she would report it on Monday! The school does not at present pay for the water, and it seems that the resource is not appreciated by teaching staff. Students are unlikely to learn water conservation with such leadership.

## 7.5 Conclusions and discussion

Within the education sector, the school environmental action clubs appear to be a vehicle for broadening the range of educational activities at the schools where they are working well. Of interest is that a number of schools with good physical resources have not yet made much progress with their enviroclubs.

Several of the schools evaluated in the competition were located in the Ntshongweni rural area, and all of these achieved very poor results. In two of the three schools concerned, there was no evidence of any environmental care at all. None of the schools had completed a School Environmental Policy. Part of this lack of engagement and leadership can be attributed to the poorer condition of rural schools, in terms of physical infrastructure, staff housing, and thus attractiveness to teachers; this has contributed to higher student drop out rates at rural schools than their urban counterparts (Auerbach, 1978). How much of the poor performance of EZakhiweni Garden is related to the poor performance at the adjacent Woza Moya High School? Why did Magaba Garden perform relatively well, while adjacent Ntshongweni school had made no progress with their enviroclub? The poor performance would seem to be more closely related to local leadership than to physical resources *per se*.

Ntshongweni School had had active craftwork and garden projects a few years before, but a change in Principal could have contributed to a decline in the interest of the school in these activities. The previous Headmistress had been very committed to using the school garden and craftwork activities in the school's teaching programme, and while the new Headmaster was not against this, teachers said they no longer had time for these activities. In former times the school had been a Catholic Mission School, and the previous Headmistress was a Sister in the Catholic Church. This would have facilitated the maintenance of the tradition of practical education, discipline and stewardship of resources with which the mission schools have been associated in South Africa over the years. Once again, the values lying behind the education and leadership exerted a profound effect upon the response of the staff and students. Sister Ndlela, the previous Headmistress, was often to be seen in the garden, and this had its effect on everyone else. The new Headmaster, while supportive of such activities, did not appear to know much about them when I discussed our programme with him.

The common factor in the successes reported appears to be strong local leadership by personal example, while in the schools (and the gardens) which have not been very active, there appears to be a lack of leadership. The implications of this situation for collective resource management will be explored in more detail in the next chapter, but the results indicate that design objective (d), concerning the School Environmental Action Clubs contributing to the involvement of children in care for the local environment, was achieved only where strong local leaders, supported by strong School Principals, are able to use the resources made available for the good of the community. Finding these leaders is thus an important part of effective environmental education activities.

Regarding the research question, NCMP activities at schools constitute an important platform building activity, and involving both teachers and students has far-reaching spin-off effects, as teachers are an important and respected resource in the community and students carry the message to their homes, and will later impart these values to their own children.

## Chapter 8: PLATFORMS FOR NATURAL RESOURCE MANAGEMENT

### 8.1 Introduction

Bringing people together to discuss natural resource management is a vital part of our work. Part of this process involves communicating, and supplying people with high quality information. Here three approaches to building catchment awareness have been used: our newsletter, our physical model of the catchment and our river biomonitoring programme. The Mlazi Catchment News helps people to understand the range of activities throughout the catchment, and how various activities interact. It aims to develop a sense of "belonging to the catchment", a catchment identity, since the idea of a catchment is rather abstract. The physical model of the catchment (see Plate 32) has a tremendous visual impact. Wherever we take it in the catchment, people cluster around to see where they live, and which of their friends are in the catchment. On a more scientific level, the river biomonitoring forms part of our integrated catchment management process (see Section 3.5). Working together with the Umlaas Irrigation Board Catchment Management project and Umgeni Water, the local water management agency, we monitor the entire river three times a year, in February, July and November (in the middle of the rainy season, at the end of this season and at the end of the dry season). The results of the November 1998 monitoring process are given on the cover of this book, and are discussed in detail in this chapter.

In building platforms for resource use negotiation, leadership plays an important role, but it is a leadership which facilitates, rather than dominating. A combination of vision, access to information, a commitment to democratic processes and a certain amount of environmental activism are required to inform and motivate, while allowing space for local initiatives and interest groups to emerge, and finding resources to strengthen these groups.

Nevertheless, some platforms have been built, people are taking some collective action, and that action has had some beneficial effects. The process points to some lessons for participatory catchment management in South Africa. Four subcatchment committees have been established in the upper catchment, and two more are emerging (see Figure 13). The Umlaas Irrigation Board Catchment Management project and NCMP formed these committees with local landowners. Another platform was built around the process of developing an environmental management system for the Durban Metropolitan Area, bringing with it the myriad complexities of urban planning, and including Hammarsdale, Mpumalanga, Shongweni Landfill Site, Moreland Property developments and the Durban Outer West Local Council Environmental Advisory Forum. This chapter, however, concentrates on the Upper Baynesfield Subcatchment Committee, as it is the most typical rural platform created.

### 8.2 Design objective

The general research question was posed in Chapter 1: "How can diverse communities often characterised by conflict, be helped to come together to learn about natural resources and systems, and to manage them collectively in a way which is productive and responsible?" In looking at platform building activities in the catchment, especially in the Upper Baynesfield Subcatchment Committee, this question constitutes the design objective.

## 8.3 Design methods

Communication

The physical model of the catchment (Plate 32), has been transported around the catchment to farmers days, school enviroclub meetings, public talks and workshops. While the discovery of details of local ecosystems is an amazingly diverse but easily experienced process, the recognition that some areas fall into one river basin and others into another is a fairly abstract process for most people. The development of a catchment identity has been much aided by our physical model, as well as the structured and spontaneous discussions that have arisen within groups while standing around the model. It is a framework which helps the various "social actors" within the catchment to see a bigger picture, as I did on Cliffdale Hill (see Section 2.4). Bringing the actors together to form "soft systems" based on "the multiple reality constituted by the on-going social and political struggles" that take place between them (Long & van der Ploeg, 1994, see Section 3.1) in a process of platform building is also dependent on effective environmental education, the basis of which is explained in Chapter 7.

The technical scientific aspects of this education process are provided by our biomonitoring process as described in Section 3.5 (The South African River Health Programme). The communication aspects include the physical model of the catchment and the Mlazi River Catchment News, our quarterly newsletter, as well as joint monthly team meetings of the NCMP and the Umlaas Irrigation Board Catchment Management project staff. The monthly reports produced by each team member of NCMP (and the Umlaas Irrigation Board's Conservation Officer), have contributed much of the substance of this book, which is itself a part of the programme's communication activities.

Catchment hydrology

Using secondary data made available by John Howard and Wayne Schaefer of Umgeni Water, Verburg estimates long term base flow at 36, 32 and 44 mm/yr respectively for the upper, central and lower catchment. This is about 5 % of mean annual rainfall. Excessive use of water in the upper catchment causes reduced flows downstream. Groundwater reserves have limited potential for meeting irrigation needs, resulting in rapid fall of water table when these are used for irrigation. The resources are only suited for low demand applications such as domestic and livestock use. This is due to the secondary aquifers having a low storage capacity. Increasing groundwater recharge is thus important, although results of recent work in Zimbabwe's Romwe catchment indicate that in Zimbabwe, seasonal factors are far more significant than local water use in affecting the rise and fall of water tables. They conclude that if water is not used when it is available, water tables will anyway fall in the dry season. Management of local groundwater thus requires further study, to determine to what extent changes from average borehole depths of 40 m in Cliffdale in 1990 to an average of 120 m for new boreholes in the drought of 1993-96 were due to abstraction of water for irrigation, and to what extent they were purely a reflection of prevailing seasonal conditions. Such quantitative research could easily be carried out on Bachs Fen Ecological Research Farm, now that devices for measuring the water balance on the farm are functioning effectively.

Parameters are quantified at field, farm and catchment level

The main objectives at field level would be reducing surface water run-off, resulting in higher crop water availability, lower soil erosion and reduced nutrient leaching. More efficient

irrigation techniques will also reduce water use. At farm level, wetlands and small dams can store water on the farm, although larger dams have negative impacts on some aquatic ecosystems. At catchment level one needs to understand the requirements of water users throughout the catchment, and match these optimally with stream flow characteristics to ensure productive and equitable access to water. This includes establishing criteria for equitable access to water, improving access during dry periods, improving the efficiency of water related ecosystems and reducing the severity of floods and droughts.

The development of a catchment management plan will require an in-depth assessment of irrigation potential, rainwater harvesting potential and groundwater potential and costs and benefits of alternative uses of water for various activities in various parts of the catchment. Such a plan will have little value if local land users and resource managers have not been intimately involved in developing the plan. If they have an intimate understanding of how water is used throughout the catchment, and of the perspectives of a wide range of stakeholders, they are more likely to agree on a catchment management plan which accommodates productivity, equity, conservation and sustainable development (Figure 2).

Effective Catchment Management Plans, then, depend on effective subcatchment planning and management processes. Scoones & Cousins (1994), discussing *dambo* management, emphasise that collective resource management requires that those managing the resource see one another regularly (more than once a week), as a general rule. This level of intimate contact between resource manager and resource, and among resource managers is simply not practical at catchment level, and even less so at the level of the Water Management Areas which appear to be the main level at which the Department of water Affairs and Forestry proposes to approach catchment management. The description and analysis of the Upper Baynesfield Subcatchment Committee will illustrate this point.

## 8.4 Designing Platforms for Resource Use Negotiation

Involving a wide range of people throughout the catchment in understanding local ecosystems has been a major part of the work of NCMP. Work with the Durban Metropolitan Environmental Policy Initiative (DMEPI, 1998), the Durban Outer West Local Council Integrated Development Plan (OWLC, 1998) and a range of local planning activities, from local development plans to community gardens and school enviroclubs has been an important part of this work. This section describes work in the Upper Baynesfield area to illustrate how local communities characterised by high levels of conflict can come together and plan and manage resources collectively.

### 8.4.1 The tools

As mentioned earlier, the physical model of the catchment, the river biomonitoring programme and the Mlazi River Catchment Newsletter were key environmental education tools used in creating a catchment identity, and informing people about issues and activities within the catchment, along with a certain amount of environmental activism. Developing these tools was an important part of the process of facilitating discovery learning amongst catchment residents. The catchment model was discussed in Chapter 7.

River biomonitoring

River biomonitoring is a technically demanding process. It requires a good knowledge of entomology and taxonomy, and a shrewd ability to link the stream life to the quality of the habitat (see Section 3.7). If the habitat is poor, then one will be happy to find moderate biological diversity. A poor habitat does not mean an impacted habitat, and so the Habitat Assessment Matrix is vital, in assessing whether the biological diversity is "good considering the habitat" or "not up to what one would expect to find" (thus probably impacted).

Both the NCMP Ecologist and the Umlaas Irrigation Board Conservation Officer received thorough training in biomonitoring, and although the process only started in earnest at the end of 1998, we are already developing a picture of the health of the Mlazi River system. Details of the results of the NCMP biomonitoring are supplied in the reports of Patrick (1998a, 1999). These results give a preliminary indication of river health, but they were taken during the rainy season, and future samples during low flow periods may have different (probably poorer) results, as there is likely to be less of a dilution effect. Only after regular sampling for several years are we likely to be able to develop a reliable understanding of the functioning of this complex ecosystem. Holling's cautions (see Section 3.1) about a too narrow problem definition are pertinent here.

From these preliminary results in the rainy season, where the upper reaches of the Mlazi River (Patrick, 1998a) are still experiencing a relatively high level of ecological integrity as defined by Roux (1997, see Section 3.7). The first report concluded that "The high diversity of pollution sensitive invertebrates recorded ..... indicate that the biological health in this reach of the Mlazi River is good". The same is true about the upper reaches of the Mkuzane River, a tributary to the Mlazi in the upper catchment. Tests at the end of January 1999 indicate that at Osgodsby, river health is excellent, while lower down at Maywood the river is slightly impacted (sampling points 1-3, Patrick, 1999, see map and explanatory notes on pages 260 to 262). Following the Mlazi River downstream, Sample points 4-10 on the cover map show that river health is good (in the earlier tests, points 8 and 9 were moderately impacted by pollution, which Patrick (1998a) attributed as "probably due to diffuse pollution sources from agricultural activity and faecal contamination from Mophela and Mpumalanga townships". The fact that sample point 10 was then only moderately impacted is already a considerable achievement, as this area was severely impacted in November, 1995 as a result of faecal pollution from blocked sewers (pers. comm., Dr Quentin Espey, Umgeni Water, 1996). That the health of the river improves between sample points 10 and 11 is probably due partly to the natural resilience of the river and partly to the fact that considerable capital expenditure has now occurred to reduce sewerage pollution.

Sample points 19 and 20 show that the Sterkspruit (or *Mncadodo* Stream) five km below Hammarsdale Industries (referred to on the map as the Elangeni Industrial area) has been severely impacted, but it improves as the Sterkspruit flows towards Ntshongweni Dam (sample point 13). The formation of the Hammarsdale Industrial Conservancy has been a factor in bringing industrialists together, and collective action has resulted from these endeavours. Press coverage of pollution incidents, and peer pressure from fellow industrialists is contributing to more responsible river management. Reports in the Mlazi Catchment News, and NCMP News Releases to the press (regularly published in the local newspapers) have at least contributed to the changing climate in Hammarsdale. After a spill of chemicals from an

American-based multinational company in Hammarsdale had killed off aquatic organisms for several kilometres below the factory, the company responded with a series of promises. After more than two years of on-going pressure, including intervention from the Hammarsdale Industrial Conservancy and a letter from NCMP to the company's head office in Memphis, Tennessee, the company has agreed begun to take remedial action.

A notable success story is that of the LTA Quarry, below Hammarsdale Falls. Following complaints from a number of residents downstream from the quarry, I arranged a visit to the quarry with an Inspector from the Department of Water Affairs and Forestry and the Msinsi Holdings Reserve Manager from Ntshongweni Dam. After explaining the impact of soil and aggregates washed from the crushing plant into the Sterkspruit on the breeding of Bass, and other problems being experienced downstream, we examined the site and discussed possible remedies. Soon after, at the encouragement of the Department of Water Affairs and Forestry, the Quarry Manager commissioned an environmental management plan, which has since been largely implemented, with positive results. Patrick (1999) comments "When sampled on 27 November 1998, biological health at this point [below the quarry, sampling point 12 on the map] was moderately impacted. However, when sampled recently on 15 February 1999 the result indicated that biological health was good".

There is still need for further conservation, but the contact helped all parties understand the ecosystem, and since this time, several of the factories in this area have used NCMP resources to contact local people who have helped them to control invasive alien vegetation and to plant indigenous trees in the riverine area. This points to the importance of a maintenance aspect in platforms for resource use negotiation. For the Hammarsdale Industrial Conservancy, we still provide a minute-taking service, and we refer messages to a wide range of actors in the catchment. Copies of documents for the Shongweni Landfill Site and for proposed developments by Moreland Property Developers are lodged at the NCMP office, which is conveniently located for a wide range of people, on the bus and taxi routes (see Figure 1).

The upper reaches of the Weke-weke River also appear to be moderately impacted (sampling points 14 and 15) while health improves at point 16. Programme staff have had discussions with a drum-washing factory above point 15, and they have undertaken to improve the situation. It would be easy to identify a few key variables, set targets and mobilise resources to achieve those targets, yet this would have the result of focussing on these variables and monitoring only them, defining the problem too narrowly. Even a process such as river biomonitoring, while examining the effects of water quality on stream life, tells us little about people, productivity or poetry. All three are important parts of life in the catchment.

Points 17 and 18 show the differences between a site with sugarcane and a landfill site above the sampling point (point 17), and one with only sugarcane and no landfill site above (point 18). Patrick (1999) states "Biological health at point 17 has experienced a major impact, with no aquatic invertebrates being found and a smell of leachate occurring here with a dirty white froth on the water surface. The SASS score recorded for this point was 0, resulting in biological health at this pointy being categorised as poor. In comparison, 8 families of invertebrates were found at point 18 with a SASS score of 18 with a SASS score of 53 and an average score per taxon of 6.6. These families included pollution sensitive families such as *Amphipoda, Leptophlebiidae* and *Philopotamidae*. When previously sampled (179/98), point

17 had 5 families, a SASS score of 18 and an average score per taxon of 3.6 confirming a reduction in biological health over time at this site".

Sampling points 19 and 20 show the impact of spills of petrochemicals on the N3 highway (8/12/98) and of an energy drink at the same point (14/12/98). "A major impact on biological health was recorded at point 20, just downstream from the spills, with no aquatic invertebrates being found here (SASS score of 0)" (Patrcik 1999). However, when resampled in February, the status had improved from "poor" to "moderately impacted".

The Mlazi River Catchment Newsletter

The Mlazi River Catchment News regularly reports on progress on these and other projects, and tries to give credit to those companies who are taking responsible action, but also to report irresponsible resource management. As a result, NCMP is not always popular. Some see us as too scientific, and not willing to make clear statements blaming polluters for River health problems, and by others as too emotional, and showing partiality to the conservation lobby, to the detriment of local industrial and economic development.

In the seven issues of the newsletter which have appeared during 1998 and 1999, there has been a steady development from general information describing what a catchment is and what integrated catchment management is, to hard news and information, reporting about problems, but even more about activities and solutions that people have developed. A children's section is being developed specifically for the School Environmental Action Clubs.

Distribution of the newsletter currently totals 300 copies of the English language and 200 copies of the Zulu language version. Distributing the Zulu language version is a major logistic effort, as many of the readers do not have reliable postal addresses. Each school at present receives only two copies of the newsletter, and it is intended that the children's section will be distributed in larger numbers to all enviroclub members. Although the newsletter was initially produced every six weeks, it will now appear three times a year. This will coincide with river biomonitoring, and is also intended to start off the year's school activities in February (the school year runs from late January to early December), to encourage club activities in July and to report on the competition results late in November.

### 8.4.2 The process

The factors which led to the formation of the Upper Baynesfield Subcatchment Committee included the careful establishment of a number of networks, with the Entembeni, Tafuleni and Willowfountain communities, with Baynesfield Estate and local farmers, with Mondi Forests through the local forester, but also at a more senior level, through their nature conservation and technical officers, and also at a senior executive level. Before describing the process, it is important to re-examine the political context, but at a more local level.

In Section 2.3, the policy context of the new South Africa was outlined. Many people came together to analyse how resources could be brought into the service of people who had previously been denied assistance. The Reconstruction and Development Plan of the African National Congress was the culmination of this process. Subsequently, the difficulties of applying new policies with the same people made major restructuring of the Public Service a priority. With a growing "culture of entitlement" on the part of some activists who felt that

those who had suffered in the past had a right to redress, the government found itself facing a social dilemma. Röling (1997, see Box 5) says that understanding social dilemmas and the conditions under which people are willing to opt for the collective choice is a key issue in sustainable land management, particularly where exclusion of some beneficiaries is problematic or where some beneficiaries can use the resources of others.

After recognising that sustainable development in South Africa at present requires a growing economy, the government supplemented the Reconstruction and Development Plan with the Growth, Equity and Reconstruction Strategy. Some critics argue that the government has abandoned its commitment to equity, but the underlying philosophy at present appears to be an attempt to mobilise entrepreneurial creativity within the country, by supporting emerging leaders who are capable of using resources to provide goods and services for society. The dilemma which now presents itself is that much of the leadership is directed at what Covey (see Section 3.7) calls Independence, rather than Interdependence. Small business often aims to exclude other beneficiaries, and also tends to plunder common resources, with a view to short term profit-taking.

In this climate, the Department of Agriculture is trying to launch the National Landcare Programme, and the KwaZulu-Natal Department of Agriculture is launching its *Xoshindlala* programme ("Chase away hunger"). Both of these programmes are aimed at collective management of natural resources, and both find themselves struggling with social dilemmas. A growing number of black commercial farmers are becoming increasingly productive, and are now accessing technology, credit and land, and using this effectively in terms of profitable production. Like many white farmers, their emphasis is on short term production. The dilemma faced by researchers and extensionists is how to support emerging commercial farmers while also addressing rural poverty and resource degradation.

The KwaZulu-Natal Department of Agriculture's South West Region has come up with an innovative approach. Regular meetings of a Regional Technical Working Group (RTWG) bring together representatives of government, non-government and farmers organisations to discuss planned projects and make recommendations on financing them. A part of the Region's project budget is allocated through this committee, and procedures for joint evaluation of projects, development of business plans and implementation strategies have been developed. Many of the projects are community gardens, and at the start of the NCMP the Mpumalanga District fell under the South West Region. Due to internal reorganisation, Mpumalanga now falls under South East, where a similar process is being developed. This new openness of government agencies to partnerships is indeed exciting, and is resulting in resources becoming available for both resource poor community gardeners, and commercial entrepreneurs wishing to enter the market.

The RTWG has been a key player in allocating resources to garden development in the Upper Baynesfield area (Entembeni and Tafuleni), and Local, District and Regional Agricultural Staff have been very supportive. In addition, the Department of Water Affairs and Forestry has allocated funds for the control of invasive alien plants, and together with the Umlaas Irrigation Board's Catchment Management Project, NCMP has helped local people in the upper catchment to access training, find short term seasonal employment, and direct some of the funds earned towards small scale agricultural development.

At the same time, Mondi Forests (South Africa) and Baynesfield Estate (both major landowners in the upper catchment), together with smaller commercial farmers and local Zulu rural communities, have begun to resolve some of the local social dilemmas. Baynesfield Estate has been working for several years to make available some of its land to aspirant small scale commercial farmers, in the process resolving some historical land claims from long-standing residents. Mondi has had to grapple with damage to trees from local cattle and from arson, while nature conservationists are concerned about the impact of commercial forestry on soil erosion and hydrology, with sporadic pollution of the Mlazi River with nitrates, and with decimation of much of the indigenous wildlife through local hunting with packs of dogs.

During 1997, Jenny Dean carried out a pilot survey of a range of large and small scale commercial farmers concerning their perceptions about resources, problems and possible solutions (sixteen respondents). Nearly 70 % of the farmers interviewed had already heard of NCMP. Farmers were aware of pollution of rivers and dams in the Mlazi catchment, by industry, agriculture and informal settlements, and opinions were divided about whether there should be more dams in the area or not. Some felt that many small dams would be better than a few large dams. Ideas about improving water resources in the area included reducing pollution, reducing afforestation, making irrigation more effective and building more dams. Improving the environment required clean up campaigns, better crop management, better grazing management, control of invasive alien plants and planting of indigenous trees. Soil conservation enforcement and better riverine management were also mentioned. Farmers knew about invasive alien plants growing in their area, and were aware of initiatives to control these. Most farmers were prepared to engage in tree planting activities, and many of these expressed an interest in obtaining seedlings of indigenous plants. Most were prepared to pay for seedlings. There was general awareness that wetlands are important, but a feeling that little was being done to manage or rehabilitate them.

The initial pilot survey carried out by NCMP, was followed up by a broader survey by the Conservation Officer of the Umlaas Irrigation Board's Catchment Management Project. This survey formed part of a riverine rehabilitation programme which linked into the Working for Water programme, and joined up with Mondi and Baynesfield initiatives, and with NCMP's work at Entembeni and Tafuleni.

In 1995 and 1996, NCMP had set up two workshops, first with Mondi alone, and then with Mondi and Baynesfield (Appendix 6). The main conclusions of the first workshop, regarding Mondi's plantation management were: Harvesting: Ensure that timber is harvested in panels of 0,5 ha or less at any one time; Use high-line timber extraction; Avoid windrowing up and down the slope; Minimise burning in whatever ways are sensible. Post-harvest: Earmark areas to be withdrawn from planting well ahead of felling operations; Plan the future use of these areas (medicinal plants, grasslands, hardwoods, recreation); Develop contracts with community contractors to prepare and plant the areas timeously; Set up clear management contracts with contractors; Monitor the implementation of land-use plans intervening where necessary. These conclusions are in line with Mondi Conservation policy, and with both the "Guidelines for environmental conservation management in commercial forests in South Africa" (Bigalke, 1995) and the ITTO Guidelines (International Tropical Timber Organization, 1990), as discussed in Appendix 1.

The second workshop developed a vision for the area:

"As concerned land-users in the catchment, we would like to see the upper catchment **conserved, commercially viable** and with active participation by the **community**. This means to us primarily improving land use practices in the area with an emphasis on farming practices which protect and develop wildlife habitats, ensure the long term sustainable use of natural resources and promote access to these resources for sustainable exploitation by local communities, as well as for the enjoyment of the broader public".

Although this was a vision developed by commercial farmers and foresters, it outlined a strategy for working with other communities, and emphasised the need to share access and negotiate conditions of access to resources. They were willing to participate in a platform for resource use negotiation (see Appendix 6).

Meanwhile, the Department of Ecological Agriculture at Wageningen Agricultural University had assisted us by sending out a forester and an ecologist, who spent April to August, 1997 carrying out a design study on Maybole Plantation (van Heck & Barten, 1997). Their study had provided some general information which confirmed that harvesting, burning, riparian zone and soil erosion management, control of invasive alien plants and lack of biodiversity were the major problems to be addressed. In addition they identified problems with the alignment and construction of roads in the plantation, herbicide use and rodent pesticides,

Sakhile Ngcobo (NCMP Agricultural Facilitator) began to work with the Entembeni Community, and later also with nearby Tafuleni and Willowfountain. Willowfountain is technically out of the catchment, as is half of Tafuleni, but the people saw themselves as part of the community, and asked to be involved with Entembeni. A series of meetings were held in the community, and then a series of joint meetings with Mondi, Baynesfield and Umlaas Irrigation Board representation, and these eventually led to the formation of the Upper Baynesfield Subcatchment Committee.

Several meetings with the Entembeni Development Committee during the same period eventually led to a PRA (see Appendix 7). We discovered that there was a farming tradition in the area which had largely broken down over the past twenty years. An irrigation system had existed, drawing water from the upper reaches of the river (Plate 35), and piping it by gravity over a distance of about four km to a number of fields. It was interesting to note that even intensive horticultural crops such as carnations had been grown in the area, which require not only intensive inputs, but also developed market links.

Shortly after the PRA exercise, a joint meeting was held with some people from Entembeni, Mondi's Forester and Baynesfield Estate's Managing Director. Some of the conflicts were discussed, including the lighting of fires, cattle and crime. Regular meetings followed monthly, until in May 1998, the Umlaas Irrigation Board Conservation Officer and NCMP staff met to plan a community workshop which would discuss the establishment of a subcatchment committee. We invited representatives from the Department of Water Affairs and Forestry, who promised to attend, but did not arrive. Mondi, Baynesfield and the Umlaas Irrigation Board pledged their support. Entembeni Development Committee was positive, and the local chief Inkosi Mlaba, was also very supportive. The first one day workshop (Plate 36)

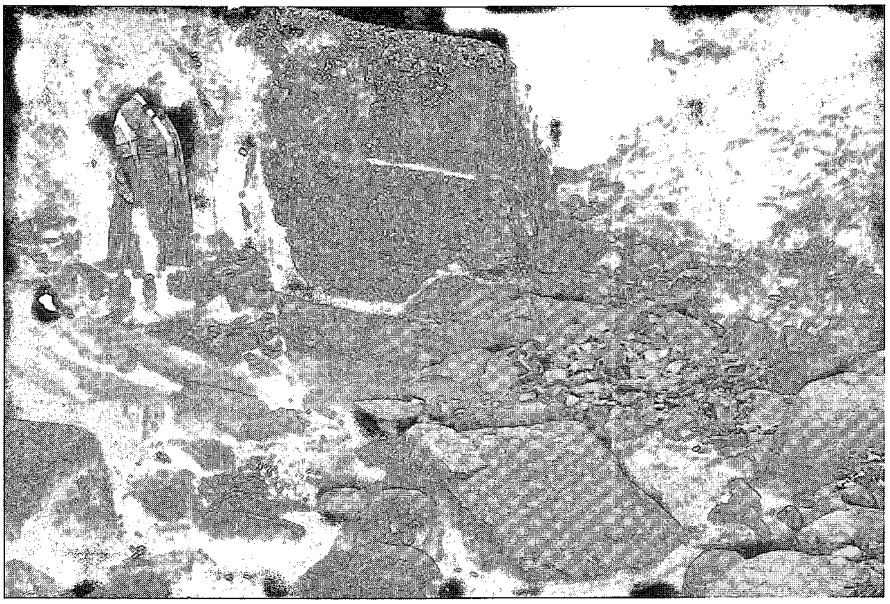


**Plate 35:** **Residents indicate where the old gravity irrigation scheme drew water from the upper reaches of the river, which was then piped to fields below, growing crops which included carrots and carnations for market.**

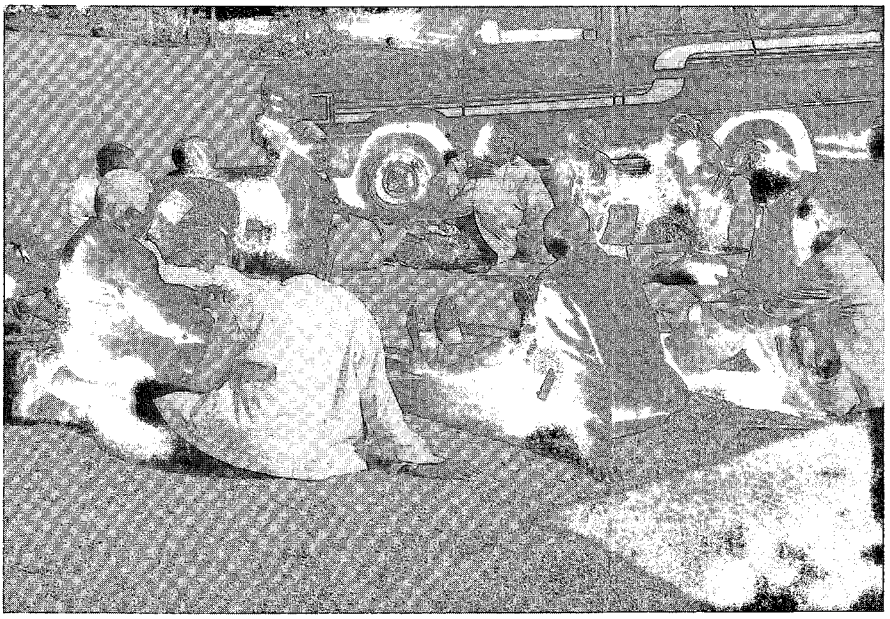


**Plate 36:** **The first meeting of the Upper Baynesfield Subcatchment Committee included people from Entembeni, Tafuleni, Willowfountain, Mondi Forests, Baynesfield Estates, local commercial farmers, Umlaas Irrigation Board and NCMP.**

was held in July 1998. About fifty people attended, including 25 men and 12 women from Entembeni, Tafuleni and Willowfountain. There was much interest in the catchment model, and much discussion of the role of the river in the local economy. Inkosi Mlaba gave a stirring speech in support of cooperation within the subcatchment, and having outlined the work of the subcatchment committee, it was agreed that we would meet again in September. At that meeting, eleven committee members were elected. Criteria for office holders were decided upon, after which a chairman was selected. There was general acceptance that it was important to select on the basis of agreed criteria, rather than simply electing a popular person. Making this point has proved to be an important part of facilitating platform building. Often, groups characterised by diversity choose leaders who have the right credibility credentials, but do not have the skills required to do the job. The discussion reflected in the minutes of the meeting of 7th October 1998 (see Appendix 8) identified the following criteria as important for subcatchment committee Chair and Vice Chair:

- Chairing skills (the ability to challenge a meeting, and to give direction);
- Communication skills (Zulu and English language, telephone, mobility);
- Credibility with a range of the communities in the subcatchment.

After some discussion, the meeting elected Sakhile, the NCMP facilitator, to the Chair. I protested, pointing out that he was not from the local area. A number of committee members very firmly pointed out that he presently lives in the area, that he works in the area, that he is mobile, has access to telephone, and is paid to do a job which they want him to do. In terms of the criteria, he did fit the description better than anyone else, and once again, I had to accept that people were making a pragmatic and sensible decision. Taylor (1998) cautions that often people are expected to carry out a range of onerous tasks in the name of participation which they are not really interested in doing.

A similar process had taken place at Mophela, near Mpumalanga, where Sakhile's work with the local farmers had led to a request for meetings to address local conflicts, and an Conflict Resolution Committee was set up to promote joint discussion between residents of Mophela, Sankontshe and Killarney Valley. These have also led to the recent formation of a Catchment Subcommittee.

### 8.4.3 The results

Mondi Forests and Baynesfield Estates perspective

Mondi Forests is one of the largest commercial forestry companies in the southern hemisphere. Mondi has been very active in defending the role of forestry as an important force for sustainable land management. While Mondi's commitment to environmental conservation has been confirmed by its achievement of Forestry Stewardship Council registration and International Standards Organization 14000 registration, and is reflected in its commitment to applying the Forestry Commission Environmental Guidelines for Conservation Management in Commercial Forests in South Africa (Bigalke, 1995), the management of Maybole Estates in the Upper Baynesfield Subcatchment leaves much to be desired (Auerbach, 1996; van Heck & Barten, 1997).

Mondi Forests has, however, committed itself to implementing a conservation plan, a burning plan and a harvesting plan, together with attending to the poor design of roads on the

plantation and erosion problems on steep land which has already been clear-felled (see photographs). Mondi has been very supportive of Sakhile's work with the Tafuleni community, which is in the process of taking over some State Forest in the Upper Catchment, which Mondi is helping them to manage. Mondi has also offered to manage an area of 40 ha jointly with the Entembeni community as a joint agroforestry trial.

Baynesfield Estate Horticulturalist Athol Currie helped with the design of the agroforestry trial which is based on mixed avocado and arable cropping on the lower area, and on commercial forestry with a mixture of fast growing and slow growing trees on the upper slopes. However, neither Mondi nor the Entembeni community have at this point committed resources to the establishment of this agroforestry trial.

Both Baynesfield and Mondi have helped to establish the Upper Baynesfield Subcatchment Committee, and have regularly attended its meetings. John Kennedy (Managing Director of Baynesfield Estates) and Peter Gardiner (Technical Director of Mondi South Africa) have personally supported the process with their attendance and resources from their organisations.

Entembeni and Tafuleni perspective

Community representatives, including the local chief, Inkosi Mlaba, the local Councillor Mr Madlala, the local Induna Mr Mlaba and members of the local Development Committee, notably Siyabonga Thabede, have contributed to the formation and development of the Upper Baynesfield Subcatchment Committee. Community members have canvassed livestock owners to gain acceptance of the branding of all cattle in the area, and a community management programme whereby local men are paid to herd the livestock of community members in areas agreed to by Mondi and Baynesfield. Joint fire prevention strategies are presently being negotiated, and a joint programme to report crime and cooperate in dealing with criminals is under discussion. Community representatives regularly participate in Committee meetings and report back to their communities.

Although local people have said a great deal about their commitment to establishing gardens and agroforestry activities, their practical involvement has been less than spectacular. Nevertheless, three community gardens and three enviroclubs are now functioning in the area.

The Working for Water Programme

The Umlaas Irrigation Board was able to access funding from the Department of Water Affairs and Forestry Working for Water programme, and they worked together with NCMP on the control of invasive alien plants. Through the programme, funds may be obtained in order to employ local people to control invasive alien plants, particularly near rivers, in order to reduce their unproductive use of water, increasing river flow for ecological, domestic and productive purposes. Although the sporadic funding of the programme has made it impossible to plan activities properly with communities, the possibility of bringing people together to care for the riverine areas has been very useful, and the two existing programmes, one oriented more towards commercial irrigators, and the other more towards resource poor communities, have been able to bring about a very worthwhile joint effort. The injection of funds into rural communities has also had many positive benefits. The Working for Water programme insists that all people employed on the programme should open bank accounts, and should undergo training on the job. This has helped to give some skills (including the financial management

skills which go with operating a bank account) to many rural people in the area. The programme also insists that at least two thirds of employees should be women, and the rest either under 25 or unemployed.

The initiatives in the Mlazi River catchment using Poverty Relief funds in the first three months of 1998 were so successful, that the programme was one of two in the province which were given special extra funding to continue after the poverty relief funding ended at the end of March 1998. The beneficial relationship of the two projects has much to do with this fact. Umlaas Irrigation Board was able to access the money and secure the cooperation of irrigators, who had to be convinced that signing a contract binding them to follow up with invasive alien plant control was in their own interests; many were very suspicious initially, but in the end most landowners did see the benefits. The positive influence of the Board, and of Mondi Forests and Baynesfield Estates, were important in reassuring farmers. The NCMP worked closely with the Board, serving on the organising committee, finding an appropriate person to be Field Supervisor, helping to recruit people who were prepared to work and helping to create a climate which supported the productive use of the time and resources. Although some of the commercial farmers would have preferred to start off working only in areas controlled by private commercial farmers, the organising committee was a sufficiently broad platform to ensure that the interests of the catchment as a whole were kept in mind.

Ten teams each comprising twenty people each were trained and equipped in a relatively short space of time, and covered the entire catchment from the top to Ntshongweni Dam. The Outer West Local Council was also able to secure funding through the programme, and the Summerveld Conservancy fielded another team to work on the Weke-weke subcatchment. This team subsequently continued as a private contracting group, clearing invasive aliens in some of the commercial and farm areas of Hammarsdale, Summerveld and nearby areas.

Working towards a bigger picture

In October, 1998 the committee began to function, and cattle management and fire control have improved substantially, while thanks to assistance from the RTWG, three community vegetable gardens have been established. A major initiative has seen the government agreeing to transfer a section of local state forestry to the control of the community. Mondi has agreed to manage a section of 40 ha adjacent to Entembeni jointly with the community, and the land reform agreement has resulted in land being transferred to a community trust.

The frustrations expressed by members of the Upper Baynesfield Subcatchment Committee, reflected in the Declaration in the minutes of the meeting of 7th October 1998 (Appendix 8) arise from a feeling that all the policy about water management is not leading to the development of new structures which can effectively bring people together to manage catchment resources collectively. Here, where people are doing this effectively, there has been little tangible support from the Department of water Affairs and Forestry. My explanation that it is impossible for Water Affairs staff to attend subcatchment meetings all over the country were accepted, but local people felt that Water Affairs could at least have written a letter of support, and apologised for their inability to attend. In addition, they wanted to see a practical procedural framework through which they could contribute to the development of a catchment management plan, and they were angry that there would not be a Catchment Management Agency for their catchment.

## 8.5 Conclusions and discussion

The above examples of interaction with the quarry, the drum-washers and the landfill site give an indication of the importance of information and communication in understanding and addressing the problems of this complex ecosystem. The newsletter has served as an important vehicle for communicating about issues such as these, and now that biomonitoring information is also included, at least there will be an on-going record of how biological health along the river changes with the seasons and over the years. Moving from education and monitoring to conflict resolution to platform building to collective action is not always a straightforward process. Section 3.6 reported Röling's concept (1997) of "coupled systems" in helping us to develop adaptive resource management. The environmental education activities of the NCMP constitute a series of coupled systems. On the one hand, there are the "hard" (though complex) realities of the biological health of the Mlazi River ecosystem; since it is a complex ecosystem, it is not easy to define precisely which activities lead to which positive or negative results in the ecosystem. On the other hand, there are our range of platforms. According to Röling, coupling occurs through adaptive management which is based on learning, making visible the state of the land, monitoring human activity, negotiated agreement with respect to the norms for sustained use of the land and collective action with respect to the resolution of conflicts. The above description of the environmental education activities of NCMP illustrates how the state of the land can be made visible by monitoring processes which yield information, and by interaction with a range of "social actors", who may be children, teachers, youth leaders, farmers, industrialists, planners, regulators or politicians.

An on-going function of the education process is to try to keep a wide range of monitoring activities operational, so that the interaction of social well-being, economic development and ecological integrity is kept in mind. This can help to avoid Holling's too narrow problem definition (1995, see Section 3.1). For example, a narrow environmentalist perspective could argue that the Mgoshongweni Stream is polluted because of the Shongweni Landfill Site, and that the solution is to close down the site. This would totally ignore the need for Durban's industries to dispose of hazardous by-products safely. Equally, a narrow business perspective could argue that a small alleged impact on a tiny river which does not even flow into the Ntshongweni Dam is a small price to pay for a well-designed hazardous waste facility. This argument could lead to a future disaster if the potential of the site to impact dramatically on the river is underestimated, and if monitoring of the actual impact becomes inadequate.

Farmers in the upper catchment have responded with remarkable openness and commendable investment when pollution problems have been brought to their attention. Most people would rather be seen as responsible landusers, and once the actual state of the land, and the impact of landuse, become visible, resource managers respond by taking some action. However, it is also important that the impact of the response should be made visible. In the case of the chemical pollution of the Sterkspruit by the multinational factory, the initial response was a series of palliatives. When on-going monitoring and peer pressure continued, a more realistic response was at least considered. Positive recognition of responsible management is at least as important. Articles reporting on the LTA Quarry and its environmental management plan, on improvements at the drum-washing plant and on better forestry management in the upper catchment have helped the resource managers involved to justify expenditure to head office in terms of positive public relations and improved cooperation with local communities.

## *PART THREE: IMPLICATIONS FOR THE FUTURE*

This book is written in the middle of an eleven year participatory action research programme. Part One presented the theoretical and contextual framework behind the organisation of the programme. Part Two described the design questions, design objectives and the actual design for four aspects of participatory catchment management.

Part Three examines the implications of the past five years of work, firstly for the people of the Mlazi River catchment area, secondly for the NCMP Team and the University of Natal's Farmer Support Group of which it forms a part, and finally for Integrated Catchment Management and Landcare in South Africa. Recommendations for future work in the catchment, for the future of NCMP and for implementation of government policy aimed at improving the quality of life of all South Africans emphasise necessary conditions for collective action, support requirements and appropriate institutions.

## Chapter 9: LESSONS LEARNED

The first two chapters of this book emphasised participation, the balance of hard and soft systems, of technical products and social processes, and the importance of local leadership. The third chapter emphasised the importance of various aspects of design in a research journey such as the NCMP, where the agenda is an open one, to help people to identify their problems, and to help them deal with these problems. An open agenda does not mean a programme without structure, and it is the structure of conscious design processes within the a participatory action research approach which helped to give form to the programme, stimulated on-going critical reflection and made for a rigorous process. The conceptual framework presented in Chapter 3 has thus provided a methodology to guide this research journey, and give some direction and focus among the myriad activities. The fourth chapter provided the contextual framework - there is political will for a change of approach, and there are some resources to help uproot poverty and to begin to build a land and water care ethic.

However, one of the fundamental learnings which comes through all of the work of NCMP is that no person can develop another person. Each stakeholder has to do it for him or herself.

In reflecting on the process, the experiential learning cycle remains a guideline (Figure 4). My own concrete, subjective experience is the base on which I build my view of reality. Reflecting on my experience can give me insight into the nature of the experience. If I remain in my little world, I reflect on that. If I move from independence to interdependence, then, like the FSG Field Praxis meetings, my own experience can be enriched by the experience of others, and an inter-dependence can emerge.

Subcatchment platforms take this a step further, from a group of colleagues reflecting on their work, to a group of people who live in the same area, and share a mutual dependence on a river. First, they learn about the area as individuals, from their own perspectives. Like Plato's Allegory of the Cave, they see the world dimly, and only in part. If they can find the courage to let go of their own comfortable secure world, and wonder about how others see the world, they move into dangerous territory.

When I climbed Cliffdale Hill, I left the predictable safety of my own little "Subcatchment 3", where my main worries are what comes down the hill from subcatchments 1 and 2, what is spilled on our bit of highway, and what my bank manager has to say about my overdraft. That is all very interesting to me, but it is a small world. On the hill, I could see MaShelembe's perspective, as well as the difficulties of metropolitan planners and Hammarsdale industrialists. Already, I stood on a relatively elevated platform, but I stood there alone. The move from the physical world of "my farm" to the social world of "our subcatchment" needed a visionary leap into the world of "wouldn't it be wonderful if...?"

As Argyris, Putnam & Smith (1985) point out (Box 4), it sounds sensible to think before you act, to plan sensibly, but you can't learn to swim without getting wet. Theories developed away from the field of action are usually inappropriate. "It is necessary to act and then reflect in order to discover what reasoning informed the action. A second and more generally recognized reason for acting "first" is that action serves as a means for exploring a situation. Action produces information that can be used for the design of future action".

Röling's steps in platform building (see Figure 10) trace a process of exploring, interacting, planning and taking collective action, and using this approach NCMP has set up hundreds of opportunities for people to engage in a process of public reflection. Some have accepted the challenge, others, for a wide variety of reasons, have not. Not everyone likes my view from Cliffdale Hill, and no doubt some will build their own platforms, and some will carry on, content with their own personal perspective.

Over the past five years, the NCMP team has had the privilege of looking at life from many hills, with many diverse actors in the local, regional, national and global dramas. We have witnessed "critical events" of many types (Long, 1997), ranging from excited small faces shining with the experience of placing a drop of water on a leaf, and looking at the beauty of this small miracle of reflection and refreshment, to gun-toting, angry local politicians, who will only tolerate us on their platforms on their terms. On the whole, it has been a refreshing surprise to recognise that most of the people in the Mlazi River catchment area do care about their catchment. More than that, they have showed that they are prepared to take action, even if it means some hard work.

Figure 15 shows that NCMP is currently involved with 4 subcatchment committees, 9 conflict resolution platforms, 20 school enviroclubs, 18 community gardens and 5 craftgroups. Each one of these activities has some local people who are prepared to do something practical to build the nation, rather than complaining about corruption, crime, taxes and the cost of living. Each small step in the service of others frees one from the bondage of "my own small world". It may appear comfortable, but it can be a very ugly place.

What did we learn about leadership? It was quite a startling statement "the true leader leads because he obeys" (MacLaren, pers. comm., 1994). Yet it has proved to be so. When team members faithfully respond to the needs which are put before them, people in the community work together to achieve a common purpose. As soon as the agenda becomes "my power" or "my wealth" or even "my importance", people are not very interested in becoming involved.

In reviewing our activities and what we have learned, the process of conceptualisation remains dangerous, as it is prone to force complex situations into convenient, plausible oversimplifications. However, in reflecting on the work of the past five years in the light of government policy on catchment management and Landcare, and also on environment, health and education, a few considerations will be highlighted concerning the implementation of these policies, and their potential for helping rural people to become more confident, access skills, and live in a wider world.

Having looked at some technical innovations developed on an individual small farm in Chapter 5, seen how community gardens were supported in Chapter 6, mostly with good results, though not always so, and having looked at the importance of environmental education in Chapter 7, the eighth chapter looked at the process of platform building within the catchment. The complexity of activities related both to ecosystem complexity and to the complexity of social learning processes.

Synthesising technical and social information from a range of disciplines, bringing together a range of perspectives of various "social actors", building a respect for the truth and a humility

concerning any individual's ability to see the whole truth, the leader must be open to inspiration, and must seek out the opinions of the wise. This gave us an overview of design as synthesis, design as social learning and design as visionary leadership (see Figure 11).

Chapter 4 outlined the context within which NCMP functions, including the aridity of sub-Saharan Africa, food security at household level, the policy of participatory resource management of the South African government, the need for adaptive resource management and the physical resources of the Mlazi River catchment. Chapters 5, 6 and 7 built on these foundations, and bring us to the process of platform building itself.

## 9.1 What did we learn about community participation?

### 9.1.1 Discovery learning and catchment identity

The excitement of finding out for oneself is an experience that most of us have had at one or another time. Sometimes it happens spontaneously, that one stumbles upon something new. At other times, one works in a disciplined way, as a researcher, developer or designer. Most often, however, there is a teacher guiding the process of discovery.

Facilitating discovery learning requires preparation and an intimate familiarity with the problems one is trying to help people investigate. Sometimes the discovery learning curriculum is exactly known, as with the work of Hamilton (1995), where his use of a rainfall simulator, a soil corer, tools to discover *How wet* a soil profile is, the *Fallow management game* and the economic analysis tool *With and without* were carefully managed to take participants through a range of discovery learning processes which enabled them to understand much about soil structure, moisture holding characteristics of soil, and aspects of production economics. Hamilton explains that an important part of the process was allowing the participants to discover exactly how the tools operate. While they remained "black boxes" there was much scepticism about their practical relevance to the situation of participants, but once they had been thoroughly investigated and understood by the farmers themselves, their relevance was clearly understood. The curriculum requires joint development by "clients" and "facilitators", who learn together as they discover together. Once a curriculum has been developed it may be applied in other situations as a learning tool.

In discussing the development of learning tools and the changed role of scientists in constructivist approaches, Hamilton points out that it is often not easy for scientists to relinquish their status as "Technical expert" to become a facilitators in a process in which they are not experts, but helpers. The tools must be used by the participants, not demonstrated to the participants. The learning process should support decision making in the context where the decisions are made. Rather than trying to capture the decision-making process in a positivistic sense, the constructivist approach emphasises the need for both scientists and clients to understand the decision making process. This helps clients to develop their own strategies to cope with unexpected circumstances, and scientists to understand how they can better support the process.

In NCMP, we have had some successes in helping people to learn about the catchment. Many visitors to Bachs Fen have been able to see some of the processes at work in the catchment, including soil erosion, wetlands and their purifying and water storage effects, swales, mulches

and compost. Simply lifting up a layer of mulch on a hot day, and comparing the dry, hard soil exposed to the sun to the moist, soft soil under the mulch blanket is a learning experience that few people can forget. The use of the River Action water testing kits in our School Enviroclubs has also led to some exciting discoveries for both experts and children. Finding out what creatures live in the river where it is clean and how this changes once the river is polluted is a major step in the development of ecological understanding. Tools of this sort lead towards "an ecology of education" (Auerbach, 1972). The farm visits which Angus Burns has organised for members of the Subcatchment Committees in Tala Valley, Lower Baynesfield and Upper Baynesfield are also good examples of collective discovery learning, where farmers share their experience to develop an understanding of problems or successful strategies within their subcatchment. Thus the farmers themselves have become facilitators for the discovery learning process.

An important discovery about discovery learning within the catchment has been the value of careful facilitation of the learning process. A good learning process takes time and thorough preparation. In general, our preparation was not nearly thorough enough. This is partly because of the size of the area, and the number of people with whom we interact, but is partly also because of a tendency to value the quantity of activities more highly than the quality of activities. It is also tempting to use, as an excuse, the "politically correct" explanation that participants must discover everything for themselves. Taylor's comment that people are often dragged into things which do not interest them is important to remember. The "new orthodoxy" can expect resource-poor people to do all the participating, all the preparation, all the discovery and all of the collective action to address national resource conservation problems. It does not work, nor should it be the expectation of policy makers or resource managers that this should happen. If experts become facilitators, then they themselves become a part of the learning process, a part of a dialogue. They are then no longer "doing it to others", but rather "doing it with" them.

Nevertheless, there is tremendous scope for discovery learning within the catchment, and the NCMP over the next five years has the challenge of developing learning tools and facilitating discovery learning processes which help catchment residents and visitors to discover how to care for the catchment while reducing risk and increasing productivity, and establishing a more sustainable process of personal and local development.

### 9.1.2 Planning feedback processes

In Section 3.10, we heard of the steersman after whom cybernetics is named. All of us, like the steersman, periodically assess whether we are "on course", and the feedback is used for both self-regulating and self-reinforcing "course corrections". A simple example comes from my experience of being a parent. Often, it takes my question to my son "Aren't you hot in that jersey?" to make him consider whether he is too hot or not. Having thought about it (sometimes while beads of perspiration roll down his cheeks), he decides on self-regulation ("Yes, I think I'll take it off") or on self-reinforcement ("No, I'm fine, thanks"). Learning about facilitation has at least taught me that a direct positivist instruction such as "It is cold - put on a jersey" is what a parents say when they themselves are feeling cold!

On the one hand, the danger of "acting the expert" has become very clear, both in parenting and in facilitating collective action in the catchment. On the other hand, one needs to be

conscious of the fact that the constructivist strategy of asking the question "Are you cold/ hot" is also an intervention which may trigger a response designed more to please the questioner than to solve a real problem. Knowing when to issue directives, when to ask questions, and when to remain silent is the skill of a good facilitator, and it requires awareness, truthfulness and a dedication to service.

Within the NCMP, one of the major feedback processes which we have developed is the biomonitoring programme. Observing what the river and its immediate inhabitants are telling us about the impacts of our activities is indeed useful feedback; communicating this information to residents and resource managers is often not so easy. We have developed our Mlazi River Catchment Newsletter, and the excellent work of our ecologist and the Conservation Officer of the Umlaas Irrigation Board Catchment Management project has been an essential part of this process. Good layout of this information is also important in making it accessible, as has good translation into the Zulu language, which is spoken by the vast majority of residents in the catchment. Effective distribution of the newsletter is still a problem, which has been partially addressed by the growing number of School Enviroclubs in the catchment. Many of the garden groups share the newsletter by reading it at their meetings, and in this way it can also reach those who have not yet acquired literacy skills. If the contents of the newsletter are shared with a class by an enthusiastic teacher, discussed by concerned students, and used to inform collective action, then the feedback has been effective. This is not yet the case in the Mlazi River catchment, which is why we need to develop ICM further over the next five years.

The evaluations of the three community gardens were another form of feedback, and they were found very useful by staff, although they required a good deal of planning to set up, and patience to endure, sometimes. Judging the school community gardens for the first competition was a rather formal type of feedback, but it did help me to realise that as time has progressed, I have spent less time in the field, and more time on staff management issues, project proposals, reports, and scientific writing. Feedback from my family is that this makes me crabby and boring to be with. So, all round, there are some course corrections to be made.

### 9.1.3 Addressing constraints to development (poverty, aridity, land, leadership)

Poverty, aridity, access to land and leadership were mentioned in Chapter Six as the major constraints to the development of small scale farming. Poverty is in itself feedback about the relationship of people and their environment. Nature produces an abundance sufficient for all, there is no shortage in the world of adequate food, shelter and meaning; the problems are human greed and ignorance, resulting in some having too much, and some living in poverty (MacLaren, 1971). Wisserhof's description of lifestyles at EZakhiweni illustrates what poverty looks like in practice in the Mlazi River catchment. Its effects on blocking development have been discussed in Chapters Six and Seven. Tradition, lack of selfless leadership, power relations, ignorance and greed seem to contribute to the continuation of poverty as self-reinforcing feedback.

One of the major challenges in building a new South Africa based on truth, dignity and justice, is how we deal with this cycle of poverty. The Department of Education has recognised that one vitally important aspect is providing resources for resource-poor schools. Although many complaints are being eloquently voiced by affluent parts of society, who see the standard of

education dropping in the schools to which their children have access, upgrading education in resource-poor areas is one of the most essential strategies for addressing poverty in South Africa. However, the provision of physical resources is relatively ineffectual unless the inspiration of good teachers accompanies provision of infrastructure. In the United States of America, children were bussed to schools in different communities. Opinions are still divided as to how effective this process was in combatting the effects of racial prejudice, and there seems little doubt that there were major costs, both in terms of transport costs, and of stress to communities and students. It is probably more practical to provide special incentives to teachers to encourage highly qualified, innovative teachers to teach in resource-poor areas.

Special attention will need to be given to allowing more teachers to be appointed at these schools. My experience of trying to teach a class of eighty about the hydrological cycle was sufficient to convince me that discovery learning in such a situation is very difficult to facilitate! The remarks of Jiggins about the importance of educating girls and women should be borne in mind in this process. Pro-active development of schools with good teachers, good libraries, good laboratories and good physical infrastructure is one of the most powerful investments in the future which the country can make.

### 9.1.4 Leadership and the service ethic

National policy on Landcare and ICM will have to find a range of ways to stimulate local leadership and to develop a service ethic. As Versveld & Nduli put it (1998) "A national Landcare Programme calls for a national effort .... the logical home base for such a movement [is] the National Department of Agriculture and the Directorate of Agricultural Resource Conservation ... The Department of Environmental Affairs has taken on the Convention to Combat Desertification, and the Department of Water Affairs the National Water Conservation Campaign and Integrated Catchment Management. Each of these initiatives has a vital role to play and all would be first line beneficiaries of a community-based land management movement." It will be important to organise structures in such a way that the three initiatives mentioned by Versveld & Nduli can interact effectively, to promote synergy, rather than cause endless meetings leading nowhere.

These policies will have to find ways of involving local landusers (*Ibid.*) "The key to community-based land management is that all land users can be empowered to care for their own environments through knowledge and understanding". But simply writing policy is not sufficient. Finding practical means to support the emergence of small scale ecological farms will require practical measures which address the constraints: aridity, poverty, access to land and leadership which facilitates, rather than dominating.

### 9.1.5 Platforms and coupled systems

In bringing people together into new structures which promote collective action, Röling's approach to platform building was found to be effective (see Figure 10). The process has much in common with Holling's four ecosystem functions, being a dynamic process depending on available resources and connectedness (see Figure 7). However, initially it is certainly not self-regulatory, and our role as facilitators is still crucial in keeping the process going. How long our input will be required is uncertain, and it is also not clear whether the Department of Water Affairs and Forestry will give any support to such local-level initiatives. Capra (1996) argues that as networks develop, they become increasingly self-regulating, "because the

consequences of a mistake will spread through the network and return to the source along feedback loops. Thus the community can correct its mistakes, regulate itself, and organize itself". The concept of networks has not been extensively explored by social scientists. In my view, Capra is rather optimistic, and the self-regulating property of networks is only likely to be valid if there is effective facilitation in helping collective action to address prioritised needs effectively.

Helping the Upper Baynesfield Subcatchment Committee to develop criteria for selecting office-bearers rather than simply electing a popular person, is an example of the kind of role that resource people with facilitation skills can play.

Platform building, as a special application of the experiential learning cycle (Figure 4), has a slow lead-in exploratory phase. In the NCMP, this phase has been approximately three years. Building up networks (connectedness) in an area is a slow process, but a vitally important one. Although employing local people is not without its difficulties, the fact that Sifiso, Barry Thami and I came into the programme with diverse established local networks greatly facilitated the development of many of the platforms which have been established. The exploratory phase of platform building leads to interaction (Figure 10), and this is often characterised by the surfacing of many conflicts, especially in a situation as loaded with inequalities and injustice as South Africa.

Dealing with such conflict is very demanding on facilitators, who often bear the brunt of local anger, in the absence of more appropriate targets. Even when conflict resolution is able to bring opposing groups together, as it must eventually do if there is to be interaction, tensions from different perspectives have to be internalised by the facilitator and transformed into processes for using the energy of engagement to move from confrontation to joint problem appreciation and then to collective planning and action. Providing adequate resources for this process is an important ingredient of success.

A good example of this was provided by the Integrated Development Planning process of Durban's Outer West Local Council (OWLC, 1998 a & b). A highly diverse range of local residents were brought together in very pleasant surroundings and presented with a range of perspectives on local development. There was much heated discussion about the current situation, and many honest but emotional reflections about the current problems. A good process with adequate facilitation then allowed a range of perspectives to surface, and provided for interaction between people from different backgrounds. For many, it was clearly the first time that they had spoken about the past, the present or the future with members of such different groups within their geographical area. *Apartheid*, of the ideological, the cultural and the economic varieties, has been highly successful in compartmentalising South African society more rigidly than many others.

The Outer West's Integrated Development Plan and the Durban Metropolitan Area's Open Space Plan, Environmental Education Initiative and Environmental Management System (DMEPI, 1998) are examples of how platforms can be constructed to involve people in collective planning. It is hoped that these will lead to structures which promote collective resource management, but this will require quite a radical shift in resource allocation for Durban's Local Agenda 21 Programme, and for the city's environmental management in

general. Durban's Twin City, Rotterdam, employs more than a hundred people in the Environmental Planning department, and as many again in the Environmental Development and Regulation section. Durban Central's Environmental Section at the beginning of 1998 had four staff members.

The appointment of an Environmental Officer for each of the six Local Council areas is already a major step towards facilitating local collective action, and the establishment by Durban's Outer West Local Council of a Local Environmental Advisory Forum is another major progressive step. NCMP has been able to help the Outer West in communicating with some of the resource poor communities through community garden committees and school enviroclubs, and we have reported back through the Mlazi River Catchment Newsletter about these exciting developments. Local gardeners such as MaShelembe Ndimande, Mrs Cebekhulu and Mrs Meyiwa have commented on how exciting participation in local discussions has been, and the significance to them of attending provincial gatherings such as the Farmers' Summit organised by the KwaZulu-Natal Department of Agriculture, and the launching of the multi-racial KwaZulu-Natal Farmers Union by President Mandela.

Such participation at local government and provincial level would not have been possible without the development of effective garden committees, and local structures such as the Mpumalanga Environmental Forum. When we tried in 1995 to get local people to attend the National Energy Summit and the National Agricultural White Paper workshop, local people were too frightened to attend. I attended both of these gatherings accompanied by rural people from areas where I had previously been involved in platform-building activities.

These initiatives represent first steps in the emergence of coupled systems (Section 3.8), where interaction between planners and residents leads to the state of the land becoming visible, human impact being monitored, agreement on future action being negotiated and collective action taking place. In the case of the Upper Baynesfield Subcatchment Committee, collective action has taken place already, in the form of the joint action on controlling invasive alien plants (with the help of the Working for Water programme), the programme to brand all cattle in the Upper Baynesfield area, and agreement on their management, and joint forestry activities at Tafuleni and Entembeni between local people, Mondi Forests, Baynesfield Estates and local commercial farmers.

Representation will never be perfect for such processes, but it is preferable to have an evaluation of EZakhiweni Garden attended by negative local politicians who complain loudly, and to have an angry representative with a gun on his hip speaking at an EZakhiweni craftgroup function which he feels threatened by, rather than to have the actual re-emergence of violence and separation. Uncomfortable though they were, the garden evaluation and the craft exhibition (Chapter Six) were platforms, where exploration and interaction took place. Moving on from exploration and interaction to joint planning and collective action is sometimes slow and sometimes immediate, and steadiness and good facilitation are required to help angry people to transform anger into understanding and commitment.

## 9.2 What did we learn about managing the process?

One of the difficulties with ICM is the range of scales at which one works (Campbell, 1994): at field level, the starting parameters are mainly agronomic, and the time frame is usually several seasons. At farm level, the starting parameters are micro-economic, and the time frame stretches over human generations. At catchment level, the starting parameters are ecological, and the time frame is hundreds of human generations. For the region or nation, the starting parameters are macro-economic, and the time frame is limited by political and economic planning horizons. Globally, it should be remembered that once again, the starting parameters are ecological, and the time frame is indefinite.

### 9.2.1 Multi-disciplinary teams and participatory action research

As mentioned in the previous section, building networks takes time. During 1994, I as a local person was able to lay the foundations of a communication network which allowed the workshop to produce a rich, diverse picture of the catchment in November 1994, helped the Water Research Commission to take the research proposal seriously, and led directly to contact with groups with whom Thami, Barry and Sifiso were in contact. When we then advertised for our first staff members after the proposal had been approved, we were able to attract applications from these three people who were already locally involved.

Help from Nonhlanhla Kunene of Msinsi Holdings in selecting staff was invaluable, also in the later staff appointments. Only one other member of the team had formal research experience (Barry was working on his MSc research when he joined us). Like many other colleagues at FSG, some members of the team were rather sceptical about research in general. Other University colleagues took the opposite view: FSG's activities cannot be dignified with the designation "research" they argued, due to lack of precision and control. In spite of the commitment of the Executive of the University of Natal to "becoming a learning organisation critically coupled with its environment" as Bawden (1993) said it should become, most senior researchers remain committed to excellence in their discipline rather than relevance to transforming South Africa into a better place.

The tensions of managing a multi-cultural, multi-disciplinary team which was also young and mostly fairly ambitious were not quite as severe as the tensions in the community. Although the four tasks of a leader (de Vries, 1998) only came to my attention in writing this book, the points made about vision, appropriate structures, community values and personal growth are highly relevant to the management of the NCMP Team. Our two strategic evaluations, our FSG organisational development workshop, and our strategic planning workshop were all facilitated by exceptional people from outside the organisation. Like Wiener's *Kybernetes* the steersman (see Section 3.10), these course appraisals helped us to decide where we needed self-reinforcement, and where self-correction. This feedback was invaluable in keeping in mind that our programme goal was not "fixing the catchment" nor publishing myriad research papers, but "community participation in catchment management".

Some of the bureaucratic feedback which forced us to report and meet together, and to follow financial procedures which often appeared overly restrictive was not particularly welcome at the time, but given the wisdom of hindsight, this feedback too, reflected the changes in NCMP

from a pioneer group to a larger organisation requiring structures for efficient and accountable administration. As a relatively inexperienced manager, I could not see this myself at the time. Issues such as the employment of local people without proper appointment processes, use of private equipment and premises and conditions of service were all issues which gave rise to some uncomfortable situations, increasingly as the programme grew.

This is likely to be a problem in other similar ICM and Landcare programmes. On the one hand, it is essential that there be local flexibility in adapting to the changing demands of an unfolding process of problem identification and local activity, which is highly unpredictable. On the other hand, there is always the danger of nepotism, misappropriation of funds, lack of accountability of programme staff and manipulation of community perceptions of what is needed locally. The policy and supportiveness of the South African Water Research Commission staff was exceptionally helpful here. There was a complete willingness to allow programme resources to be used where they were required, only moderated by insistence that proper authorisation of expenditure and good accounting procedures were followed.

The rigour in recording our work and reflecting regularly upon it which the participatory action research approach demanded were important to maintaining our focus, and have been very valuable in helping to produce this book, and the opportunities provided to discuss our work with a wide range of practitioners from various places and disciplines has enriched the insights which this analysis of the NCMP has been able to develop.

### 9.2.2 Personal growth as a goal of learning organisations

The Accompaniment process at FSG has been described as part of the discussion on *Praxis* in Chapter 3 (after Box 4). This process was important in attuning the goals of the University of Natal, the Farmer Support Group, the NCMP and individual staff members. The capacity of individual team members to see our work in the light of national policy and development has grown remarkably with each opportunity for reflecting on the significance of our work. One staff member came to me on five separate occasions (after our strategic planning meeting, after our organisational development workshop, after the Entembeni PRA, after the Upper Baynesfield Subcatchment Committee Community Planning Workshop, and after the community garden evaluation), to comment how he had never understood the meaning of each of these terms until he participated in the process. On two occasions, he commented that the insights gained would stay with him for the rest of his life.

Most of the NCMP staff are under 30, and a better balance of experienced and younger staff would possibly have produced less tensions, though it would have probably cost more in terms of salaries. The training aspect of a programme such as NCMP is also of considerable importance, especially when many of the team members are local people, whose training will directly benefit the local area, both in terms of available skills and in terms of increased earning capacity. The role models provided by local young people who serve their communities effectively and accountably is also important, especially in a field such as agriculture, which tends to have a low level of esteem among many young people.

### 9.2.3 Communication

Local networks and local staff contribute to communication, but the construction of the physical model, the production and distribution of the pamphlet "Do you care about your catchment?", and the development of the Mlazi River Catchment Newsletter were important factors in spreading awareness of the problems within the catchment, and of helping to focus attention on collective action to tackle these problems. Publicity for both negative and positive activities has been important. Some organisations only agreed to take action after negative aspects of their behaviour were publically reported, while others were more pro-active. In all cases, any positive activities, from whatever quarter, have been reported as positively as possible, and this has helped to establish a reputation for NCMP as a problem-solving resource. In view of the need for us to take a stand on certain occasions, whether against unreasonable behaviour from the Department of Water Affairs and Forestry, unethical behaviour by local businesses or unaccountable behaviour by individuals, NCMP has not been universally popular, but we have earned a measure of respect as a group dedicated to sustainable natural resource management.

The evolution of the NCMP team from one member with a vision (1994) to four (1995-96) to ten (1997-99) saw a corresponding need for organisational development from a pioneer to a bureaucratic system. Administrative procedures became necessary after the 1997 appointments, whereas before that time the group was small enough to communicate spontaneously. Under-provision for staff training requirements was a serious short-coming of the budget, especially if one takes the four tasks of de Vries (1999, see Section 3.10) as the basis of organisational leadership (task 4 - motivating and mobilising colleagues so that personal development of colleagues becomes a goal of the organisation). Since the Employment Equity Bill requires that black staff from disadvantaged backgrounds should be assisted with career development training, the legal requirement becomes an added impetus towards staff development. At the same time, lack of funds for staff training did force us to prioritise, and to keep the emphasis on service to the community, rather than self-improvement. Unfortunately, the current climate does sometimes lead to the emergence of a "culture of entitlement". The negative aspect of this tendency also requires firm and balanced management, if resources are to be used for the benefit of resource-poor rural people, in accordance with the Mission of FSG (see Appendix 1), rather than mainly for the benefit of programme staff. The tension between staff development and service to clients seems to be a fairly widespread problem in South Africa today. Accountability within such a team as ours requires the development of values of service, reliability and integrity which can be expected from professionals.

In fact the team did not start off as a team of professionals. Training backgrounds varied from one year post high-school to post-graduate qualifications, and experience varied from no experience in development or management to thirty years of experience. Just as external tensions have played their part in complicating the development of effective ICM, so internal tensions kept us awake to the need for personal development based on progress towards agreed objectives. The FSG mentorship approach was an extremely useful management tool in this respect. Staff choose a mentor in consultation with their supervisor. Within NCMP at present, I act as mentor to all NCMP staff, while the FSG coordinator is my mentor. Each staff member writes an Accompaniment Report every three to six months, reviewing their

work, reflecting on what has been achieved, reflecting on positive and negative aspects of the work and setting out a plan for the next period, including support needed and possible solutions to problems. The mentor then discusses the report in a confidential meeting with the staff member, and raises whatever ideas or concerns seem appropriate. After discussion, new objectives are decided upon, and minuted. If appropriate, a Memo is drafted for circulation, while the minutes remain a confidential record of the accompaniment, available only to the staff member and the mentor.

This dimension of personal development helps facilitators to integrate our own learning as a part of the process of co-learning within a catchment. The process runs at a level of scales here too: at farm and community level, people learn about farming and community management. The NCMP has helped to initiate a process of learning about subcatchments and catchments, and nationally, South Africa may follow other countries in learning about catchment management and land and water care.

## 9.3 Implications for ICM and Landcare in SA

The Ntshongweni Catchment Management Programme was funded by the Water Research Commission in order to show how community participation in integrated catchment management can be brought about in South Africa. The programme has certainly succeeded in achieving a high measure of success in stimulating community participation at local level. The question of effective operationalisation of government policy at provincial and national level is far more difficult to address, given financial and human resource constraints. However, a few fundamental guidelines can be given towards a framework for ICM and Landcare in South Africa.

Integrating government efforts

Progress in South Africa's rural areas requires that local people find ways to build their confidence and skills, in order to improve their terms of trade in the economy, as creative and productive human beings. Water and high potential land are scarce in South Africa, as the 1995 White Paper on Agriculture (Department of Agriculture, 1995) points out. Ensuring equitable access to these resources is one of the main objectives of agriculture and water policy, while caring for theses resources is in addition, an objective of environmental and education policy. The new Water Law (Act no 36 of 1998) provides for community management of catchment resources through Catchment Management Committees and Agencies. The new Agricultural policy discussion document (Department of Agriculture, 1998, version 3-3-99) sets out to strengthen agricultural research aimed at helping small scale farmers, in particular to tackle food security and drought. The policy objectives call for the reorientation of applied research towards the requirements of small scale, resource poor farmers, with a stronger emphasis upon extension and farming systems research, and on environmental protection. The top research priorities are listed as Land care, soil and water management.

Water is seen as the most valuable of agricultural inputs, and the implication is that "agriculture must change to more rational, economic and sustainable cropping and water-use patterns". The implications of the new Water Act are mentioned, and the provision they make

for Catchment Management Agencies and for Water User Associations, but the Discussion Document then proposes that separate Irrigation Action Committees and Agricultural Water Liaison Committees should be formed to develop decision-making procedures and criteria, so that resource poor farmers can be assisted in gaining access to water and finance. Unless the Departments of Agriculture and Land Affairs and of Water Affairs and Forestry can find more efficient ways of helping rural people to work together, integrating water and land management, little efficient service delivery is likely to result from the policies, which are both excellent in themselves, simply because they lack coordinating mechanisms. Rural people cannot be expected to attend meetings of several departments, each at local, provincial and national level, not can government afford to carry out such processes, except in a few expensive pilot trials.

Rainwater harvesting and ecological agriculture

Neither agricultural nor water policy have recognised the importance of rainwater harvesting, with its potential contribution to productivity, equity, conservation and therefore to sustainable development in South Africa. Research on Bachs Fen Ecological Research Farm has demonstrated that swales, mulches, compost and wetlands can transform marginal land into irrigated and thus potentially highly productive farming systems. Ecological integrity of the catchments can be enhanced if the emphasis of the farming system shifts from a short term production orientation to a more balanced approach including the perspectives of productivity, equity, conservation and sustainability. International experience shows that appropriate economic instruments can encourage this shift, but that current approaches actively discourage it.

Support for local subcatchment development committees would be the logical way to integrate the efforts of government in rural areas. The experience of NCMP has shown that given sensitive support and a participatory action research approach, local communities, black, white and Indian, small scale and large scale, with agricultural, forestry, conservation, industrial and urban land uses, whether old or young can come together to form platforms for resource use negotiation which are likely to lead to sustainable development.

## 9.4 Conclusion

The research question posed in Chapter One was "How can diverse communities often characterised by conflict, be helped to come together to learn about natural resources and systems, and to manage them collectively in a way which is productive and responsible?"

In terms of a conceptual framework, technical, social and transcendental aspects were examined. These translated into strategies for dealing with production in an arid and resource poor environment, strategies for bringing people together to learn about their environment, plan for the future and take collective action to manage resources sustainably and strategies for supporting local leadership and the development of local values and vision for the future.

Four design objectives were formulated in order to address aspects of the research question:

a What strategies are available to help improve food security in a way which addresses aridity, poverty and restricted availability of land?
b Are there effective methods of producing good yields of crops without resorting to the levels of fertilisers, poisons and other technologies which have produced the environmental problems currently being experienced in Europe?
c How can Bachs Fen become more useful as a teaching facility?
d Can School Environmental Action Clubs effectively involve school children in caring for their local environment?

Rainwater harvesting, water conservation and ecological farm design constitute effective strategies for accomplishing design objectives a and b (Chapter 5). Since short term production has led to land degradation and desertification in many countries including South Africa, it would appear irresponsible to ignore the impacts on the resource base of short term approaches, whether based on high inputs of fertiliser, poisons and other technology, or on unsustainable low-input production strategies (Chapter 6). Local leadership is an important factor in achieving objective a, and is essential for objective b.

Establishing a teaching facility (objective c) requires the transformation of Bachs Fen from a private farm to a research and education foundation, with appropriate facilities for stimulating discovery learning by visitors, as noted in the conclusion to Chapter 5. School Environmental Action Clubs can involve children in caring for their local environment (objective d), but this also requires local leadership to guide students through a process of discovery learning (see conclusion to Chapter 7).

Subcatchment Management Committees appear to be effective platforms for resource use negotiation (General Research Question), but they, too, require local leadership in developing joint values and vision. Platforms can take many forms, and outside facilitation is very important in bringing people together, especially where there is a history of conflict.

Conflictual situations, predictably, resulted in some of the attempted developments failing or being only partly successful. Nevertheless, communities did come together to a remarkable extent in spite of conflict, and through exploring and learning about local natural resources and ecosystems, there has been some joint planning and some collective action directed towards sustainable management of natural resources. Sustainable development is not a goal with an achievable end point, but an on-going process of discovery, moving towards an understanding of complex ecosystems. It is hoped that NCMP will be able to work with residents in all parts of the Mlazi River catchment area to help improve the management of natural resources in such a way that productivity, equity and conservation lead to an improved quality of life for all while safeguarding natural resources for future generations.

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## APPENDIX 1: FORESTRY DESIGN

The International Tropical Timber Organisation (ITTO) agreed in 1990 to adopt objective 1(h) of the International Tropical Timber Agreement of 1983, "To encourage the development of national policies aimed at sustainable utilization and conservation of tropical forests and their genetic resources, and at maintaining the ecological balance in the regions concerned" (International Tropical Timber Organization, 1990). In its Guidelines for the sustainable management of natural tropical forests, 41 principles and 36 possible actions are outlined (Box A1) which are intended as a basis from which national or regional guidelines can be developed.

South African guidelines have in fact been developed, and both the international and the South African guidelines will be reviewed briefly before discussing ecologicallly sound forest design more generally. The ITTO principles were developed for natural tropical forests, but they have much in common with sustainable forest plantation management. The South African Forestry Industry Environmental Committee developed "Guidelines for environmental conservation management in commercial forests in South Africa" (Bigalke, 1995). These guidelines set standards for site preparation on varying slopes, discourage planting close to the edges of cliffs or steep slopes, provide that commercial species should not be planted closer than 30 m from a permanent stream or 50 m from a wetland and recommend that residue should be spread and left to decompose, or if this is impossible, should be stacked in piles and burned under conditions favouring a cool fire. Existing watercourses and waterways should not be planted up. Long term planning of weed control should be integrated with wildlife management, and biological control of weeds and pests should be employed where possible. Compartments should be planned so that natural areas are linked with one another by corridors, and a mosaic of different aged compartments is desirable. The aesthetic quality of the landscape should receive special attention. Roads should not be within 20 m of waterways, and should be planned to minimise soil erosion, while providing effective access to compartments. These minimum international and South African requirements should be kept in mind while considering some forestry design principles.

Mondi Forests have applied these criteria in redesigning the Maybole plantation. All trees planted less than 30 m from streams will be removed (if less than three years old). Where trees are older, the replanting programme will transform these areas into conservation sites, according to the conservation plan. Burning and harvesting plans are presently being revised. Joint forestry and agroforestry activities are being developed with the Entembeni and Tafuleni communities.

**Box A1: Key forestry principles (International Tropical Timber Organization, 1990)**

Key ITTO principles include: (Principle 1) A strong and continued political commitment at the highest level is indispensable for sustainable forest mangement to succeed. (Principle 6) Certain categories of land, wether public or private, need to be kept under permanent forest cover to secure their optimal contribution to national development. (Principle 11) Forests set aside for timber production are able to fulfil other important objectives, such as environmental protection and, to a varying extent, conservation of species and ecosystems. These multiple uses should be safeguarded by the application of environmental standards to all forest operations. (Principle 19) Working Plans should guarantee the respect of environmental standards in field operations. (Principle 20) Forest management operations can have important positive or negative environmental consequences, both in the forest itself and outside (transboundary effects). These consequences should be assessed in advance of operations to ensure overall sustainability. (Principle 21) Harvesting operations should fit into the silvicultural concept, and may, if they are well planned and executed, help to provide conditions for increased increment and for successful regenration. Efficiency and sustainability of forest management depend to a large extent on the quality of harvesting operations. Inadequately executed harvesting operations can have far-reaching negative impacts on the environment, such as erosion, pollution, habitat disruption and reduction of biological diversity, and may jeopardize the implementation of the silvicultural concept. (Principle 22) Pre-harvest prescriptions are important to minimize logging damage to the residual stand, to reduce health risks for logging personnel and to attune harvesting with the silvicultural concept. (Principle 23) Planning, location, design and construction of roads, bridges, causeays and fords should be done so as to minimize environmental damage. (Principle 24) Extraction frequently involves the use of heavy machinery and, therefore, precautions must be taken to avoid damage. (Principle 25) Post-harvest operations are necessary to assess logging damage, the state of forest regeneration, the need for releasing and other silvicultural operations to assure the future timber crop. Principles 26, 27 and 28 deal with protection of forests from incompatible uses and fire and of people from chemicals. (Principle 33) Montioring and research should provide feedback about the compatibility of forest management operations with the objectives of sustainable timber production and other forest users. (Principle 34) Sustained timber production depends on an equitable distribution of incentives, costs and benefits, associated with forestry management, between the principal participants, namely the forest authority, forest owners, concessionaires and local communities. (Principle 35) The success of forest management for sustained timber production depends to a considerable degree on its compatibility with the interests of local populations. (Principle 36) Timber permits for areas inhabited by indigenous peoples should take into consideration the conditions recommended by the World Bank and the ILO for work in such areas *inter alia*. The last five principles deal with economic sustainability of forestry. *Source: International Tropical Timber Organization, 1990.*

Oldeman, writing on the elements of silvology, or forestry science (1990) states: "Design is the gathering, selecting and weighing of information in order to process it into a step-by-step development plan. Application is the use of already available, selected and weighted

information according to known directives. The designer starts with an open problem, the applied worker begins with the elements for a solution ..... Because knowledge and insight remain incomplete, every silvicultural design is partly a gamble. That is why every silvicultural design should contain openings in which cheap and easy monitoring research can be fitted as an accompanying activity ... The optimisation of the initial forestation phase, so that the ecosystem balances out as soon as possible, is a property of good forestation design. Optimisation of silvicultural treatments, in such a way that existing forest remains healthy and stable, taking into account the limiting conditions, is the main aspect of forest conservation design ... Finally, a design has to be comprehensible. ..... It should be a well-illustrated, simple, clear and concise document".

Discussing the behaviour of living systems, Oldeman (1990) comments that biological changes, whether induced by man or not, are never completely reversible; the same is true of the behaviour of living systems. He therefore concludes that the question we should be asking is, "What are we after? Is it the impact of human activities and their dosage that should be analysed? Or are we interested in the fundamental rules which explain the behaviour of forests and their components under all kinds of influences? The order seems clear. If the fundamental aspects are tackled first, the human aspects can be solved afterwards as a variation on the theme of fundamental forest patterns and processes". Although there is compelling logic in understanding the characteristics of systems thoroughly before commencing the design process, it is interesting that in the very next paragraph Oldeman states that "... forest sciences have up to now been largely isolated, or marginalised, or both. They have been isolated as far as they tackled specific problems relevant to a quite small and socially hidden group of professionals in forestry. They have been marginalised to some extent in biological and ecological sciences, as special and difficult cases...".

Oldeman therefore recognises that, although human activity has often had disastrous results for forest systems, and although it is still necessary to understand forest systems before designing forests, it is also important that the relationships between people and forests should be explored. Issues such as equity of access to resources, and design which takes the specific needs of women into account will only be brought into the design process if it includes a broad range of stakeholders. In terms of design approaches which will help to bring about sustainable rural development in South Africa, this is an important point to note. If clients are left out of the design process in its initial stages, it becomes increasingly difficult to involve them later on.

Forests and water use

Pereira (1973) states that clearing of streambank vegetation increases flow for South African mountain streams, while advection from dry grassland adds to the water loss. He estimated in 1973 that then current levels of afforestation (9-14 % of high rainfall areas of South Africa) made efficient, profitable use of water where it fell, while transmission losses and inefficient furrow irrigation used water wastefully in the farming areas. Molchanov (1960), summarising a century of Russian observations on the subject of forestry and water resources, states that for maximum water yield forests should be distributed in the form of shelter belts on the contour. As a general result, 6 % of the watershed area under contoured forest strips can be expected to halve the overland runoff of a completely agricultural watershed; 30 % to 40 % of the area thus afforested will ensure that the entire surface runoff is transferred to subsoil and

erosion is thereby prevented.

More recently Peter Dye (1996) reports that "South African forest plantations, by virtue of their presence in very limited areas of high rainfall, and their increased water use relative to pre-afforestation vegetation, have caused significant reductions in streamflow from afforested catchments. The demand for both water and wood products is expected to increase strongly in the future, challenging the forestry industry to increase efficiency, both in timber production and in minimising the impacts of forest plantations on water supplies". Commercial forestry in South Africa has taken significant steps towards doing this with the development of their conservation policy (Bigalke, 1995). The cooperation of Mondi Forests (South Africa) in the forestry design process is reported on in Chapter 8.

Social forestry

Box A2 outlines some of the problems which are experienced in terms of the social impact of afforestation or the management of natural forests. Already in 1978, the FAO publication cited discusses Integrated Watershed Management as follows: Comprehensive watershed management is in fact a complex of systems which is geared towards four main objectives: the rationalization of the land-use pattern, according to the land-use capability and other environmental criteria; the optimization of the use of natural renewable resources, within the concepts of multiple purpose use and continuous yield of goods and services; the protection of water resources quality, quantity and timing and the conservation of the soil's productivity; the improvement of quality of life, both for the benefit of local communities as for other human settlements which are dependent on the watershed's resources and on the stability of the tributary area".

"Therefore, integrated watershed management requires the combined input of all pertinent rural development actions, plus a series of specific actions which may involve the application of one or more of the following measures and techniques: preventive regulations, manipulation of the vegetation cover, mountain road stabilization, afforestation and revegetation, torrent control, conservation farming and range management".

Social uses of tree products have major importance to many communities. Among the Mayans, the production of tree fruits was an insurance against maize crop failures (Oldeman, 1990). The breadfruit does the same for traditional village forest gardens of South East Asia, while the borders of the Sahara have date palm oases as an arid area variant. In KwaZulu-Natal, certain trees fulfil ritual functions, such as the *mlahla-nkosi* ("bury-the-chief") or *mpafa* tree *(Zizyphus mucronata* or Schotia, known by the voortrekkers as the *blinkblaar wag-'n-bietjie*) which was planted over the grave of the chief, and has many uses including the bringing home of the spirit of one who has died far from home (Player, 1997).

**Box A2: Forestry for local community development (FAO, 1978)**

The problem is thus not one of bringing change to people who resist all change, but one of reconciling technically desirable change with the value systems that it seems to threaten. Any voluntary solution presupposes confidence on the part of the population and imaginative sympathy on the part of the instigators of development. The alternative is to force change on an unwilling people, and this is generally not to be countenanced. ...

Finally, there are certain particular features of forestry that are not always conducive to effective impact at the community level. As has been noted already, the traditional preoccupation of forestry with conserving the forest, combined with management objectives which focus on the production of wood for industry, are likely to be at variance with the needs of the rural people who live in and depend on the forest. This bias is usually reflected in the structure and staffing of forestry administrations, and in the budgetary priorities of forestry. It is also reflected in the traditional training of foresters, who often therefore find that they are not well equipped to deal with people rather than trees. The challenge to forestry of contributing to bettering the condition of the rural poor is consequently likely to entail a radical reorientation extending from policy all the way through to its technical foundations.

Project design and evaluation: Institutional and educational aspects

If forestry is to take its rightful place in local community development, the active interest and involvement of the rural people in forestry programmes right through the design stage will be a first essential, followed by a continuous process of communication between the rural people and the various government agencies which will be involved in any integrated rural development programme. Changing the minds and attitudes of the people and of government officials through extension, training and education, and providing an appropriate institutional and organizational structure to foster communication and participation must be of prime importance for the promotion of rural forestry.

Of particular importance will be the organizational structure of the government agencies to ensure an integrated approach and sufficient staff at the 'grass-roots' level to encourage motivation and provide technical advice; the organization at the community level to ensure full participation; an examination of the legal provisions relating to forest land tenure and customary usage rights to ensure that these will not conflict with the development process; and a reappraisal of the educational programmes to ensure that the staff has a wide understanding of rural and social problems, not only from the forestry aspect.

## APPENDIX 2: NATURE DESIGN

Responding to the need to consider conservation aspects in farm design, Frans Smeding (1995 & In press) has developed a "Protocol Natuurplan", which outlines an approach to planning for nature on the farm. He starts with a process of helping the farmer to identify goals and objectives, which Smeding calls attunement. The second step is an inventory of nature on the farm. This process results in the production of two maps, a map of the dimensions of the various biotopes (ecological areas), and a map of natural vegetation, fauna and management approaches. This map include plans and the results of discussions about nature management. The third step is an assessment of the value of nature and the ecological cohesion within the farm and its surroundings; during this process, one looks out for creative ideas and opportunities. Fourthly, farm objectives for the benefit of nature are identified, and here it is important to make explicit the most important objectives. The fifth stage is the design for nature, in which objectives must be substantiated in terms of appropriate sites and practical measures to be taken. Smeding's approach bases the design on a detailed understanding of the habitat requirements and behaviour of wild animals, and the ecological significance of plants and animals to the ecological infrastructure.

A similar approach has been used by Elizabeth Charter (1995) on Orkney Island under the auspices of the Farming and Wildlife Advisory Group. The image of Orkney is important for the marketing of its products and for tourism. Its unique landscape has a mixture of intensive farmland which is complemented by land which is very rich in wildlife. She looks at the whole farm and follows a process of choosing suitable species for tree planting sites; restoring old woodland around houses; planting gorse or hawthorn hedges on suitable land; creating ponds and marshes on suitable sites; establishing nest boxes in the right places; increasing the colour of the farm environment with native wildflowers, both in crops and on otherwise wasted or unsightly places; where possible, farmers are encouraged to allow access for walkers on their farms, and consideration is given in the planning process to how this access can be managed. Finally, the eco-tourism and other business opportunities offered by wildlife projects need to be examined. Pesticide use on winter wheat has been reduced in the Boxworth Project on Orkney. Although crop yields did fall, they were on average only 12 % lower than previously. Since costs were reduced by 34 %, the nett result was a 5 % increase in the gross margin for the crop. By early spraying of herbicides, the Scottish Agricultural College has shown that using one eighth of the recommended dose, it is still possible to achieve 80 % control of weeds on spring barley (Charter, 1995).

What constitutes a beautiful landscape has to do with coherence, according to Hendriks, Stobbelaar and van Mansvelt (in press). They analyse the inter-relationships in space and time between a number of farms in The Netherlands, and show how organic farms, with their greater diversity, and their understanding of ecosystem integrity, tend to preserve and develop more landscape coherence, while conventional farms have had more drastic effects on disrupting the landscape. They point out that the idea of coherence will vary from person to person, and van der Ploeg (1997) asks what in fact is meant by the word rural. Speaking of rural development he asks "What is this rural we want to develop? And how is the countryside to be moulded given the new claims being articulated by the cities?" He concludes that concerns about change in the countryside are not new, and that the process of change sees the charms of the rural countryside defined both by the urban-rural and by the

rural-wilderness boundary. However, pressures of modernisation have led to intensification and to larger farms, but there is still a great deal of diversity in the responses of farmers to modernisation.

Landscape

Hendriks, Stobbelaar and van Mansvelt (in press) point out that in The Netherlands, there is a move among farmers towards more integrated agricultural systems, which they believe will have positive effects in terms of coherent agricultural landscapes. They analyse landscapes in terms of their coherence vertically, horizontally, over seasons and with historic time.

Landscape is essentially a subjective matter of opinion, which can only be analysed through opening a debate about which subjective values people choose to prioritise. Many people do hold strong opinions about what "rural landscape" should look like.

The debate about farming as an industry, farming as a lifestyle, and farming as stewardship of natural resources is likely to see increasing divergence in approaches to landscape development.

**APPENDIX 3: DAILY RAINFALL AND WETLAND YIELD FOR BACHS FEN FARM: 27/9/98 to 27/2/99**

| Date | Daily Rainfall 0 - 24hours (mm) | OUTFLOW Weir 3 (Cubic Metres) |
|---|---|---|
| 27-Sep-98 | | 0 |
| 28-Sep-98 | | 0.63 |
| 29-Sep-98 | 3 | 3.9 |
| 30-Sep-98 | 4 | 2.64 |
| 01-Oct-98 | | 0.13 |
| 02-Oct-98 | 9 | 15.22 |
| 03-Oct-98 | | 8.55 |
| 04-Oct-98 | 4 | 7.3 |
| 05-Oct-98 | | 9.39 |
| 06-Oct-98 | | 17.04 |
| 07-Oct-98 | 3 | 20.9 |
| 08-Oct-98 | 2 | 23.5 |
| 09-Oct-98 | 2 | 18.42 |
| 10-Oct-98 | | 20.66 |
| 11-Oct-98 | 11 | 7.94 |
| 12-Oct-98 | 3 | 6.06 |
| 13-Oct-98 | | 5.03 |
| 14-Oct-98 | | 4.29 |
| 15-Oct-98 | 14 | 6.82 |
| 16-Oct-98 | | 47.86 |
| 17-Oct-98 | 2 | 11.53 |
| 18-Oct-98 | | 10.93 |
| 19-Oct-98 | | 14.98 |
| 20-Oct-98 | | 14.76 |
| 21-Oct-98 | 1.6 | 6.16 |
| 22-Oct-98 | | 6.64 |
| 23-Oct-98 | 0.8 | 8.88 |
| 24-Oct-98 | 8 | 18.26 |
| 25-Oct-98 | | 10.81 |
| 26-Oct-98 | | 6.87 |
| 27-Oct-98 | | 8.05 |
| 28-Oct-98 | 3.2 | 27.76 |
| 29-Oct-98 | | 30.68 |
| 30-Oct-98 | 0.4 | 17.09 |
| 31-Oct-98 | 0.6 | 25.81 |

| Date | Daily Rainfall 0 - 24hours (mm) | OUTFLOW Weir 3 (Cubic Metres) |
|---|---|---|
| 01-Nov-98 | | 30.41 |
| 02-Nov-98 | | 47.95 |
| 03-Nov-98 | | 66.73 |
| 04-Nov-98 | | 79.70 |
| 05-Nov-98 | | 96.88 |
| 06-Nov-98 | 2.0 | 127.20 |
| 07-Nov-98 | | 40.95 |
| 08-Nov-98 | | 55.05 |
| 09-Nov-98 | | 50.83 |
| 10-Nov-98 | 0.2 | 50.24 |
| 11-Nov-98 | 0.2 | 58.54 |
| 12-Nov-98 | | 65.01 |
| 13-Nov-98 | | 77.74 |
| 14-Nov-98 | | 58.44 |
| 15-Nov-98 | | 25.89 |
| 16-Nov-98 | | 9.38 |
| 17-Nov-98 | 0.6 | 3.38 |
| 18-Nov-98 | 8.6 | 2.72 |
| 19-Nov-98 | 8.8 | 7.10 |
| 20-Nov-98 | 25.8 | 366.81 |
| 21-Nov-98 | 0.4 | 130.08 |
| 22-Nov-98 | 0.4 | 66.53 |
| 23-Nov-98 | 0.2 | 67.79 |
| 24-Nov-98 | 0.2 | 58.12 |
| 25-Nov-98 | 18.6 | 196.71 |
| 26-Nov-98 | 2.2 | 320.84 |
| 27-Nov-98 | 2.2 | 140.86 |
| 28-Nov-98 | | 83.17 |
| 29-Nov-98 | 0.2 | 82.91 |
| 30-Nov-98 | 9.6 | 96.43 |

| Date | Daily Rainfall 0 - 24hours (mm) | OUTFLOW Weir 3 (Cubic Metres) |
|---|---|---|
| 01-Dec-98 | 7.0 | 236.99 |
| 02-Dec-98 | 37.2 | 2507.43 |
| 03-Dec-98 | 5.0 | 1377.55 |
| 04-Dec-98 | | 355.33 |
| 05-Dec-98 | | 232.71 |
| 06-Dec-98 | | 160.38 |
| 07-Dec-98 | 2.6 | 139.64 |
| 08-Dec-98 | 0.4 | 150.03 |
| 09-Dec-98 | 1.0 | 113.19 |
| 10-Dec-98 | 5.6 | 167.99 |
| 11-Dec-98 | | 148.08 |
| 12-Dec-98 | 5.6 | 123.43 |
| 13-Dec-98 | 0.2 | 143.66 |
| 14-Dec-98 | | 105.61 |
| 15-Dec-98 | 0.8 | 96.40 |
| 16-Dec-98 | | 87.05 |
| 17-Dec-98 | 0.4 | 75.02 |
| 18-Dec-98 | 0.2 | 66.40 |
| 19-Dec-98 | 0.4 | 59.62 |
| 20-Dec-98 | 0.2 | 52.38 |
| 21-Dec-98 | | 45.15 |
| 22-Dec-98 | 9.0 | 49.11 |
| 23-Dec-98 | 4.6 | 73.47 |
| 24-Dec-98 | | 51.57 |
| 25-Dec-98 | 3.2 | 50.25 |
| 26-Dec-98 | 1.0 | 48.63 |
| 27-Dec-98 | 2.0 | 47.84 |
| 28-Dec-98 | 0.8 | 58.94 |
| 29-Dec-98 | | 42.02 |
| 30-Dec-98 | | 35.25 |
| 31-Dec-98 | | 38.68 |

| Date | Daily Rainfall 0 - 24hours (mm) | OUTFLOW Weir 3 (Cubic Metres) |
|---|---|---|
| 01-Jan-99 | | 36.63 |
| 02-Jan-99 | 1.2 | 34.13 |
| 03-Jan-99 | 1.4 | 31.16 |
| 04-Jan-99 | 1.2 | 30.66 |
| 05-Jan-99 | 1.8 | 27.96 |
| 06-Jan-99 | 10.4 | 29.93 |
| 07-Jan-99 | 2.8 | 26.40 |
| 08-Jan-99 | 0.4 | 31.24 |
| 09-Jan-99 | | 26.40 |
| 10-Jan-99 | 4.2 | 26.26 |
| 11-Jan-99 | 75.0 | 3415.21 |
| 12-Jan-99 | 7.6 | 738.53 |
| 13-Jan-99 | | 256.22 |
| 14-Jan-99 | 0.2 | 41.55 |
| 15-Jan-99 | 6.6 | 50 |
| 16-Jan-99 | | 45 |
| 17-Jan-99 | | 40 |
| 18-Jan-99 | 13.0 | 224.84 |
| 19-Jan-99 | 1.2 | 180.61 |
| 20-Jan-99 | 3.6 | 93.00 |
| 21-Jan-99 | 0.2 | 85.05 |
| 22-Jan-99 | 0.4 | 70.62 |
| 23-Jan-99 | | 61.85 |
| 24-Jan-99 | | 55.76 |
| 25-Jan-99 | | 45.05 |
| 26-Jan-99 | | 43.78 |
| 27-Jan-99 | | 40.18 |
| 28-Jan-99 | | 32.93 |
| 29-Jan-99 | | 42.43 |
| 30-Jan-99 | 7.2 | 45.22 |
| 31-Jan-99 | | 35.37 |

| Date | Daily Rainfall 0 - 24hours (mm) | OUTFLOW Weir 3 (Cubic Metres) |
|---|---|---|
| 01-Feb-99 | | 44.62 |
| 02-Feb-99 | 72.2 | 2794.73 |
| 03-Feb-99 | 21.2 | 3110.35 |
| 04-Feb-99 | 47.8 | 5475.06 |
| 05-Feb-99 | 8.8 | 3062.89 |
| 06-Feb-99 | 8.0 | 861.66 |
| 07-Feb-99 | 11.2 | 1865.42 |
| 08-Feb-99 | 1.2 | 452.32 |
| 09-Feb-99 | 0.2 | 287.32 |
| 10-Feb-99 | | 220.66 |
| 11-Feb-99 | | 163.61 |
| 12-Feb-99 | | 141.86 |
| 13-Feb-99 | 2.0 | 145.16 |
| 14-Feb-99 | 7.2 | 253.57 |
| 15-Feb-99 | | 129.90 |
| 16-Feb-99 | 0.2 | 122.44 |
| 17-Feb-99 | | 113.75 |
| 18-Feb-99 | 0.2 | 95.54 |
| 19-Feb-99 | 0.6 | 82.25 |
| 20-Feb-99 | 9.6 | 132.19 |
| 21-Feb-99 | | 91.80 |
| 22-Feb-99 | | 84.09 |
| 23-Feb-99 | | 76.54 |
| 24-Feb-99 | | 70.24 |
| 25-Feb-99 | 1.0 | 63.32 |
| 26-Feb-99 | | 11.00 |
| 27-Feb-99 | | 10 |

## APPENDIX 4: SUMMARIES OF PLANNING PROCESSES AT EZAKHIWENI

### 1 PARTICIPATORY RURAL APPRAISALS HELD IN MAY AND JUNE 1994

This first Participatory rural appraisal (PRA) exercise was undertaken in order to learn about the farming systems of the area, with a view to understanding what support is required to develop sustainable and profitable farming enterprises. It included a time-line study, an activity profile for men and women, interest group perspectives for crop farmers, gardeners and livestock owners, a Venn diagram illustrating what institutions assist people in the area, and a discussion of local approaches to managing the conflict which racked the area from 1986 to 1990. Later PRAs gathered specific information about resources in particular micro-catchments (see Mascarenhas and Pretty, 1991).

**Time-line study**

The first exercise was designed to gain some understanding of the historical context of local agricultural production (see Figure A1). The oldest people still living in the community were born just before the Bambatha Rebellion (1906), probably in 1902. Baba Okwakhe Zungu is one of these old people. The oldest person present at the meeting was Baba Khwela, who was born in 1925. Mr Khwela's memory of his boyhood is that there were many goats as well as cattle and sheep, and that grass was plentiful. There were no erosion gullies, and the water in the *Mncadodo* Stream (Sterkspruit) was clean and flowed perennially.

| What happened? | When? | What was noticed? |
|---|---|---|
| | ⇑ | |
| Baba Okwakhe Zungu born | 1902 | |
| Bambatha Rebellion | 1906 | |
| Baba Khwela born | 1925 | No dongas, much grass |
| | \| | Many goats, sheep, cattle |
| | \| | Stream full, clear water |
| | \| | We ate from our fields: maize, |
| | \| | sorghum, potato, sweet potatoes, |
| | \| | dry beans, cowpeas, pumpkins, |
| | \| | *ibhece* melons, monkey nuts, |
| | \| | *indlubo* beans and *amadumbe.* |
| Group Areas Act | 1950 | Unmarried mothers and |
| breakdown of | \| | family, traditions weaken, urban |
| Population Growth | \| | migration, more crime. |
| People lose their land | 1960 | People can't feed themselves |
| Smaller fields | \| | Agriculture less important |
| | \| | to the youth |
| Violence endemic | 1985 | |
| | \| | |
| Mpumalanga Peace Accord | 1990 | We did this ourselves |
| | \| | & IFP helped bring us together |
| Shongweni Resources Reserve established | 1993 | Some services through SRR |
| | ⇓ | |

**Figure A1: A time-line for Ntshongweni**

People lived from the land, planting a wide range of crops, some of which were sold at Umbumbulo and Pinetown. These included the following crops: maize, sorghum, sweet potatoes, potatoes, dry beans, cowpeas, pumpkins, *ibhece* melons, monkey nuts, *indlubo* beans and *amadumbe* (taro).

The main changes that people noted were that the number of people has increased dramatically, and that fields are now smaller. Simultaneously, traditional morality has been eroded, and babies are born to women without a firm commitment by both parties to a stable relationship. This process seems to have happened gradually, but most of the deterioration is linked by the people to the coming of the Group Areas Act (1950). People say that this Act was only applied in their area after 1960, when many people lost their land. Land was allocated to white and Indian farmers. The land left over was insufficient for agricultural production to support the people.

An earlier problem was the influence of the missionaries, who were rather inflexible with their interpretation of morality. They made local people feel that traditional practices were sinful, and this promoted the disintegration of traditional cultural structures. Coupled with loss of land, the result was to marginalise the community. The result was that many people sought work in the urban areas, and agriculture was relegated to a very minor role. The rainfall seems to have become more erratic, and droughts more severe, and planting annual crops has become a very risky business (Auerbach and Dandala, 1995).

**Interest group perspectives**

Crop farmers, gardeners and livestock owners met in groups to discuss their problems. Practical difficulties were described and then ranked; high numbers indicate high priority:

**Table A1: Arable priorities**

| Field cultivation | | Community gardens | |
|---|---|---|---|
| 5 | Soil fertility and variable soil types | 6 | Knowledge regarding good cultivation |
| 5 | Stalkborer problems | 6 | Selecting improved seed |
| 4 | Plant diseases and insect pests | 5 | Water |
| 3 | Animal pests (moles, porcupines and wild pigs) | 4 | Fencing |
| 2 | Water | 3 | Pests |
| 2 | Fencing of the fields | 2 | Marketing outlets for produce |

**Table A2: Livestock priorities**

| Rank | Issue |
|---|---|
| 10 | Domestic animals require paddocks, grass and water. |
| 9 | A local veterinary clinic is needed, so that rabies in dogs and cats can be prevented, and other animal health procedures could be implemented. |
| 8 | Animal health requires dips against ticks (not in summer). Stock remedies are also needed for worms (Izikelemu), redwater (ubhendeni), and gallsickness (umkhonywana); this applies to cattle, sheep and goats. Poultry also suffer from diseases, and they could play an important role, both for meat and egg production. |
| 7 | Stock watering points are needed, especially for drought times, as stock have to travel far in search of water, and this causes soil degradation; boreholes at strategic locations could relieve this problem. |

**Conflict Management**

Mr Zwane was the active spokesperson for the community during the first part of this discussion, explaining how Archie Gumede, at the time President of the United Democratic Front (UDF) managed to bring about the Umfolozi Peace Accord in 1989/90 at Empangeni, working with Inkatha leaders. Later during 1990, the Mpumalanga Peace Accord was developed locally, after Gumede had instructed Zwane to act as an apostle of peace. When problems are experienced, the local Inkatha and ANC executives get together to solve these. However, there are many youngsters and high levels of unemployment in the area, and it is vital that recreational facilities be established so that they can let off steam on a football pitch rather than with violence.

Other participants then pointed out that Mr Zwane's comments referred specifically to Ntshongweni. Toni and Zwelibomvu had very few problems with violence, while at Salem the problems were mainly of a factional nature, and were dealt with by the older people.

**Second Participatory Rural Appraisal: transect walk and mapping exercise**

A month after the above exercise, a second PRA was held in the Ntshongweni area. Here, the results of the first PRA were used to examine the practical farming systems issues raised. After a brief discussion, a transect walk led revealed the following:

* the community garden, with 14 members, was largely dormant because of the decrepit fence; previously, indigenous hardwoods had been used for fence-poles, but these were now hard to find, and many fence poles were made of Jacaranda which is eaten by termites; gardeners had already approached Raymond earlier, requesting help in renewing the fence, which is why the area was selected for the intensive PRA;
* gardeners used raised beds for vegetables because, in spite of the current drought conditions, the gardens were subject to high water table during the rainy season;
* two small dams had been dug out by hand to store water for the gardens, and a third to store water for the nearby plunge dip - all were almost empty, and had also been used for stock watering during the drought, as they were the only available water source;
* the fields above the garden were Trustland, originally owned by the government, more recently transferred to the Ngonyama Trust (Zulu Monarch);
* fields had originally been allocated to the new settlers in the area by the KwaZulu Department of Agriculture. These people had been removed from nearby areas some 20 years before - access to land was still respected locally according to this allocation;
* a number of indigenous trees were found in the fields, many of which had medicinal significance (one of the transect party was a local herbalist);
* the land adjacent to the arable fields was used for communal grazing - formerly, youngsters used to herd cattle, sheep and goats, but more recently they were left to wander, since herd-boys are now at school;
* main crops in the fields in summer are maize, dry beans and some cabbage - crop failures have been common, due to drought, late planting and livestock damage;
* cattle graze the maize stover during the winter;
* local patches of *ikwane* reeds (Cyperus latifolia) are used for sleeping mats - other reeds from the river are used for various other craftwork purposes;
* reeds were more plentiful in the past, in wetlands and down by the Mlazi River.

After the transect walk, a map of the area was drawn at the Charles Memorial School, and an animated discussion of some of the issues highlighted during the walk took place.

## 3 THE WAY AHEAD: Report of a vision-building process with the community

Agriculture at Ntshongweni - EZakhiweni will only progress if local people can find ways of managing the natural resources more productively. This requires a process of negotiating resource-use and evolving management strategies and procedures for common resources. The wetlands, the community garden, the arable land, the grazing land and the streams and rivers of the area are all common property at present. The land is a Trust Farm, and thus presently is owned by the Ngonyama Trust and held by the King on behalf of the local citizens makes it important to show how such land can be developed productively and sustainably.

The vision-building process consisted of a series of visits to other projects and discussions on what the future agricultural production systems at EZakhiweni should look like. Visits included Bachs Fen Ecological Research Farm and a small commercial vegetable farm run by Mr Sookoo and son in the Cliffdale Valley (one of the farms which had been analysed as part of the farming systems analysis reported on at the Harare SAAFSRE conference, see Wisserhof and Auerbach, 1995). Several agricultural shows were also visited, as well as the KwaZulu-Natal Farmers' Summit (attended by the Chairlady of the gardening committee). The process was then formalised in a community meeting at which the locals decided:

**Table A3: A vision for the future**

| | |
|---|---|
| 1 | A Farmers' Association was required. |
| 2 | Plot access rights should be respected, with minor modifications. |
| 3 | Trees should be planted around the field perimeter. |
| 4 | Cattle access should be strictly controlled. |
| 5 | A research and demonstration plot would be made available to try out crops and trees. |
| 6 | Agroforestry fodder crops should be established for winter cattle feed. |
| 7 | Cash crops (coffee, groundnuts) and food crops (maize, beans).to be established. |
| 8 | Craftwork groups to work on using wetland reed crops to generate income. |

Turning the vision into reality meant deciding what was to be done, by whom, when and how. Gathering the required resources was also a major task. The NCMP found money to appoint a local Agricultural Facilitator, nominated by the women from the garden association. While this process was underway, a formal meeting was again held.

## 4 PARTICIPATORY LAND USE PLANNING EXERCISE FOR EZAKHIWENI - NTSHONGWENI AREA HELD AT LALELANI SCHOOL ON 28/5/1995

### Outline

The meeting opened with prayer at 10h20. R Auerbach, R Dandala and C Wisserhof represented Farmer Support Group, and twenty-one local people attended. Mr Ndlovu from the KwaZulu-Natal Department of Agriculture attended the first part of the meeting, and assured us of his Department's support in achieving the developmental goals set by participants before he left. People then drew a map of their area and a bird's eye view of what they would like to see at EZakhiweni in five years time in the school quadrangle outside. We did this, and very soon a good map of the area had been produced, using coloured powder, lines scratched in the soil, stones, beans and twigs.

People were then able to start drawing in what they would like to see. Some of the improvements included:

* develop field above garden as vegetable production area if possible (maize takes too long and is too risky; need higher value crops but realise that water will be a problem);
* plant trees around perimeter and get Raymond to try out a range of crops on the bottom section of this field (including coffee);
* make water available in the garden;
* get the services of a tractor for ploughing local lands;
* establish fodder crops for the cattle such as Napier fodder;
* establish a market below Lalelani School for selling vegetables;
* fence off the area below the dip as a grazing camp;
* install water troughs in this camp in case of inadequate water in Umfulungashe;
* establish handcraft training and production centre (AO' s office);

Non-agricultural developments wanted included:

* eventually build a clinic next to the market (start off using the AO's office);
* develop the creche which Mrs Mokoena presently runs;
* bring telephones into the area (need a public phone at AO's office and some private);
* repair and renovate the schools;

**Helps and hindrances**

After discussion of what was wanted in the area, Raymond drew a large waggon on the blackboard, representing agriculture at EZakhiweni. Each of the 21 community members present was given two cardboard oxen and six cardboard rocks, two small, two medium-sized and two large. They were asked to write on the oxen the most important things which could help agriculture at EZakhiweni to develop, and to use the stones to list problems (annoyances, minor and major). The "stones" would be loaded onto the waggon, which would be pulled by the "oxen". Those who had difficulty in writing were helped by facilitators to list helps and hindrances, and all oxen and stones were stuck up on the board, and then regrouped into the major themes represented. Additional oxen and stones were made available as required. Each ox scored one point as a help, and stones scored one, two or three points as hindrances, depending on size. The results are summarised in Table A4.

Since the primary aim of the WRC programme is to develop a framework for participation in catchment management it is interesting to note that "people" and "organisation" are also seen as important by the Ntshongweni community. This has confirmed the importance of developing appropriate institutions as a programme objective. The experience of FSG and many other development organisations around the world has shown that unless institution building is given adequate attention, development initiatives will not be sustained once the developing agency withdraws.

**Table A4: Helps and hindrances to development at EZakhiweni-Ntshongweni**

| Total Score | Helps | Score | Hindrances | Score |
|---|---|---|---|---|
| | **Directly programme related** | | | |
| 29 | Water | 8 | Lack of water | 21 |
| 26 | Tractor & equipment | 4 | Lack of tractor | 22 |
| 16 | Availability of inputs | 4 | Inputs (seed-breed) | 12 |
| 15 | | | Pests and diseases | 15 |
| 6 | | | Soil conservation problems, floods | 6 |
| | **Indirectly programme related (income-generation & institutional)** | | | |
| 33 | Money | 16 | Lack of money | 17 |
| 15 | People (and employment for them) | 9 | Org. associations | 6 |
| 11 | Market | 2 | Craft centre-creche | 9 |
| | **General development issues** | | | |
| 15 | Clinic | 2 | Clinic and health problems | 13 |
| 7 | Road improvements & transport | 2 | Roads | 5 |
| 3 | Adult education | 3 | | |
| 3 | | | Thieves | 3 |
| 3 | | | Telephone | 3 |

**Action Plan**

As time was limited the role plays were not performed. Instead a brief discussion on future action was held. It was agreed that Mondi's offer to help with tree planting should be accepted, and Raymond will negotiate an appropriate design, and then report back to the community. Raymond and MaShelembe later met to identify who has traditionally used which sections of the upper field subsequently Peter Verburg from Wageningen Agricultural University (WAU) designed a soil and water conservation strategy for the field. Kees Wisserhof (also from WAU) had been busy analysing local farming systems (Wisserhof, 1995), and he also later presented a Zulu-language summary of his report on the farming systems in the area (Ntshongweni, Cliffdale and Peacevale).

## APPENDIX 5: EVALUATIONS OF COMMUNITY GARDENS

**EZakhiweni Garden Evaluation, 5 October 1998**
**(Sifiso Ntinga facilitated process, (groups: also Sakhile). Thami and Zenzele recording)**

*9am History: Raymond to present brief time line - locals to add items.*
*10am What went well - groupwork on benefits associated with garden and craftwork?*
*10.30 Cooldrinks, bread & polony/peanut butter, white & brown bread, paper cups & plates.*
*11am Why is the community not using mulch? Swales? Compost?*
*11.30 What did not go well - groupwork on problems and complaints?*
*12am The way forward - groupwork on what should happen next? Closure: 1pm*

**Attendance:** 14 women; 5 men (local residents) + Mr Vilakazi & Mr Biyela (Department of Agriculture) + T Mthembu, R Auerbach, S Ntinga (NCMP).

Mr Mthetwa opened with prayer.

Sifiso explained that the purpose of the workshop was to evaluate the local farming activities, and especially how effective FSG has been in helping with agricultural and craftwork development. He encouraged all present to feel free to air any problems they had, and yo speak frankly from their own point of view. Mr Vilakazi intervened to thank Sakhile for all his help in transporting gardeners to Mpumalanga for the show. Sifiso commented that Thami had also helped with the show, through obtaining funds from the Durban Outer West Local Council.

Raymond gave a short outline of the process plan, which was agreed to by those present, but not before Mr Sibisi (Local IFP leader) had made it clear that he was not impressed by Raymond, Thami, Sifiso or the FSG's NCMP. He stated that in his opinion, FSG has given nothing to the community. He does not count FSG staff salaries or equipment as "given to the community", and his opinion is that Raymond started with a small programme, came and took photographs and made videos, went overseas and raised lots of money, and now has a big programme. Meantime, the local community has nothing. There should be transparency about where money comes from and how it will help the community. Sifiso explained that the presentation to be held the following day, when tools would be presented to the gardens, would also give full account of how the money for each community had been spent, and what was left over still to be spent.

Raymond pointed out that apart from FSG staff, transport and equipment, the programme had helped the local community identify their needs, and helped to design strategies for meeting those needs. In actual physical terms, FSG had fenced the demonstration site which the community asked for help with, purchased and planted coffee trees (which we fetched from Nelspruit), fruit trees and a range of crops, windbreaks and hedges. Initially the demonstration site had been maintained by gardeners, but after a few months the community stopped this, and more recently the fence had been opened and cattle allowed in to graze, which had destroyed most of the fruit trees.

Mr Sibisi denied that anything useful had been done by FSG. FSG is claiming to have done things (like erecting the fence) which were in fact done by the DoA. Sifiso explained that

FSG's job is to help bring the DoA and the community together, and to help the community to articulate their needs. Mr Sibisi said that at the start of the project, Raymond had consulted him and his ANC counterpart, Hlome Zwane. He had been hopeful that good things would happen. Thereafter, Raymond did not come to see him, and failed to communicate with him. He claimed that he is the landlord of the garden (*Mnikazi wasengadi)*, and that he should be consulted on any activities relevant to the garden. Raymond queried whether he was the landlord, and he repeated that he was. No-one present challenged him, although the site is owned by the Zulu King's *Ngonyama Trust* and has always been administered by the Department of Agriculture. He said that Raymond took his photographs earlier and then never came back to the garden. Now he has come to do an evaluation and take more photographs, and will go overseas again to look for more money. Raymond responded that the evaluation will report honestly on what the complaints of local people are. He commented that FSG does not work in a way which creates dependency, by giving handouts to the community. FSG's job is to help people to design systems which are ecologically and economically sound, and then to help people to access resources to implement these systems. FSG set up the demonstration garden to show people some plants which would do well in the area, and to try out coffee to see if it is a suitable crop for the area. The coffee turned out to be unsuitable, which was important to know. This meant that FSG advised people not to try coffee. The failure of the local people to maintain the demonstration garden which they asked FSG to develop was of great concern, especially the fact that the fence had been opened to allow cattle to destroy the fruit trees. FSG's contribution had been to appoint Thami and support him after the local women proposed him as facilitator, and then to appoint and support Zenzele after the women asked for help with craftwork.

Mr Mthetwa (the new Chairman) complained that the Mpumalanga Agricultural Show had not been well-run. He claimed that his 10 Drumhead cabbages were entered under the names of women from Mpumalanga Township and his Oxheart cabbage was ascribed to a woman from Magaba Garden, and they subsequently won prizes for these cabbages. They have also not yet had the money for the vegetables which were sold at the show.

**Time line for EZakhiweni Garden**

The meeting proceeded to construct a time line, to help review the progress of the garden.

70/80s BJ Njokwe was the first extension officer to be posted out to EZakhiweni by KDA; he later worked for INR. David Mpisane was then AO, then Mr Cele, and then Mr Nkabinde, followed by Mr Vilakazi. Raymond mentioned that he visited the site while working as Professional Officer for KwaZulu Department of Agriculture, and noted a thriving community garden, with fields above under Mr Mpisane in 1979. Mr Sibisi objected to Raymond imposing his version of history on the community. He commented that Mr Nkabinde had helped the community by transporting seedlings, and he always brought receipts for money which he took from the community.

85-90 Violence in Mpumalanga & Ntshongweni, many people killed, Vilakazi leaves area.

90-93 Drought in the area. Mrs Khumalo appointed as Home Economist. She made promises, but the community did not receive anything.

1994 MaShelembe asks Raymond to help expand the garden and to fence it.

1995 District Agriculture Head Mr P Gumede agrees to supply wire and poles. Raymond,

Kees Wisserhof (Dutch MSc student) and the gardeners erect the fence. Mr Sibisi gets permission for erection of a fence between the school and the garden, and helps to erect the fence. Communication good at this stage. Thami nominated by local women to help with the development of EZakhiweni and other gardens. Demonstration site fenced. Mr Biyela appointed as agricultural assistant. Raymond carries out mulching demonstrations.

Raymond suggests that trees and other plants could form a "live hedge"around the fields. Heavy rains experienced around Christmas time. Thami creates jobs for local people to construct dams and to fence the fields above the garden.

1996 Coffee, paw-paws and fruit trees planted. Craftwork groups started by Thami. Sifiso helps develop constitution. Thami starts job creation project with Dept Agric - local people dig dams, fence fields (after they bought wire & been given poles by DoA), & construct a swale to prevent soil erosion in their field. Ntshongweni Agricultural Show held at Lalelani Primary School.

Farmers Association committee elected, Chair Mrs Ndimande (Mr Sibisi claims not fully representative). Thami organises ploughing of fields - local farmers pay for this.

1997 Craftwork exhibition in October (Mr Sibisi says he was not invited, Zenzele says he gave all invitation letters to Vice-Chair Mrs Gumede, including one for Mr Sibisi).

Heavy rains reduce potato yields. Mr Vilakazi returns as Agricultural Officer.

Zenzele Gumede starts as Craftwork Facilitator.

Outer West Local Council promises money to Ntshongweni gardeners.

Mr Sibisi and Induna claim that they were not contacted about the craftwork exhibition, and that is why it was disrupted; Zenzele says that he gave the invitation to Mrs Gumede to deliver to Mr Sibisi. It is not clear whether she delivered it or not.

1998 Thami no longer helping regularly in the area.

Complaints about Thami and Mr Vilakazi from the women.

New committee elected (Mr Mthetwa now Chair).

Sakhile starts working at EZakhiweni temporarily after complaints about Thami.

Garden standards of production and profits go up.

Water pipe finally laid in garden, and two taps installed.

Problems with Outer West and FSG re delivery of assistance promised.

Constitution of Farmers Association changed from what Mr Sibisi claims FSG "foisted upon" community. Drainage furrow constructed in wet part of garden.

Help from Sifiso with seedlings and a little manure; poor seedlings supplied.

Establishment of Ntshongweni Farmers Association.

Water from dams all used up for irrigating crops - shortage of water.

Sifiso and Sakhile invite Mr Sibisi to this meeting.

Arrival of students from university to learn about gardening.

This meeting turns into a workshop which we were not expecting.

Farmers request seed potatoes as a form of compensation for their presence at workshop. No proper arrangement for tap water in the garden.

Local people want FSG to help with job creation.

**Group work on what has been good/ bad about the project**

**Good aspects**

Group A:

Construction of furrow and laying of water pipeline.
Fencing of garden.
Choosing new committee more representative of members.
Improvement of control of money by farmers.
Craftwork training workshop with Beauty.
Help from Mr Biyela, Zenzele and Sakhile.

Group B:

Bringing of tractor.
Bringing of manure.
Help with fencing.
Installation of water metre/ tap.

**Bad aspects**

Group A:

Shortage of water for crops.
More weeds in the garden.
Provision of poor quality seedlings by Sifiso.
Unavailability of room which women had used as a craft store since Biyela moved in.
Erratic arrival of seedlings makes planting erratic.
Mr Vilakazi and Thami neglecting their duties.
Mr Vilakazi and Thami not consulting farmers.
Mr Vilakazi drinking during working hours.
Farmers not showing up on Wednesday at 10h00.
More promises are made by Sifiso to gardeners.
Mpumalanga Agric Show was not for people of Ntshongweni; we won no prizes - unfair judging.
No place to sell craftwork.
No help for sewing group at EZakhiweni (MrVilakazi, Mr Biyela, Sifiso, Sakhile).
Old house has not been repaired for use as a craftwork centre (Raymond and Mr Vilakazi).
Nothing said about the disappearance of Thami (Raymond).
Location of creche far away from EZakhiweni.

Group B:

Mpumalanga Agricultural Show 29/9/1998:
Ntshongweni items only won one prize, unfair judging.
Closure of sales meant not all produce was sold, and this rotted causing loss of income.
Non-receipt to date of money for produce sold (Mr Vilakazi promised it is still coming).
Mr Vilakazi and Thami have not been coming to the garden regularly to help with planting.
Thami meets other club members secretly.
Interference of FSG in management of community money: i Thami opened the bank account for farmers; ii Money for potatoes which were sold (Thami); iii People are not clear what happened to the money collected for fencing material; iv Money for joining KwaNalu; v Money for waterpipe; vi Money for installation of metre-box; vii Promises are made, but it is not clear how money has been spent (Sifiso); viii Provision of poor seedlings at erratic times (Sifiso); ix Thami's way of working with the community's money.
Not receiving copies of photographs taken.
Way of handling work opportunities for temporary workers.

**Wise use of water**

Raymond then outlined the purpose of NCMP: the programme is funded by WRC to encourage community participation in catchment management. The new Water Law provides that communities should be involved in managing land and water, and finding ways to increase access of historically disadvantaged communities to resources. Three key technical innovations had been introduced to the community to help use their limited water resources more efficiently. These were mulch, swales and compost. Mulch conserves moisture, swales harvest and concentrate water where it can be most useful, and compost increases the moisture holding capacity of the soil. An important part of the evaluation is to assess whether all the time, effort and money which FSG has spent at EZakhiweni has had an significant effect on improving the effectiveness of water use. Mulch has hardly been used by farmers, with the exception of Mr Khumalo. Only one swale was constructed by the local women after the two demonstration swales had been constructed by FSG. Compost was not made by gardeners after the demonstration of compost making two years ago. Raymond commented that he himself is a farmer, and he knows that people can come onto a farm and give one advice, and leave again, and that the farmer has to decide whether the advice is practically useful to him or her. He is not therefore saying that these three innovations are good for everybody, but would rather know what people think about them, and why they have not applied them much.

Mulching

Mr Khumalo commented that he finds mulching very useful, and has used far less water than he normally would have, as the mulch reduces evaporation significantly. Mr Mthethwa agreed, saying that although he does not use mulch much, he buries the grass in the soil, and this improves the soil's fertility and structure and keeps it moist. The other gardeners agreed that mulch is useful, but feel that it is too much hard work.

Swales

Those present agreed that swales do help prevent soil erosion, but they feel that on their sandy soils, which slope only gently, soil erosion is not a major problem.

Compost

Mr Sibisi commented that manure is much better than fertiliser, because manure builds the soil, whereas fertiliser must be applied again and again in ever-increasing quantities. No reasons were advanced for why compost is not used, but several gardeners confirmed that they use manure but do not have access to large quantities.

Demonstration garden

People commented that they had stopped maintaining the demonstration garden because they felt that FSG was dictating to them what they should do, and this had discouraged them.

**Way forward**

People concentrated in this final period on stressing that they see no advantage from FSG's further involvement in the area. They commented that Mrs Khumalo from the DoA was very good at writing reports about things which she never did, and that managers should ensure that technicians actually did what they reported they had done. The community will still be there, whether they get help from DoA or FSG, or not. In evaluating, people commented that FSG and DoA should respect local people. Mr Sibisi said that they must work through him at all times, as consulting traditional leaders is vital to orderly development.

**Magaba Gardens Evaluation: 8 October 1998, 2 pm.**
**(Sifiso Ntinga facilitated the process; Thami and Raymond recording)**

**Attendance:** 9 women (local residents) + Thami Mthembu, Raymond Auerbach, Sifiso Ntinga, Zenzele Gumede.

Sifiso explained that the purpose of the workshop was to evaluate the local farming activities, and especially how effective FSG has been in helping with agricultural and craftwork development. He encouraged all present to feel free to air any problems they had, & to speak frankly from their own point of view. Raymond gave a short outline of the process plan,

**Time line for Magaba Garden**
The meeting proceeded to construct a time line, to help review the progress of the garden.

70/80s Mpisane, Cele, then Nkabinde present as Agricultural Officers. Raymond visited the area while Professional Officer for KwaZulu Department of Agriculture, and noted a thriving community garden at EZakhiweni, with fields above in 1979.
85-90 Violence in Mpumalanga/ Ntshongweni, many people killed, AO Vilakazi leaves area.
90-93 Drought in the area
1995 CMR introduce themselves to the community at large; formation of the Magaba Club. Delia approaches the Church Ministers to use church buildings to train community on gardening and sewing; CMR paid rent (R45 per year) to Mr Ngcongo (landowner) on behalf of the community; heavy rains experienced around Christmas time.
1996 Good yields: they managed to feed their families and sell some surplus produce.
Problems started: Mr Ngcongo informed gardeners that church does not own the land; if they want to use it, they must now pay R50 **per month**, otherwise they should move.
Gardeners failed to pay, and moved off and block-making project came to an end.
Subsequently Thami and gardeners leased land from Mr Sishi at R45 per year.
Magaba Garden took part in Ntshongweni Agricultural Show and won prizes.
1997 Gardeners continue to pay R45 per year rent to Mr Sishi.
Gardeners used fencing material from another project to fence the garden.
Thami and CMR assisted with manure, seed and seedlings.
Outer West Local Council promises money to Ntshongweni gardeners.
CMR donate two hand hoes and a watering can to each garden.
Permaculture workshop held at Ntshongweni. Sifiso helped to draft the constitution.
1998 Thami no longer helping regularly, complaints re Thami, Mr Vilakazi from women.
Establishment of Ntshongweni Farmers Association. Poor seedlings supplied.
Thami assisted in obtaining the use of a larger site (Landlord, Mr Cele).
Thami requested by Mrs Cebekhulu to fill in the water application form.
Magaba won the prize for best garden at the Mpumalanga Agricultural Show.
Gardeners attended the Sweet Potato production workshop at Nansindlela.
Craftworkers learned how to use Ilala Palm during FSG training workshop (Beauty).
Thami not satisfying the needs of the community.
Thami, Councillor Moyo, Mrs Cebekhulu discuss & resolve situation re Thami.
Garden tools presentation.

**Group work on what has been good/ bad about the project**

Good aspects
Availability of a good site for crop production.
Availability of seed and seedlings.
Sifiso's help in delivering manure and compost.
Purchase of garden tools (Outer West and FSG).
Raymond finally seen again (at this meeting)!
Mrs Cebekhulu attended the permaculture workshop at Stoffelton.
Mrs Cebekhulu elected as Treasurer for District Farmers Union.
Mrs Cebekhulu attended the launch of KWANALU

Bad aspects
Thami was not available much during 1997.
Gardeners are not well trained in crop production (especially crop rotation, pest control and making of liquid manures).
Damage from neighbouring chickens entering the garden.
No block-making site available.

**Wise use of water**
Raymond then outlined the purpose of NCMP: the programme is funded by WRC to encourage community participation in catchment management. The new Water Law provides that communities should be involved in managing land and water, and finding ways to increase access of historically disadvantaged communities to resources. Three key technical innovations had been introduced to the community to help use their limited water resources more efficiently. These were mulch, swales and compost. Mulch conserves moisture, swales harvest and concentrate water where it can be most useful, and compost increases the moisture holding capacity of the soil. An important part of the evaluation is to assess whether all the time, effort and money which FSG has spent at Magaba has had an significant effect on improving the effectiveness of water use. Raymond commented that he himself is a farmer, and he knows that people can come onto a farm and give one advice, and leave again, and that the farmer has to decide whether the advice is practically useful to him or her. He is not therefore saying that these three innovations are good for everybody, but would rather know what people think about them, and why they have not applied them much.
Mulching: Some mulch had been used, but the chickens tend to destroy it while scratching.
Swales: The siting of the garden made it difficult to catch water. The members asked that Thami & Sakhile help plan an extensive water harvesting system for new site-This now done.
Compost: Compost and poultry manure were used on the garden and found to be effective.

**Way forward**
Thami to facilitate the training of the gardeners, especially on water harvesting techniques.
Commitment from gardeners to work hand-in-hand.
To plant with the aim of getting profit and a better life.
To develop a vegetable market place.

**Zimeleni Garden Evaluation, 8 October 1998 at Mrs Meyiwa's House.**
**(Sifiso Ntinga facilitated the process (in groups, also Sakhile). Thami and Zenzele recorded)**

*9am History: Raymond to present brief time line - locals to add items.*
*10am What went well - groupwork on benefits associated with garden and craftwork*
*10.30 Cooldrinks, bread & polony/peanut butter, white & brown bread, paper cups & plates.*
*11am Why is the community not using mulch? Swales? Compost?*
*11.30 What did not go well - groupwork on problems and complaints*
*12am The way forward - groupwork on what should happen next Closure: 1pm*

**Attendance:** 11 women and 3 men (local residents), Mr Biyela (Department of Agriculture) + Thami Mthembu, Raymond Auerbach, Sifiso Ntinga, Sakhile Ngcobo (NCMP).

Mrs Meyiwa opened with prayer.

Sifiso explained that the purpose of the workshop was to evaluate the local farming activities, especially how effective FSG has been in helping with agricultural & craftwork development. He encouraged all present to feel free to air any problems they had, and yo speak frankly from their own point of view. Raymond gave a short outline of the process plan,

**Time line for Zimeleni Garden**
The meeting proceeded to construct a time line, to help review the progress of the garden.

70/80s Mpisane, Cele and then Nkabinde present as Agricultural Officers. Raymond visited the area while working as Professional Officer for KwaZulu Department of Agriculture, and noted a thriving community garden at EZakhiweni, with fields above under Mr Mpisana in 1979.
85-90 Violence, Mpumalanga & Ntshongweni, many people killed, AO Vilakazi leaves area.
90-93 Drought in the area.
1995 Heavy rains experienced around Christmas time.
1996 DAFTA gave club members food to eat and material off cuts for sewing.
Thami started working with club members.
Agricultural land was a problem - Parak leased them land, but Mboshobane circulated rumours that this land belonged to him.
Mrs Meyiwa went to DoA to request assistance.
Thami, Mrs Meyiwa & Edith from DAFTA went again, but no promises made.
Mr Meyiwa was hesitant about leasing land to the community.
1997 Mr Meyiwa signed a one year lease in April (no trees to be planted).
DoA (Inchanga) agreed to supply fencing materials for garden.
Zimeleni Garden was formed - gardeners erected the fence with help from Messrs Vilakazi, Biyela, Ndimande, Shoba, and Thami.
Thami pushed DoA (Inchanga) to plough the site; eventually done, but poorly.
Community recultivate the site; Thami demarcates plots.
Thami assists community to get chicken manure from Mr Nicholl's farm.
Each gardener contributed money towards seeds and seedlings; Thami purchased.
Gardeners draft constitution, join KWANALU.
1997.. Outer West Local Council promises money to Ntshongweni gardeners.

Official opening of Zimeleni (shortage of money for opening - Mrs Meyiwa asks FSG help, and Raymond eventually agrees to R300 assistance).
Thami and DoA carry out needs analysis for garden.
Sakhile demonstrates compost making, insect repellants and liquid manure.
Thami assists with demonstration on mulching.
Good initial harvests help local food security (some food sold).
Seedlings donated by CMR.

1998 Thami no longer helping regularly in the area.
Complaints about Thami and Mr Vilakazi from the women.
Establishment of Ntshongweni Farmers Association.
Poor seedlings supplied.
Expectations of gardeners high after hearing of Outer West funds - dependency.
Sifiso and Sakhile brought kraal manure, compost and seedlings.
Thami not seen often.
Size of garden increased.
Women say they don't want to Thami to work with them at Ntshongweni.
Investigation about the disappearance of the KwaNalu joining fees.
Permaculture workshop.
Gardeners attend sweet potato workshop at Nansindlela.
Thami helps with ploughing.
Gardeners participate in Mpumalanga Agricultural Show.
Formation of Ntshongweni Farmers' Association.
KwaNalu joining fees explained by KwaNalu officials - Thami absolved of blame.
Application for water metre-box from Durban Metro.
Gardeners receive garden tools.
Gardeners get seed potatoes.

**Group work on what has been good/ bad about the project**

Good aspects
Sweet potato workshop at Nansindlela (Sifiso).
Availability of chicken litter (Thami, Sakhile and Sifiso).
Seedlings and availability (Thami, Sifiso and CMR).
Resolution of disappearance of KwaNalu joining fee.
Fencing of the garden (Vilakazi, Thami, Biyela and Shoba).
Biyela sent tractor to garden.
Commitment and enthusiasm from Thami.
Gardeners received garden tools (Sifiso).
Official opening of the garden (Thami).
Permaculture workshop (Sakhile).
Mrs Meyiwa attended permaculture workshop at Stoffelton (Thami).

Bad aspects
Late arrival of seed, poor quality of seedlings (Sifiso).Late arrival of seed potatoes (Thami).

Delay in spending of Outer West money for agriculture (Outer West Local Council).
Lower yields in garden due to Thami's disappearance earlier on (Thami).
Failure to purchase seeds after gardeners requested this (Sifiso).
No receipts after paying to join KwaNalu (Thami and KwaNalu).
Thami not well trained in laying out the plots in the garden.

**Wise use of water**

Raymond then outlined the purpose of NCMP: the programme is funded by WRC to encourage community participation in catchment management. The new Water Law provides that communities should be involved in managing land and water, and finding ways to increase access of historically disadvantaged communities to resources. Three key technical innovations had been introduced to the community to help use their limited water resources more efficiently. These were mulch, swales and compost. Mulch conserves moisture, swales harvest and concentrate water where it can be most useful, and compost increases the moisture holding capacity of the soil. An important part of the evaluation is to assess whether all the time, effort and money which FSG has spent at Zimeleni has had an significant effect on improving the effectiveness of water use. Raymond commented that he himself is a farmer, and he knows that people can come onto a farm and give one advice, and leave again, and that the farmer has to decide whether the advice is practically useful to him or her. He is not therefore saying that these three innovations are good for everybody, but would rather know what people think about them, and why they have not applied them much.

Mulching

The community see the importance of mulching especially in conserving soil moisture and reducing soil erosion. Mrs Meyiwa felt that gardeners are lazy, and therefore have not done much mulching. They are determined to put this innovation into practice, as they know how to do it, and have seen how effective it is on Bachs Fen Farm.

Swales

Mrs Meyiwa pointed out that they have not heard much about swales, but that they would like to learn how to make them, as they realise the importance of water harvesting.

Compost

Gardeners have been using chicken manure, and have realised that compost is important, especially now that manure is more difficult to obtain.

**Way forward**

The community garden members are committed to rectify their mistakes and shortcomings, and ask that FSG also attends to the problem areas identified.
They feel that there is a need for a seedling nursery in the area.
Gardeners are committed to learning and sharing experiences with FSG facilitators.
They are resolved to get on with swale construction, which they see as important.

## APPENDIX 6: MINUTES OF THE FIRST UPPER MLAZI ACTION GROUP MEETING HELD AT BAYNESFIELD ESTATE 4/6/96

**Present:**

| Baynesfield Estate | Mondi Forests | Farmer Support Group |
|---|---|---|
| Paul Miles | Owen Odell | Barry Patrick |
| Glen Ireland | Raymond Auerbach | Doug Burden |
| Miles Mander (Consultant) | **Apologies:** Carl Seele | |

**Vision:**
As concerned land-users in the catchment, we would like to see the upper catchment **conserved, commercially viable** and with active participation by the **community**.

This means to us primarily improving land use practices in the area with an emphasis on farming practices which protect and develop wildlife habitats, ensure the long term sustainable use of natural resources and promote access to these resources for sustainable exploitation by local communities, as well as for the enjoyment of the broader public.

**Aims and objects:**
It was agreed that this will remain a loose action group which tries to identify practical projects in the Upper Mlazi Catchment which will contribute to improving land use, controlling alien plants and developing joint management activities.

**Who should be involved?**
It was agreed that all local farmers as well as community representatives should work together with those who are already involved in conservation and agriculture in the area. Charlie Arter, the Parks Board Zone Officer for the area, was mentioned, as well as the two local conservancies.

**Strategy:**
It will be essential to obtain the active support of senior management of both Mondi and Baynesfield Estates; both companies are already working actively on conservation and have detailed conservation plans for some aspects of their enterprises. The lease of land by Baynesfield to Mondi is at present being renegotiated, and this presents an opportunity for improving the siting of future forestry, and looking at ways of making Maybole a good example of sound conservation-oriented forestry.

* The conservation plan is already being implemented, and if afforestation on the steeper areas and near the water courses ceases, the positive impact should be significant. This will be modelled hydrologically and effects monitored.
* However, this does mean that the control of invasive alien plants will become more problematic, especially in the areas which are no longer planted; management strategies will have to be developed to deal with this.
* Myles Mander's suggestions from the April workshop can be developed, so that the open spaces at Maybole could become a source of revenue for local communities and for Mondi through the strategic cultivation of medicinal plants.

After a brief tour of some areas on Baynesfield estates, the meeting adjourned, having mandated Raymond to come up with some firm proposals which can be taken to management and to other land-users and communities within the upper catchment.

**Draft proposal for Mondi**

The vision is based on conservation, commercial viability and community participation. This implies that action will have to be based on an understanding of ecological principles, a systematic approach to conservation practices and maximum involvement of local communities with appropriate training and back-up (the Ntshongweni Catchment Management Programme is prepared to help with this), all under-pinned by cost-effective production.

The above points prompt me to suggest that for Mondi (and other timber farmers who participate), much of the programme should be systematically linked to harvest and post-harvest programmes. It will be very easy to take on too much if activities are not systematically linked into sound forestry practice. In addition to this, certain more urgent problems can be addressed on an *ad hoc* basis. The essential elements coming out of the two meetings (April & June) are:

**Harvesting:**
Ensure that timber is harvested in panels of 0,5 ha or less at any one time.
Use high-line timber extraction.
Avoid windrowing up and down the slope.
Minimise burning in whatever ways are sensible.

**Post-harvest:**
Earmark areas to be withdrawn from planting well ahead of felling operations.
Plan the future use of these areas (medicinal plants, grasslands, hardwoods, recreation).
Develop contracts with community contractors to prepare and plant the areas timeously.
Set up clear management contracts with contractors.
Monitor the implementation of land-use plans intervening where necessary.

**Other initiatives:**
Mondi: Target Mauritius Thorn in the upper reaches of the tributary streams; clear in spring. Try to work with a local group from Enthembeni Community as well, so that they can get some practical training, with a view to forming a contracting team (Raymond to find out about community dynamics through AFRA and Chief Zibusi Mlaba and Induna Mzweleni Mlaba).

Look at the development of a prototype hardwood forest with medicinal plants on the area adjoining the Oribi Reserve (old sugar cane lands, presently infested with bugweed). This area could also have some pine plantations, but would be designed as an integrated ecological forest to be selectively harvested once trees are mature, with on-going yields of bulbs and other medicinal plants. An area of approximately 50 ha is envisaged as a pilot research programme, with diverse inputs from the University of Natal, CSIR and others. Need

agreement from Baynesfield and Mondi to develop a research proposal for this area.

Mondi and Baynesfield: Identify key public access routes and develop an indigenous habitat creation plan with other landowners, with a view to marketing the tourist potential of the area.

Baynesfield: Develop reed-beds around the lower piggery effluent dam (Ikwane - *Cyperus natalensis* and Idumo - *Cyperus latifolia*) with a view to using nutrients (reducing pollution) and creating a filter with material which can also be used for handcrafts locally.

Ensure that the dairy effluent which currently flows into the river ceases once the new dairy is built, and that the new dairy and the other piggery have adequate water treatment systems; it should be possible to use the nutrients to grow crops, either in the same way as proposed for the lower piggery, or directly on commercial crops.

Look at the management of sugar cane and maize with a view to promoting biodiversity and designing some wildlife corridors, and trying to minimize nutrient flow into the river.

Raymond: To follow up on Entembeni Community and developments with Willowfountain (through Duncan Hay at Institute for Natural Resources). Try to set up contract alien plant team.

Principles of alien plant control: Concentrate on areas of low alien plant infestation first. The thickest areas will not get much worse, but the odd weed rapidly multiplies if not controlled. Hit these areas as systematically as possible, concentrating on one or two species at first (I suggest Mauritius Thorn and Bugweed be declared Public Enemies No 1 & 2). Programmes should be based on a three phase approach, according to Cedara: First, initial control; second, follow up six weeks later; third, maintenance every three months. If desired, Raymond is prepared to try to find some money to employ community people on such a programme in addition to the training of a small contracting team as suggested earlier.

## APPENDIX 7: REPORT OF ENTEMBENI PARTICIPATORY RURAL APPRAISAL 23/11/97

We (Sakhile and I) arrived to find Siyabonga Thabede waiting, and people gradually drifted in. Councillor Madlala arrived at 09h10, and explained that there was a Development Committee meeting at the school, which he would have to attend briefly, but could we carry on, as this meeting had the blessing of the Development Committee. We took a short walk around the fields while we waited for others to arrive, and noted deep Hutton soils with a high clay content and good structure and root penetration (at least 2 metres at a recent cutting made for the creche). Terraces were noted, and local people (farmer Mkhize) said that they had been made by ploughing, over the years. Although there had been regular ploughing, with different people having rights to different fields, this had gradually declined over the past ten years. Lack of draft power was given as one reason. A bank of sandy gravel was noted near the football ground, where local people mine the soil for building purposes. The presence of actively growing kikuyu indicates that soil phosphate levels are not bad. Locals say that potatoes do very well in the area. They buy seed potatoes at NCD or McDonalds in PMB, usually BP1 seed. They plant in August and get a good proportion of first grade potatoes. They were not impressed with my suggestion of red potatoes, as their experience is that these tend to yield small, inferior quality tubers. They use a lot of manure, and sometimes also fertiliser, and usually harvest 5 - 10 good tubers per plant. They also plant beans in Jan-Feb. Some beetroot and carrots are also planted, especially in the home gardens. The fields were mainly planted to maize, with some beans. Cabbage and onions were also planted. After I probed, it was admitted that other crops such as madumbe, sweet potato, ndlubo beans, monkey nuts and occasionally cowpeas were planted on a small scale. Beans have gone up in price even at the local (Indian) wholesaler, from R15/5 kg to R22.50/5 kg. Several farmers were very keen on the idea of setting up irrigation. It only became clear later during the transect walk that an old gravity irrigation scheme had been in use for years, but had gradually fallen into disrepair.

We started the formal meeting at about 10h00. Siyabonga took the chair, and after a request from one of those present, Mr Hlubi was asked to open with a prayer, which he did. I introduced the University, FSG and the programme, and suggested we concentrate on pressing agricultural issues, and at the next meeting we could look at the history, and then divide into garden, cropping and livestock groups. I asked a little about potential conflict between arable and livestock farmers, and was assured that there is a clear understanding of where cattle should be at which times of the year. There had been a fence along the arable land, but it had been stolen some years ago. Sakhile then took over leading the discussion at about 10h30. At this time, Madlala arrived, and there were 13 men and two women present. By 10h45, the number had increased to 17 men and 4 women. The question was put to us "What kind of help do we provide?" Tractors? Money? Facilitation? Sakhile responded, outlining FSG's approach to capacity building and planning. I added that one of our roles is to help communities to access resources, through KZNDA or others. I reported that Thami had contacted KZNDA at KwaGubeshe, and that they had expressed their willingness to work with the people of Entembeni. The point was raised that reticulation of irrigation water from the streams above Entembeni is a priority. Fencing of the arable land was also urgent. Ploughing was a major problem. Provision of inputs such as seed, and marketing difficulties were also raised as problematic. Mr Hlubi commented that he had had help from ACAT, but only as an individual. He had a lot of their pamphlets, and they could help communities, especially with setting up gardens. Another Mr Thabede said that it was imperative that people once again learn to use natural resources productively, as rising unemployment means that people have to become more self sufficient. By this time (11h15) there were 20 men and 6 women present. Someone asked whether it was possible to obtain monetary assistance for fencing the land. I asked whether anyone knew under what circumstances the government grant of R15 000 per household could be used. Councillor Madlala said that people should form groups. An agricultural committee would eventually have to be formed. for this purpose. People needed to show that they were serious about commercial production in the short and long term. People commented that cattle are relatively

easy to keep out of the fields, but that goats are quite a tough challenge. Farmer Mkhize suggested that people should form a company, and farm together commercially. Mr Madlala agreed that a good working plan for efficient land use should be developed. Raymond commented that it was important to ensure that as much good agricultural land as possible should be secured for agriculture. While the creche and the site of the proposed community hall, school and football ground made sense in terms of location, it might be possible to fit a community garden into this area, and have the arable fields in the adjacent area.

**Transect walk**

The meeting was closed with a prayer by Mr Hlubi soon after 12h00, with 20 men and 8 women present. After this, Raymond and Sakhile were accompanied on a transect walk by a number of those present, including Mrs Thabede, Siyabonga's mother. There was a lively discussion about the football ground, with some prospective agriculturalists feeling that the area set aside is too large. Severe infestation of Mauritian Thorn was noted. Apparently, it is used by some people as a livestock hedge (called *ulosisi* or *umthamtuna*?). An old community garden is still fenced next to the football ground on the far side. Walking back up into the upper valley of Entembeni, evidence around the households of good gardening skills was noted, although much land is lying idle. Lantana and Mauritian Thorn, as well as bugweed, are broadly scattered through the area.

About a kilometre from the creche, we crossed a small stream (about 20 *litres* per minute flow). We were shown a small dam next to this stream, which had previously been used as an irrigation sump. I thought that water had been led there from the small stream, but it later became clear that the upper stream had been piped through initially a 150 mm pipe, reducing to 50 mm heavy gauge black pipe lower down. This system had worked for years, set up, it seems, by a number of local farmers including Mkhize and Hlubi's father. Hlubi works for the University of Natal, and his father put them all through school by growing carrots and carnations! The stream where the water was abstracted has a flow which I estimated at upwards of 500 *litres* per minute. The area is breathtakingly beautiful, and I suggested that there is the potential for ecotourism if people wanted to develop a trail, and perhaps a craft shop and restaurant. There seemed to be some interest in this suggestion. Still heavy Mauritian Thorn infestation, however.

Mrs Thabede's homestead is a model of agroforestry, with a well-developed fruit orchard (mainly citrus and peach, some plum and avocado) interspersed with a thriving vegetable garden including cabbage, carrots, potatoes, beans and cucurbits. Outside one of the main buildings is a solar panel which powers the TV and some low-demand appliances via a battery charging system. We were all given very sweet oranges, picked by Siyabonga, before we continued up to the stream. On the way back, we called in at the neighbouring house of Mr Hlubi, and were shown the site of the carrot and carnation venture. He has recently had the area ploughed (cost for a patch of about 0.3 ha is about R60), but the heavy kikuyu growth has made the result a very uneven surface of sod, which he will have to rework. Mr Hlubi is nearly 60 years old, he tells me. Siyabonga accompanied us back to the creche. We left at about 14h30.

## APPENDIX 8: MINUTES OF THE UPPER BAYNESFIELD SUBCATCHMENT FORUM COMMITTEE MEETING HELD AT BAYNESFIELD ENVIRONMENTAL CENTRE ON 7/10/1998.

The meeting started at 10H00 SHARP. Mrs Ngubane opened the proceedings with a short prayer. Apologies were received from Inkosi Mlaba. Sakhile Ngcobo read the minutes of the meeting held on 24/9/1998. Several corrections were made, which are reflected in the corrected minutes (attached).

Attendance:
Angus Burns, JP Kennedy, LF Forsyth, B Mlaba, Siyabonga Thabethe, Richard Phungula, NZ Mkhize, Bheka Mchunu, Phineas Zondi, Alzina Ngubane, Raymond Auerbach, Alex Dlamini, Sakhile Ngcobo.

Matters arising from the Minutes:
It was agreed that Inkosi Mlaba, Induna O Mlaba, Councillor Nxumalo, Charlie Arter of the KZN Conservation Services, and William Pitchford (Working for Water) would all receive minutes from UBSC and would be welcome to attend from time to time.

Raymond Auerbach reported briefly on his discussion with Joe Hansman, DWAF Regional Director for KZN. Mr Hansman was very positive concerning cooperation with catchment management activities in the Mlazi River catchment, but explained that with DWAF's reorganisation it is not possible for the Durban office to engage at present with local subcatchment fora. However, he sees these as an important aspect of catchment management and acknowledges that DWAF cannot manage all aspects of land use and local water resource management. It is intended that 17 to 23 Water Management Areas will be established around the country, but the number and the boundaries have not yet been established. The Mlazi River catchment is likely to fall within a WMA which will include the Mgeni River, probably Illovu and Mkomazi, and possibly also Mzimkhulu and Mzimvubu Rivers. The practical problems relate to capacity in the various regions to manage rivers and to support ICM.

Mr Hansman says that DWAF will not have a catchment management agency for each catchment, but rather the WMA will function as a catchments management agency. The only level at which individual catchments may be represented is during the drafting of catchment management plans for each catchment. Catchment specific standards may be developed, as DWAF recognises that each catchment is unique.

Mr Forsyth asked whether Mr Hansman referred at all to Water User Associations, which have been discussed recently as a possible participatory institution to replace Irrigation Boards. Mr Auerbach replied that these had not been mentioned. After discussion, the UBSC drafted and adopted the following resolution (on the proposal of Mr R Phungula, representative for Willowfountain, seconded by Mr J Kennedy, Managing Director of Baynesfield Estates):

**RESOLUTION OF THE UPPER BAYNESFIELD SUBCATCHMENT COMMITTEE OF THE MLAZI RIVER CATCHMENT**

As requested by the full meeting of the Upper Baynesfield Subcatchment Committee on 21st September 1998, the duly elected committee of the UBSC resolved at its first meeting on 7th October 1998 that:

"UBSC is deeply concerned about the lack of provision in the new Water Law for representation of local subcatchment fora in decision making structures. Whereas the UBSC has come together in the spirit of the White Paper on Water to participate in Integrated Catchment Management in the Mlazi River catchment, there appears to be doubt about whether any formal channel will be created through which local people will be able to participate in the development of catchment management plans, catchment management agencies and water management areas. It appears that management agencies for each catchment may not be established, which UBSC feels will seriously compromise the participatory spirit of the policy on Water as reflected in the White Paper on Water. UBSC calls upon the Department of Water Affairs and Forestry to respond, and records its disappointment at the failure of DWAF to engage with the process of establishment of this forum and others in the Mlazi River catchment."

Mr M Z Mkhize enquired whether it is possible to inform other subcatchment fora and related organisations of our standpoint, and several of those present agreed to do so.

Angus Burns reminded us of the five main functions which we had agreed on for the UBSC:

1 Address environmental and social issues.
2 Plan and implement strategies to solve problems.
3 Encourage social and environmental responsibility.
4 Become an active part of local catchment management projects.
5 Represent this area on a catchment management structure.

Issues from the workshop and action planning

Fourteen issues were raised at the July workshop. These were discussed and group into the following six themes, listed in order of priority:

1 Livestock management.
2 Forestry management.
3 Invasive alien plant control.
4 Agriculture and craftwork production.
5 Soil erosion control.
6 Water pollution and environmental awareness.

The livestock issue is still a hot one, but significant progress has been made, through several meetings. Herdsmen have been appointed by Willowfountain, Entembeni and Etafuleni communities, and identification documents have been made for some of them already, authorising them to supervise cattle in specific areas. The following have been appointed:

| | |
|---|---|
| Willowfountain | Mr Mnikathi and Mr Mkhize |
| Entembeni | Mr Q Thabethe, Mr E Hlatshwayo and Mr B Madonda |
| Etafuleni | Mr Ndlovu and Mr Gwala |

Two more herdsmen are to be appointed for Willowfountain in due course.

Sakhile Ngcobo reported briefly that good progress has been made in developing a forestry management plan together with Mondi, which will see local communities managing some of the abandoned forestry areas which the workshop identified as problematic. This should see a major problem turning into a major asset for local communities. Craftwork and agricultural development are also progressing well, and will be discussed at the next meeting.

Election of Chair, Vice-chair and Secretary

The following criteria were felt to be important for UBSC Chair and Vice Chair:

- Chairing skills (the ability to challenge a meeting, and to give direction);
- Communication skills (Zulu and English language, telephone, mobility);
- Credibility with a range of the communities in the subcatchment.

Sakhile Ngcobo was elected Chair, with Owen Odell as Vice Chair (to be replaced by Mr Scott when Mr Odell leaves Maybole).

Angus Burns was elected Secretary, and will take the minutes in English.
Alex Dlamini will translate minutes.
Any communications for Sakhile Ngcobo (who is now living at the Joseph Baynes Training College) can be left at the Baynesfield Estates office.

Next meeting Friday 13/11/1198 at 10h00 sharp.

It was agreed that UBSC will handle the issues without any general discussion at the next meeting, dealing with them in the above order of priority, and emphasising action plans.

## SUMMARY OF THESIS

Without local participation, integrated catchment management and Landcare will not become a general reality in South Africa. With support from the South African Water Research Commission, the University of Natal's Farmer Support Group set up the Ntshongweni Catchment Management Programme (NCMP) as a practical participatory action research investigation of ecological farming systems, integrated catchment management and Landcare. Local experience played a crucial role in helping to build credible local networks and to understand the importance of design for a sustainable future. Since small scale agriculture in South Africa faces four major constraints (aridity, poverty, access to land and local leadership) main aspects of design were: ecological farm design for efficient water and nutrient use, community garden design for production with low risk of crop failure and low levels of purchased external inputs, environmental education design and design for communication. Practical work led to the design of a prototype of an ecologically sound community garden.

To address the risks associated with farming in South Africa's dry and often unpredictable climate, a rainwater harvesting system was set up on Bachs Fen Ecological Research Farm, as part of the ecological farming system. Water from the hill and highway above the farm flows through a wetland system. The wetland slows down the flow and purifies the water, and has a significant water storage function. At present 0.4 ha of vegetables is irrigated using over-exploited groundwater resources. The rainwater harvesting system makes it possible to irrigate one hectare using the water harvested from the wetlands instead of groundwater. At the same time, groundwater recharge is improved through increased rainfall infiltration. Bachs Fen is seven hectares in extent, and is one possible model of a small scale commercial farm which is ecologically sound, economically viable and efficient in terms of water use. The development of farms in the range of five to fifty hectares is vital, if land reform and reconstruction and development are to lead to rural areas which do not exclude most of the rural people who currently live there.

Technical and economic lessons learned on Bachs Fen were incorporated into a discovery learning programme which has seen eighteen community gardens, five craftgroups and twenty school environmental action clubs started in the Mlazi River catchment area, mainly around the Ntshongweni Dam, where the NCMP started its work in 1994. Over a period of five years, there has been increasing community participation in ecological agriculture and environmental conservation. Activities have included the gardens and the school enviroclubs, establishment of craftwork groups, control of invasive alien plants, planning activities for urban agriculture using stormwater runoff, the establishment of several conservancies including the Hammarsdale Industrial Conservancy, facilitation of cooperation between teachers, industrialists, farmers and developers, and the establishment of Conflict Resolution Committees and Subcatchment Management Committees.

Environmental education has been an important part of bringing about community participation in integrated catchment management. Adults took part in a range of activities which deepened their insight into local ecosystems and helped to build a catchment identity for the Mlazi River catchment. A physical model of the catchment helped with this process. The Mlazi River Catchment News contributed to building awareness among catchment residents and resource managers about the problems facing the catchment, as well as activities which

local people and groups were involved in to address these problems. The river biomonitoring programme has helped to pinpoint several problems in the catchment. As the record of chemical and biological aspects of water quality develops, understanding of seasonal patterns and of the influence of varying landuses will increase. This will help to develop sustainable catchment management strategies which optimise productivity, equity and conservation.

School Environmental Action Clubs (Enviroclubs) have helped children to learn about their local environment and how it fits into the catchment. Each school has developed a School Environmental Policy, and the Enviroclubs have developed Action Plans based on this policy. Recycling, controlling invasive alien plants, planting indigenous trees, starting school gardens and managing water effectively are the five main areas of Enviroclub activities. Annual competitions encourage students to work at improving the school environment. The Outcomes Based Education policy of the Department of Education is thus implemented in a practical way, as children apply theoretical concepts such as the hydrological cycle, soil fertility and plant nutrition, plant ecology and community health to their school grounds and the surrounding areas. Ecology means "knowledge of the home environment", and the Enviroclubs teach children about plants, river health, resource conservation and socially responsible leadership. Mpumalanga Township is already changing, as children help to develop an environmental ethic.

The research question for the programme was: "How can diverse communities often characterised by conflict, be helped to come together to learn about natural resources and systems, and to manage them collectively in a way which is productive and responsible?" Conflict management and an integrated approach effectively answered this question by showing that people are prepared to cooperate at local level, once they have begun to communicate. However, transforming conflict management into collective natural resource management requires outside facilitation by a neutral agency with skills in both facilitation of interaction and in natural resource management and ecological agriculture. Careful design of technical and social research processes required an understanding of ecosystems which did not define problems too narrowly. Design emphasised the broad connections between human behaviour and ecosystems function, and between actions at local level and actions at catchment, provincial or national level. Local subcatchment committees proved an effective way to bring people together to manage resources collectively.

Four design questions were examined in the course of the research programme. These were:

a What strategies are available to help improve food security in a way which addresses aridity, poverty and restricted availability of land?

b Are there effective methods of producing good yields of crops without resorting to the levels of fertilisers, poisons and other technologies which have produced the environmental problems currently being experienced in Europe?

c How can Bachs Fen Ecological Research Farm become more useful as a teaching facility?

d Can School Environmental Action Clubs effectively involve school children in caring for their local environment?

In addressing these design questions, the participatory action research programme was able to show how an integrated approach involving agriculture, forestry, water conservation, environmental conservation, health and education improves the use of resources and develops local capacity for rational and sustainable resource management. The spirit of the new Water Law (Act 36 of 1998) has been implemented in the development of these subcatchment committees, but the deficiencies of the law in failing to provide adequately for structures at local level which can bring about integrated resource management have been highlighted.

For the future of South Africa, the lessons learned from this research indicate that integrated approaches at local level should centre around a process of platform building, which enables local people to learn about resource management in an integrated way, while developing a joint vision, and adapting social norms and values towards the practical realisation of their vision. Local leadership is an important part of this process, and where local leaders were not prepared to put the needs of the community before their own personal power and prestige, very little progress occurred. Where accountable leadership was present, however, remarkable progress was possible, and diverse communities were able to find ways of moving forward together, to the mutual benefit of all concerned. The constraints to rural development (poverty, aridity, land and leadership) are themselves an expression of the relationship of people to their environment.

The contribution of the research programme to the development of an Environmental Management System for the Durban Metropolitan Area, and to the Durban Outer West Local Council's Integrated Development Plan helped both of these processes to take place with greater input from under-represented rural groups. The transformation of environmental management from the previous emphasis on maintaining pleasant environments in affluent suburbs, to the creation of more harmonious and sustainable environments throughout the Durban Metropolitan Area is now underway. Further development of Local Environmental Action Fora will be an important aspect of keeping this process on track, and promoting accountability and transparency. Linking Local Environmental Action Fora to subcatchments also allows for structures which cross community boundaries in an integrative way, where community skills and insights can become more available.

# Samenvatting van het proefschrift "Design for participation in ecologically sound management of South Africa's Mlazi River catchment"

Het geïntegreerde beheer van stroomgebieden en van landelijke gebieden in Zuid Afrika zal geen werkelijkheid worden zolang de bewoners ervan niet samenwerken. Gesteund door de South African Water Research Commission, startte de "Farmer Support Group" van de Universiteit van Natal het "Ntshongweni Catchment Management Programme" (NCMP). Dat programma had een op de praktijk en op actie gericht onderzoek over ecologische landbouw, geïntegreerd beheer van stroomgebieden en bescherming van het landelijke gebied, voor ogen. Ervaringen van locale bewoners speelden een zeer grote rol bij de realisering van geloofwaardige, locale samenwerkingsverbanden en bij het ontwerp van een duurzame toekomst. Kleinschalige landbouw in Zuid Afrika heeft te maken met vier beperkingen: droogte, armoede, locaal bestuur en beschikbaarheid van land. Daaruit volgden de hoofddoelen voor het ontwerp van:
- ecologische landbouwbedrijven als instrument voor het efficiënt gebruik van water en nutriënten;
- coöperatieve moestuinen met voldoende oogstzekerheden en tegelijk met een laag gebruik van externe inputs;
- milieu educatie en
- regionale communicatie en besluitvorming.

Desbetreffende activiteiten werden gegroepeerd rondom het praktische ontwerp van een prototype van een ecologisch gezond functionerende cooperatieve moestuin.

Om de risico's van de Zuid Afrikaanse droogte en het veelal onvoorspelbare klimaat voor de landbouw te kunnen inperken, werd als onderdeel van de ecologische bedrijfsvoering van het proefbedrijf Bach's Fen, een systeem ontworpen dat regenwater opvangt, verzamelt, zuivert en voor lange tijd opslaat (hierna "rainwater harvesting system" genoemd). Regenwater afkomstig van de heuvel en autobaan die boven de boerderij zijn gelegen, stroomt door een kunstmatig aangelegd moerasgebied. Dat gebied vertraagt de waterstroom, zuivert het water en heeft bovendien een opvallende opslagcapaciteit. Met de inmiddels zwaar overbelaste grondwaterreserves van het bedrijf, kan slechts 0,4 ha worden geïrrigeerd, terwijl het "rain water harvesting system" van datzelfde bedrijf de beregening van 1 ha mogelijk maakt. Bovendien verbeteren de grondwaterreserves, als gevolg van infiltraties vanuit het "rain water harvesting system". Bach's Fen is zeven hectare groot en kan worden gezien als een model voor een kleinschalig commercieel landbouwbedrijf dat bovendien ecologisch gezond, economisch levensvatbaar en in termen van water gebruik, efficiënt is. De ontwikkeling van landbouwbedrijven variërend van vijf tot vijftig hectare in het algemeen, is onder bepaalde voorwaarden levensvatbaar; verbetering, herverkaveling en gebiedsontwikkeling van land moeten leiden tot landelijke gebieden waarin het merendeel van de daarin levende rurale bewoners niet mogen worden uitgesloten.

De technologische en economische inzichten, opgedaan op Bach's Fen werden ingebed in een voorlichtingsprogramma gericht op ontdekkend leren. In het stroomgebied van de Mlazi rivier, hoofdzakelijk gelegen rondom de Ntshongweni Dam, waar de NCMP in 1994 met haar

werkzaamheden begon, ontstonden uit genoemd voorlichtingsprogramma achttien coöperatieve moestuinen, vijf kunstnijverheid groepen en twintig milieu beschermgs clubs voor schoolgaande kinderen. In meer dan vijf jaar groeide de betrokkenheid van de gebiedsbewoners bij de ontwikkeling van ecologische landbouw en milieubescherming. Die betrokkenheid omvatte onder meer de moestuinen en de milieuclubs van scholen, het ontstaan van kunstnijverheden, bestrijding van agressieve, exotische onkruiden, planning van activiteiten gericht op de ontwikkeling van stadslandbouw die gebaseerd werd op de toepassing van regenwater dat tijdens stormen versneld de bebouwde kom uitstroomt, het ontstaan van verscheidene natuurbeschermingsactiviteiten, waar onder de Hammarsdale Industrial Conservancy, de vergemakkelijking van de samenwerking tussen leraren, fabrikanten, boeren en ontwikkelingswerkers en tot slot de instelling van Commissies voor de bestrijding van conflicten en Commissies voor het Beheer van onderdelen van het stroomgebied.

Voor de ontwikkeling van gemeenschappelijke participatie in het geïntegreerde beheer van het stroomgebied, bleek onderwijs over het milieu erg belangrijk te zijn. Volwassenen hadden een aandeel in een scala van activiteiten, die hun inzicht in de werking van locale ecosystemen verdiepten. Hun gevoel van identiteit met het stroomgebied van de Mlazi rivier nam daarmee toe. Bij het leerproces werd gebruik gemaakt van een miniatuur model van het stroomgebied. Maar ook de verspreiding van de "Mlazi River Catchment News" droeg bij aan de bewustwording van bewoners van het stroomgebied en beheerders van de daarin voorkomende natuurlijke hulpbronnen betreffende de problemen waarmee het stroomgebied zich geconfronteerd ziet. Verder groeide de bewustwording door de activiteiten waarbij locale mensen en groeperingen werden betrokken om eerder genoemde problemen te bestrijden. Het biomonitoringsprogramma voor de Mlazi rivier hielp diverse problemen in het stroomgebied te accentueren. Naarmate de registratie van chemische en biologische aspecten van de water kwaliteit zich ontwikkelt zal meer begrip groeien voor hun samenhang met de invloeden van seizoenen en met verschillende vormen van landgebruik. Inzicht ondersteunt de ontwikkeling van op duurzaamheid gerichte ontwikkelingen van het beheer van het stroomgebied, hetgeen bijdraagt aan optimalisatie van productiviteit, sociale rechtvaardigheid en omgevingsbescherming.

De School Milieu Actie Clubs ("Enviroclubs") bracht schoolkinderen kennis bij over hun locale omgeving en hoe die weer past in het geheel van het stroomgebied. Elke school ontwikkelde daartoe een eigen School Milieu Plan, waarop de Enviroclubs hun activiteiten baseerden. De vijf hoofdgebieden in het actieplan van Eviroclubs betroffen: de bestrijding van agressieve exotische onkruiden, herplanting van autochtone bomen, oprichting van schooltuinen en water beheer. Een jaarlijks terugkerende wedstrijd stimuleerden leerlingen om het milieu rondom hun school te helpen verbeteren. Het beleid van het Ministerie van Onderwwijs werd aldus op praktische manier gerealiseerd. Immers kinderen bleken theorieën zoals de watercyclus, bodemvruchtbaarheid en planten voeding, gewas ecologie en volksgezondheid op en rondom hun schoolterreinen te kunnen toepassen. Ecologie betekent "kennis van de milieuhuishouding" en de Enviroclubs leert kinderen over planten, de gezondheid van de rivier, bescherming van natuurlijke hulpbronnen en sociaal geëngageerd leiderschap. Mpumalanga Township ondergaat inmiddels veranderingen ten goede, omdat kinderen helpen bij de bewustwording van de betekenis van het milieu voor hun overleving.

"Hoe kunnen verscheidene gemeenschappen, dikwijls gekenmerkt door conflicten, worden geholpen om samen te leren over natuurlijke hulpbronnen en systemen, teneinde hen op gezamenlijke wijze te beheren op een manier die productief is en toch verantwoord" was de onderzoeksvraag in onderhavig project. Door mensen te laten zien dat zij op locaal niveau bereid zijn om samen te werken, zodra zij begonnen zijn om met elkaar te overleggen, bleek ons dat conflict beheersing en een geïntegreerde aanpak daarvan, effectief mogelijk was. Maar daarbij moet wel worden beseft dat omzetting van conflict beheersing in collectieve aanpak van de bescherming van natuurlijke hulpbronnen, een beroep doet op de ondersteuning van neutrale instituties die ervaren zijn in zowel vergemakkelijking van interacties , als in de bescherming van natuurlijke hulpbronnen, alsmede in ecologische landbouw. Zorgvuldig ontwerpen van technische en sociale onderzoeksprocessen vereisen begrip van ecosystemen, waarvan probleemstellingen niet erg specifiek kunnen worden geformuleerd. Zulke ontwerpen benadrukken eerder de veelvoudige verbanden tussen menselijk gedrag en het functioneren van ecosystemen, alsmede tussen activiteiten op locaal, stroomgebied, provinciaal of zelfs nationaal niveau. De instelling van locale, op onderdelen van het stroomgebied gerichte commissies bleken een effectieve weg te zijn om mensen samen te brengen, teneinde hen gezamenlijk te brengen tot beheer van natuurlijke hulpbronnen.

In de loop van ons onderzoek werden vier ontwerpvragen nader onderzocht:

a welke strategieën kunnen bijdragen aan de verbetering van voedselzekerheid en wel op een manier die tegemoet komt aan droogte problemen, armoede en beperkte beschikbaarheid van land;

b zijn er effectieve methoden om behoorlijke gewas opbrengsten te verkrijgen zonder dat men zijn toevlucht moet nemen tot kunstmest, vergif en andere technologieën die de oorzaak zijn van de milieu problemen waarvoor Europa zich gesteld ziet;

c hoe kan Bachs Fen Ecological Research Farm beter gaan bijdragen als onderwijs gelegenheid en

d kunnen school milieu actie groepjes effectief bijdragen aan een beter beheer van het locale milieu?

Ons op participatie en actie gerichte onderzoeksprogramma kon aantonen hoe een geïntegreerde benadering van landbouw, bosbouw, water bescherming, milieubescherming, gezondheidsbescherming en onderwijs bijdraagt aan verbetering van het gebruik van natuurlijke hulpbronnen en bijdraagt aan het vermogen van de locale bevolking om bij te dragen aan een rationeel en duurzaam beheer van natuurlijke hulpbronnen. De geest van de nieuwe Water Wet (Act 36 van 1998) is ingebed in de ontwikkeling van desbetreffende "subcatchment" commissies, terwijl de tekortkomingen van die wet, de adequate voorziening van structuren op locaal niveau die ertoe bijdragen dat het beheer van de regio op samenhangende wijze geschiedt, zichtbaar zijn geworden.

Voor wat betreft de toekomst van Zuid Afrika heeft ons onderzoek geleerd dat geïntegreerde benaderingen op locaal niveau moeten worden gecentreerd rondom een proces van platform vorming. Dat helpt bewoners te leren over het samenhangende beheer van natuurlijke hulpbronnen, onder gelijktijdige ontwikkeling van een gezamenlijke visie en aanpassing van sociale normen en waarden bij de praktische uitvoering van hun visie. In zo'n ontwikkeling is locaal leiderschap belangrijk, immers gebleken is dat locale leiders, die niet geleerd hadden om de behoeftes van de gemeenschap voorop die van hun eigen macht en prestige te stellen,

weinig vooruitgang konden boeken. Maar waar verantwoord leiderschap aanwezig was, bleek opmerkelijke vooruitgang mogelijk te zijn en bleken verschillende gemeenschappen in staat te zijn om gezamenlijk en tot wederzijds voordeel voor allen die daarbij betrokken zijn, vooruit te komen. De beperkingen bij rurale ontwikkeling (armoede, droogte, landbeschikbaarheid en leiderschap) kunnen worden beschouwd als uitdrukkingen van de relatie tussen mensen met hun omgeving.

De bijdrage van het onderzoeksprogramma aan de ontwikkeling van een Environmental Management System voor de Durban Metroplitan Area en aan de Durban Outer West Local Council's Integrated Development Plan hielp beide processen tot stand brengen met een grote inbreng van anderszins ondervertegenwoordigde rurale groeperingen. Het milieu beheer van voorgaande plannen, legt de nadruk op het feit dat de handhaving van een prettige leefomgeving in welvarende voorsteden thans wordt omgevormd in de aanleg van harmonieuze en duurzame leefomgevingen door het gehele gebied van de Durban Metropolitan Area. Om het bovengenoemde proces in gang te houden, verantwoordelijkheden te benadrukken en transparantheid te bereiken, zal de ontwikkeling van Local Environmental Action Fora een belangrijk aspect zijn. Door Local Environment Action Fora te verbinden met subniveau's van het stroomgebied, ontstaan bovendien structuren die de grenzen van gemeenschappen op samenhangende wijze, met elkaar verbinden. Vaardigheden en inzichten afkomstig van kleinere gemeenschappen kunnen dan beter beschikbaar komen.

## *BIOGRAPHICAL RESUMÈ OF RAYMOND AUERBACH*

Born on 24th September 1953 in Johannesburg, being a South African has always been important to Raymond Auerbach. His main interests are development of sustainable farming systems, initially as a farmer trying to develop and apply sustainable methods, and for the past fifteen years as an agronomist and rural development researcher, using participatory techniques of rural appraisal to identify problems of rural development and the farming systems research approach to work with local communities on improving agricultural practices and catchment management.

On the more philosophical side, understanding the links between how knowledge is gained and how humanity progresses towards a greater consciousness of the unity behind our diversity has been a major focus of activity, which has been nourished by the School of Philosophy, and the study of language, especially Sanskrit, the mother of all languages. Raymond married Christina Brett, midwife, farmer, musician and craftswoman, in 1984, and they have three children.

Raymond's involvement with agriculture started in 1972, when he worked as Agriculture Instructor at Camphill School for Children in Need of Special Care in Hermanus in the Western Cape Province. He then trained with the Biodynamic Research Institute of Australia from 1973 to 1976; this included apprenticeships as a dairy and vegetable farmer, and training in sustainable agriculture and soil science. After brief spells as Managing Director of Aquarian Estates (Pty) Ltd, Professional Officer for the KwaZulu Department of Agriculture, farm manager and later managing partner of farms in Kokstad, Raymond set up Biological Systems Consulting and Research, undertaking farm planning, work on eco-agricultural policy, and integrated catchment management. He purchased his own farm in 1981, and having established it as an ecological dairy farm, he set out to complete his scientific training, while working as Senior Technician at the Agronomy Department, University of Fort Hare, and then as Research Fellow at the Institute of Natural Resources, University of Natal. He and his wife purchased Bachs Fen Farm in 1991, which they run in partnership with Mabuye Ngubane. In 1993, Raymond was appointed Research Co-ordinator of the Farmer Support Group, still at the University of Natal. He has supervised several MSc students from The Netherlands and South Africa, and served on a number of government working groups on policy and research, publishing a wide range of scientific and popular papers over the past fifteen years.

# BIOMONITORING IN THE MLAZI RIVER CATCHMENT

The Ntshongweni Catchment Management Programme (NCMP) has started a bio-monitoring programme in the Mlazi River catchment as a means of assessing the biological health of the Mlazi River and its tributaries.

The biomonitoring results are displayed on the map. This is the second set of results, the first of which were produced in the December 1998 edition of Mlazi Catchment News.

Biomonitoring will assist in monitoring water pollution in the Mlazi River catchment. It will contribute to the nation-wide River Health Programme which aims to monitor aquatic systems so that corrective action can be taken if a system is threatened or degraded.

River health can be assessed using biological, physical or chemical indicators. Biomonitoring focuses on the first of these, making use of the South African Scoring System (SASS) which is a biotic index for the rapid biological assessment of water quality.

Biomonitoring using the SASS technique is done by sampling the benthic invertebrates which live in a variety of habitats in the river. These habitats include stone, gravel, sand, mud or vegetation.

Benthic invertebrates are animals such as worms, crabs, dragonfly larvae, water bugs, water beetles, fly larvae and snails which live on the river bottom.

A sample is collected in a standardised way from as many different biotopes (habitats) as are available. The invertebrates found in the sample are identified to family level and each is assigned a value based on its tolerance or sensitivity to organic pollution (1 = very tolerant, 15 = very sensitive).

Both the total and average value of all the families is used in interpreting the results, as well as a habitat quality index.

The habitat is carefully assessed as the greater the diversity of biotopes, the greater the potential biotic index score. The converse is also true because where a low diversity of biotopes occur, then habitat availability for invertebrates will be poor, and a low score can be anticipated.

A unique advantage with biomonitoring is that it will pick up any pollution incidents which have occurred at a site in the past several weeks. Impacts on a river can be recorded long after the cause of the impact has disappeared. It is therefore useful as an indicator of the medium term biological health at a site.

# DESCRIPTION OF MAP

For details on which families of aquatic invertebrates are found in the Mlazi River catchment, see the first map and accompanying description in the December 1998 issue of Mlazi Catchment News. Please note that the numbering of sample points has changed since the last map as some new points have been added and others have been removed.

## Mkuzane River

### Sample points 1-3

Biomonitoring was undertaken at sample points 1 to 3 to gain an idea of the biological health of the upper Mkuzane River and to look for possible reference sites.

As expected, the highest SASS score was recorded at sample point 1 as there is little in the way of development or farming activities in the catchment above this point.

The biological health drops slightly at point 2 but is still categorised as good. Forestry comprises the largest landuse in the catchment above this point.

Biological health then drops to moderately impacted at point 3. Farming activities are more intense and mixed in the catchment above this point with more people living in the area and using the river for activities such as clothes washing. In addition, a closed canopy of trees occurs at this site which can contribute to lower SASS scores.

## Mlazi River
## Sample points 4-10

From the map, it can be seen that biological health in the Mlazi River at points 4 to 9 is good. No data was available for point 10, although biological health is usually good here.

River health is expected to drop off from point 9 (which receives run off from only a small portion of Mophela) because of faecal contamination from Mophela and Mpumalanga Townships. By the time water flows past point 10 much of the sewage pollution would have been broken down by oxidation and decomposition, resulting in the improved biological health usually recorded at site 10.

## Sterkspruit River
## Sample points 11 -13

Biological health at point 11 remains moderately impacted. This point receives discharges from the Hammarsdale Waste Water Works and any effluent spills which come from the Elangeni Industrial area (approx. 5km upstream). Faecal contamination from informal settlements upstream may also be contributing to this impact.

Point 12 is a new sample site chosen to monitor the effects which quarrying and sandwinning activities in the area may be having on biological health. When sampled on 27 November 1998, biological health at this point was moderately impacted. However, when sampled recently on 15 February 1999 the result indicated that biological health was good. This indicates that sedimentation may be having a negative effect on river health here, but further investigation will be necessary to clarify this. Biological health at point 13 remains good.

## Wekeweke River
## Sample points 14 - 16

Biological health at point 14 has dropped from good to moderately impacted since it was previously sampled. It is likely that the recent flooding experienced in this area has impacted on the aquatic invertebrates in this particular reach of the Wekeweke River. Aquatic invertebrates here would be particularly vulnerable as most of the river bed comprises bedrock which provides little protection from the effects of flooding.

Sample point 15 remains moderately impacted but biological health at point 16 has improved from moderately impacted when previously sampled to good when recently sampled.

## Mgoshongweni River
## Sample points 17 & 18

The two main landuses in the catchment above sample point 17 are sugarcane cultivation and a landfill site. Sample point 18 is on a tributary of the Mgoshongweni River and was chosen as it contains sugarcane fields in its catchment but no landfill site.

Biological health at point 17 has experienced a major impact with no aquatic invertebrates being found and a smell of leachate occurring here with a dirty white froth on the water surface. The SASS score recorded for this point was 0, resulting in biological health being categorised as poor.

In comparison, 8 families of invertebrates were found at point 18 with a SASS score of 53 and an average score per taxon of 6.6. These families included pollution sensitive families such as Amphipoda, Leptophlebiidae and Philopotamidae.

When previously sampled (17/9/98), point 17 had 5 families, a SASS score of 18 and an average score per taxon of 3.6, confirming a reduction in biological health over time at this site.

## Cliffdale River
## Sample points 19 & 20

These points were chosen to assess the impact of a spill of petrochemicals and Red Bull energy drink into the Cliffdale River resulting from two road accidents (on 8 & 14 December 1998). These occurred on the N3 at the bridge over the Cliffdale River.

Point 19 is situated on the Cliffdale River above the spill site and a range of invertebrate families typical of a moderately impacted site were found here. A major impact on biological health was recorded at point 20, just downstream from the spills, with no aquatic invertebrates being found here (SASS score of 0).

However, point 20 was resampled on 9 February 1999 and had recovered from a status of poor to a status of moderately impacted. The Cliffdale River under normal conditions seems to be moderately impacted, which is most likely to be a result of diffuse sources of pollution from farming activities in the area.

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# MLAZI RIVER CATCHMENT

## Biological Health of rivers based on SASS scores