PEOPLE AND SOUTH AFRICAN INTEGRATED CATCHMENT MANAGEMENT

PILOT PHASE REPORT OF

THE NTSHONGWENI CATCHMENT MANAGEMENT PROGRAMME

by

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WRC Report No: 684/1/97
ISBN 1 86845 359 6

PHILOSOPHICAL FOREWORD AND OVERVIEW OF REPORT

Integrated Catchment Management (ICM) has become the international "Flavour of the Month" for the new century. Following on the "Green Revolution" of the 'sixties, "Integrated Rural Development" of the 'seventies, "Sustainable Development" of the 'eighties, and "Participatory Rural Development" of the 'nineties, the cynics argue that ICM is yet another attempt to conceptualise common sense development initiatives which try to operate within the whole system in which poor people in developing rural areas find themselves. Since the Rio summit in 1992, and its Agenda 21, integrating environment and development has become almost the entrenched approach, at least in politically correct circles.

The unpalatable truth is that "outsiders" no matter how well-meaning, can never "develop" anyone. Personal growth requires that each of us look into ourselves after looking around us, and take decisions involving discipline or indulgence, short term or long term goals, larger or smaller communities, and idealistic or materialistic approaches. Helping people to look around, to see the wider world, the bigger picture, the nobility of humanity, the magnificence of nature, the possibilities of technology - outsiders can help with this process. Accessing resources, helping to plan their efficient use, building networks, helping to build platforms so that people from different backgrounds can negotiate concerning resource use, these are also legitimate goals. The Farmer Support Group has always tried to act as a learning organisation. We are not experts who bring knowledge to ignorant communities, but rather partners who share in a learning experience. We do have knowledge, our experience and other resources which we bring, but so do the communities we work with. Applying this partnership approach to ICM has been exciting and rewarding. Exciting because the programme has been far more successful than we dared hope.. Rewarding because it has given us faith in the readiness of the people of South Africa to work together for the general good in situations where they could see that something worthwhile could be achieved for everyone.

The ICM approach is simply an approach which takes as its basic unit a river catchment or sub-catchment; ICM tries to put people and their needs in the centre of the picture, while balancing the short-term needs of individual people with the longer term needs of society. This is also true of a host of participatory approaches and systems-based approaches. So, social scientists, economists, agriculturalists, ecologists and water managers find themselves coming closer to one another, but still looking at development planning from the perspective of their particular discipline. This is not unhealthy, as long as there is a commitment to serve the client communities involved - diversity brings the freshness of many points of view. Since it is ecologists, hydrologists and water managers who think in terms of river catchments, it is hardly surprising that historically most catchment programmes have focused on water rather than on people. The danger is that planning and re-planning take up too much of the resources, and implementation of plans becomes a matter of almost secondary importance. The reality is that people seldom "buy in" to plans that they have not helped to formulate. The tendency to see the "Catchment Plan" as the be-all and end-all of ICM is a symptom of technocracy in ICM. Yet much of ICM implementation is not different from good agricultural planning, regional development, economic reconstruction or sound natural resource management.

Part of the difficulty is that so many different agencies are involved in all of the above already, especially in the emerging New South Africa at the end of the 20th century. Given the columnar structure of government, with numbers of departments with their responsibilities and lines of delegation from Chief Directors in the capitals, to Regional Directors with their structures in larger cities, to Supervisors in towns and their Technicians who actually work with the people, it is not surprising that junior staff from different departments often have a really tough time getting permission to work together in the field in service of the community which they serve. In building effective local government structures, natural resource management and catchment conservation are often not high priorities although it is often the poor who are most dependent on natural resources, and who directly make use of springs, rivers and the riverine environment.

The technical and social design aspects of this programme will be addressed in the final scientific report to be produced in 1999. The aim of this report is to discuss the practical benefits and difficulties of implementing ICM in South Africa today.

The report addresses six key questions in the light of experience in the pilot phase of NCMP: After a brief introduction to the Mlazi River Catchment, the process of starting with ICM is described covering the period 1994 to 1997. This is presented in such a way that it leads to the question "What is participatory catchment management?" In highlighting some of the difficulties encountered and analysing these, the limits of participation are then investigated. While much has been said about the importance of using local expertise, the practical difficulties of this approach are sometimes under-estimated. Being a local resident in the catchment, as well as Programme Coordinator has advantages and disadvantages. I have highlighted some of these in order to consider appropriate structures for catchment management agencies (CMAs) in South Africa as envisaged in the White Paper on Water (DWAF, 1997). Included as Appendices are a paper on our participatory approach to rural development (Appendix 1), two articles reporting on associated activities (Appendices 2 & 3), a paper describing water harvesting processes (Appendix 4) and a paper by Professor Eric Goewie giving an overview of ecological agriculture in Europe (Appendix 5).

In South Africa, DWAF has put the development of catchment management plans in the centre of the Philosophy of ICM (DWAF, 1996). Görgens *et al.* (1997) have already pointed out that integrated water resource management is a process, and the development of catchment management plans is only one part of this process. The need to start by developing local capacity is referred to by them, and this is discussed, highlighting the danger of rapid centralisation of decision-making. Finally, disturbing aspects of DWAF's tendency towards a command economy of water are highlighted, showing the likelihood of conflict as a necessary result of DWAF's current management style. This is juxtaposed against the excellent record of delivery which DWAF has built up, and the politics of democracy are discussed in the context of this tension between process and product.

The report concludes by recommending CMAs take an integrative position working with DWAF, with conservancies and the Department of the Environment and Tourism, and with Agriculture's proposed Landcare movement.

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ACKNOWLEDGEMENTS

The South African Water Research Commission for the major part of the programme's funding, and in particular Mr Hugo Maaren for his guidance and support.

Members of the programme steering committee for their positive engagement.

The Chief Executive of Umgeni Water for funding and support, and the many Umgeni staff who have helped with various aspects of the programme and served on the steering committee, in particular Dr John Howard, Dr Chris Dickens, Dr Quentin Espey, Mark Graham, Steve Terry, Manu Pillay, Steve Camp, Bongi Thabethe, Penny Gumede and Derek Hawkins.

Msinsi Holdings for office space for Barry and Sifiso, and for Barry's flat, and for help with many practical projects, especially from Nonhlanhla Kunene, Mike Mkhize and Nick Tredger, and earlier from Steve Hulbert.

Peter Gardiner, Doug Burden, Richard Leibnitz, Owen Odell, Glen Ireland, Dean Morgan and the recycling section from Mondi Forests for cooperation at Maybole Estates, financial support with the catchment model and costs of planning at Maybole, help with recycling and the cooperative spirit seeking improved approaches to forestry and community involvement.

Angus Burns, Lawrie Forsythe and Dr Mike Lowry from Umlaas Irrigation Board for the pro-active approach which has characterised our relationship, and their vision in starting the UIB Catchment Project.

Sharenet/ Wildlife & Environment Society for support with Environmental Action Clubs and advice from their wealth of experience, in particular Dr Jim Taylor, Kim van Wyk, Claire Holland and Wayne Peddie.

The Agricultural Catchment Research Unit (ACRU) - in particular Dr Simon Lorentz and Professor Roland Schultze for their help with measuring and modelling hydrology.

The Institute for Commercial Forestry Research for giving us access to research libraries and office space for Bart and Rutger.

The Wageningen Agricultural University in The Netherlands - in particular Professors Eric Goewie (Ecological Agriculture) and Niels Röling (Innovation and Communication) and the various students who have helped us to date: Kees Wisserhof, Peter Verburg, Bart Barten, Rutger van Heck, Léonie Berkouwer, Hilke Jansen.

1 Introduction: Why Ntshongweni - why the Mlazi river catchment?

South Africa has the potential to build mutually beneficial interactions between the developed and developing sectors of the economy, and the University of Natal's Farmer Support Group tries to facilitate this process, while acting in the interests of resource poor farmers. It is the nature of water to hold things together, and our country, which is semi-arid, needs to bear this in mind, as our aridity in terms of rainfall may be a reflection of our spiritual aridity. The Upanishads tell us:

> This subtle water holds everything together;
> it refreshes and cleanses and carries unwanted matter away.
> It is the great bonding force uniting things as one.
> It is the symbol of grace, life and love.
> Grace is like the dew or rain,
> life is like the flowing river,
> and love is like the ocean.

The common thread within the Ntshongweni Catchment is the Mlazi River. The programme has tried to use it as a unifying factor in the catchment, and to promote participation from local people in caring for the resources of the catchment, rather than plundering them in a selfish and destructive way. Social processes and the building of a sense of ownership among local people are complex processes. Since I live in this catchment, it was the natural place to start with ICM. My wife Christina, our partner Mabuye Ngubane and I have developed a small ecological farm at Peacevale, between Durban and Pietermaritzburg (Verburg, 1996; Auerbach & Jansen, 1997 [Appendix 4]; Jansen in preparation). During the early 'nineties, local people approached me, asking for help with their community gardens. Having had contact with the Ntshongweni community in the 'seventies, I decided that I would rather help these people who are our neighbours, and who have suffered a great deal through violence and drought, than far away communities where I had no experience of the farming systems involved.

The more I looked at the Mlazi River catchment, the more I realised that it is a microcosm of South Africa: the upper catchment has large scale commercial forestry, grazing and irrigated vegetable and sugar cane production, interspersed with black communities characterised by poverty and lack of access to resources. The middle of the catchment 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 lower catchment has some small peri-urban communities, with some beautiful riverine environments, and many opportunities and needs for sound planning of a rapidly urbanising environment. Most of the lower catchment falls into the southern part of the Durban Metropolitan Area. Umlazi Township, Wentworth and Merebank in this Southern Industrial Basin, have major air and water pollution problems, and are chronically under-developed.

The programme started at Ntshongweni, responding to a community request for help. Ntshongweni is a rural area between Durban and Pietermaritzburg, near Mpumalanga Township and the Ntshongweni Dam (sometimes spelled "Shongweni", also in the

names of many organisations). The Mlazi River and the Mncadodo (or Sterkspruit) flow into Ntshongweni Dam. During the 'eighties, Ntshongweni and Mpumalanga were at the centre of political violence. In 1989, the Ntshongweni community came together and hammered out the Ntshongweni Peace Accord, and in 1990, the better known Mpumalanga Peace Accord was concluded. These have proved to be two of the most effective peace agreements in this violence-torn province, KwaZulu-Natal (Auerbach, 1994). The area is typical of the province, having large urban and rural populations with very poor recreational, educational and local government infrastructures. Mpumalanga with about 150 000 residents, does not have a single public library, and has almost no recreational facilities (Shangase, 1992). Although there are about forty schools in the area, facilities are very poor, with few laboratories and only rudimentary book collections. Even the Mpumalanga College of Education has very limited facilities.

The adjacent Hammarsdale Industrial Estate has many textile factories, as well as a range of other industries, many of which produce effluents which contribute to the overall depressed and polluted environment. Hammarsdale Industrial Area was established in the 'sixties as part of the *apartheid* government's decentralisation policy, in order to keep black people out of Durban. Industries were told that there would be no strict pollution controls, and vast subsidies were paid to help them establish themselves. Combined with an inadequate sewerage system at Mpumalanga, large areas of informal settlement, extensive quarrying and sand-winning and intensive agriculture, the result is an unacceptable level of environmental degradation (Auerbach, 1995). This can be seen in the Ntshongweni Dam, which was the main source of water for Durban from 1930 until it was decommissioned in 1992 because of 60% siltation and the huge expense of purifying the heavily polluted water.

Industry and agriculture have a vital role to play in the local economy, and what is needed is positive engagement between all players, so that industry and agriculture can continue to develop, while waste is properly managed and the access to resources for black communities is improved. This would constitute sustainable development in the context of integrated catchment management.

2 How did we start the catchment management programme?

It was the juxtaposition of a typically under-developed black area with the heroic determination of local people to build a peaceful society which led to the decision to help local people to access resources by developing the Ntshongweni Catchment Management Programme (NCMP). The NCMP is a joint initiative of the University of Natal's Farmer Support Group (FSG), the Water Research Commission, the Department of Water Affairs and Forestry, Umgeni Water, Msinsi Holdings and a host of local groups and organisations. Initially, the emphasis was on doing what FSG does around the province: helping resource poor small scale farmers to use their land in a way which is economically and ecologically sound. The fact that the programme has grown from this foundation of encouraging good land use is probably of fundamental importance. As farmers, we are able to talk to farmers, we have farming skills, we could

make good suggestions about improved land use. Although there was some suspicion initially from commercial farmers, who feared political interference, the fact that all of the initial team members were local people reassured them, and the discussions always centred around positive progress and self-regulation. These factors are discussed in more detail in section 4.

Appendix 1 describes the process of engaging with small-scale farmers at Ntshongweni (Auerbach, 1996), using participatory rural appraisals, vision building exercises and participatory land use planning to help design ecologically sound farming systems (Mascarenhas & Pretty, 1991). The process is summarised in Figure 1, showing that implementation requires a parallel process of capacity building if it is to lead to sustainable development.

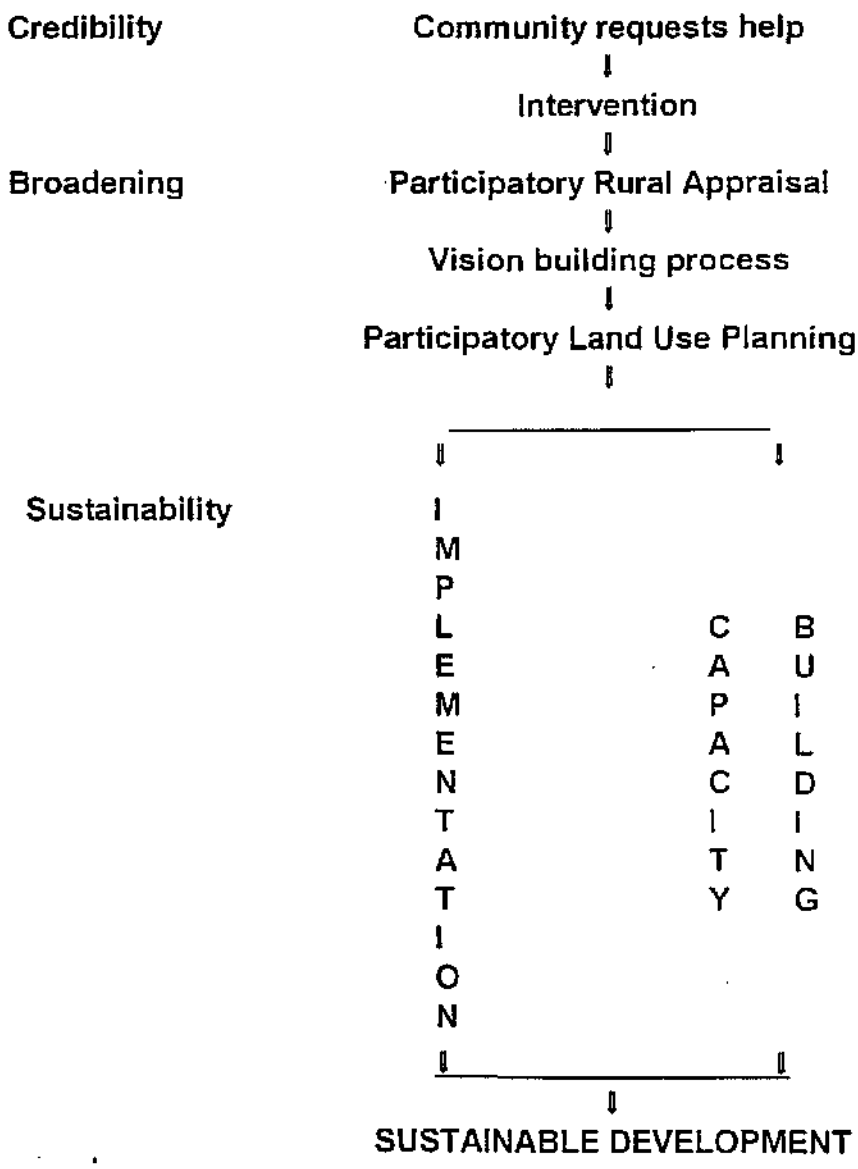

Figure 1: RURAL DEVELOPMENT: NO MODEL BUT A PROCESS (Auerbach, 1996)

Our experience at FSG in working with communities served as the basis for helping people to analyse their own situation, and helping them to become involved in taking action at local level. Along with many others, we long ago rejected the traditional approach to agricultural extension as a process of "Technology transfer" (Röling, 1988, Bawden, 1992). This fact is even reflected in the name of the organisation. We are farmers offering to work with other farmers, to share experiences and to go forward together. In this, we find much in common with recent trends in environmental education, where interactive learning processes have been found to be far more effective than the presentation of messages. As Taylor (1997) puts it "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". In moving beyond structural functionalism, FSG, like Taylor and many others, realises that social change is not a matter of technical and administrative reform (Popkewitz, 1981).

Our first activities were centred around Ntshongweni, with the emphasis on ecologically sound land use. Early work led to heated debates with Kees Wisserhof who carried out his MSc through Wageningen Agricultural University under the supervision of Dr Gerard Oomen with me as co-supervisor. He felt that I had no right to push local people towards ecological agriculture, when they simply wanted to increase their cash income. My response was that we had a duty to help them to understand the long-term implications of the way that they were farming. This is where the responsibility of the outside "development agent" lies. Try as I may to present myself as local, my education and my wide experience in agriculture also make me aware of the dangers of high input, green revolution agriculture. My role was helping local people to find solutions which would make them less dependent, not more dependent.

With Kees, we analysed local farming systems, in particular the system on our own farm, Bachs Fen, and on the nearby farm of the Sookoo family in Cliffdale, where vegetables are produced commercially (Wisserhof, 1995). This information was used to help Ntshongweni people design their own farming system. The help of Professor Eric Goewie, Head of the Department of Ecological Agriculture of Wageningen Agricultural University (WAU) was critical here. We used WAU's linear programme FARM to analyse our farm and to help optimise nutrient flows and enterprise selection and Prof Goewie's methodology to redesign farming systems (Goewie, 1995). Professors Goewie and Niels Röling (Department of Innovation and Communication at WAU) both supported the shift from attempting a conceptual academic approach, to a more responsive inter-active design process. We linked the development of new ecological farming systems to what we had learned on Bachs Fen, and what scientists at WAU had learned about some of the crucial factors in nutrient cycling and optimal enterprise selection through the agricultural crisis in Europe (Goewie, 1997 [Appendix 5]). This helped us to understand some of the strong and weak points of the Ntshongweni farming system, and how to optimise soil and water conservation (Verburg, 1996). It is important to note that each community is different, and the key is to help communities to engage practically in developing their own plan, as pointed out by Taylor and Popkewitz above.

In moving from engagement with the Ntshongweni Community during 1995, to a broader engagement with a range of communities within the catchment, three factors were of great significance: firstly, the Water Research Commission (WRC) funded the employment of three people to help with the programme; secondly, the people appointed were all locally involved and already locally known; and finally, the programme's start coincided with the emergence of local and national structures reflecting a political will to bring about more sustainable natural resource management. Without the financial resources provided by WRC and the support provided by FSG, with its political and academic credibility, it is likely that progress would have been very much slower. The fact that staff were locally active people meant that the programme automatically acquired three sets of local perspectives to augment my own. This had many advantages, but also brought with it the danger that we would only see those four views of reality. However, it gave us plenty of work to do, both in addressing the needs of which staff were aware, and in broadening our perspective through actively meeting people throughout the catchment, and through commissioning studies into aspects of resource management, mainly by MSc students of the Universities of Natal and Wageningen in The Netherlands (e.g. Wisserhof, 1995; Verburg, 1996; Van Heck & Barten, 1997, Patrick, 1997; Jansen, in preparation; Berkouwer, in preparation).

Sifiso Ntinga, our development facilitator, was on the committee of the Salem Development Committee. That he now chairs the committee is mainly because he is a highly competent networker able to attract resources to his community, but also because he has received additional training and experience through NCMP. Investments in the training of local staff are thus also investments in local capacity building. Sifiso sits on the local Shongweni Landfill Site Monitoring Committee, representing, not NCMP but the Salem Development Forum. He has been able to lobby local councillors, as a result of which NCMP is well respected in the Durban Metro's Outer West Substructure; we serve on their environmental advisory committee and they have asked us to administer funds for agricultural development in four areas. We are currently working with them to establish an Environmental Education Resource Centre which will act as a headquarters for our school Environmental Action Clubs.

Thami Mthembu was put forward as agricultural facilitator by community gardeners at Ntshongweni, and has been invaluable in building links with the KwaZulu-Natal Department of Agriculture (KNDA). Through his efforts, fencing material has been made available to community gardens and drought relief money has been accessed to pay local people to dig out dams by hand and to fence their fields. When it came to fencing the fields, it was critical (and rather difficult) to refuse to pay for fence wire. Thami had persuaded KNDA to provide fence poles, and locals felt that we had a big budget and should pay for the fence wire. We pointed out that they were already receiving the benefit of a full time agricultural facilitator backed up by other staff, and that there were many other communities needing assistance, not only them. If they wanted their fields fenced, they had to cover the costs of the wire. Eventually they agreed, and also later paid for hiring a tractor to plough the fields. To date, Thami has started three community gardens in the Ntshongweni area, and another three in nearby Mpumalanga Township. While he has handled the production aspects, Sifiso Ntinga has been available to help draft constitutions, train committee members, and build

networks with local government authorities. This is a practical example of what is described in Figure 1 as parallel implementation and capacity building processes.

Barry Patrick was involved in assessing the vegetation of the lower Mlazi River when he applied for the position of NCMP ecologist. His understanding of indigenous vegetation and ecological biogeography meant that he could advise us on ecological aspects of riverine rehabilitation. The vegetation work was part of his MSC which aimed to develop an open space plan integrating Shongweni Resources Reserve with the D'MOSS (Durban Metropolitan Open Space System). It was agreed that his MSc would become part of his job description if it was extended up the Sterkspruit to include the Hammarsdale area. I became co-supervisor with Dr Fred Ellery, and was able to encourage him to orient the study more towards the social aspects of managing the riverine open space system.

Durban's Agenda 21 programme sees the extension of D'MOSS throughout the Durban Metropolitan Area as an urgent requirement in order to minimise the destruction of the terrestrial resources base (Hindson, King and Peart, 1996). The development of Barry's study has occurred within this context. In feeding in data to Durban Metro's Physical Planning section, Barry has helped to develop the D'MOSS plan for the south and west. He has made recommendations on the sustainable use of indigenous vegetation, monitoring of vegetation and the formation of conservancies in areas where the natural resources are in danger of further degradation, including black communities which have previously not been involved in the conservancy movement. His future work will be largely related to monitoring and publicising the state of the Mlazi River. In this he and I are working as part of the National Aquatic Ecosystem Biomonitoring Programme, together with the Department of Water Affairs, Umgeni Water, the Water Research Commission and the Departments of the Environment nationally and provincially (Roux, 1997). Msinsi Holdings has provided Barry with an office and a flat at the Shongweni Resources Reserve, and all of their staff have been very supportive of his work and of our environmental education efforts. Many of our Environmental Action Clubs visit the Shongweni Resources Reserve, where Mike Mkhize introduces them to indigenous plants and animals, the dangers of insensitive development and good management of natural resources. The Provincial Department of Agriculture and the Natal Parks Board, as well as the Outer West Metropolitan Substructure and the Durban Metropolitan Authority are also working partners.

The NCMP has engaged with over a hundred organisations in the process of supporting community participation in catchment management, and has helped several community groups to form themselves into organisations, action groups or projects. Notable among those started during the pilot phase are: EZakhiweni Farmers Association, Mpumalanga Environmental Forum, Umlaas Irrigation Board Catchment Management Project and the Mondi-Maybole Eco-forestry Project. Funding from the Water Research Commission was increased after the successes of the Pilot Phase of the NCMP, so that 11 people are currently employed, with several more carrying out post-graduate research, in the programme and associated projects, representing a very wide range of disciplines and activities (see Figure 2).

NTSHONGWENI CATCHMENT MANAGEMENT PROGRAMME

10 September 1997

STAFF, CONSULTANT SERVICE PROVIDERS AND ASSOCIATES, AND THEIR LOCATIONS

Upper Catchment Office
AGRICULTURAL FACILITATOR
(Sakhile Ngcobo) with Mondi Forests

AGRICULTURAL FACILITATOR
(Thami Mthembu) **Ntshongweni Office**
CRAFTWORK FACILITATOR
(Zenzele Gumede)

Shongweni Resources Reserve Office
PROGRAMME ECOLOGIST
(Barry Patrick)

Durban Metropolitan Open Space System

Shongweni Landfill Site

Wildlife & Environment Society

Conserv (Outer West Conservancies)

Outer West Metro Substructure

Various local development groups

HIGHWAY CENTRAL OFFICES
PROGRAMME COORDINATOR
(Raymond Auerbach)
OFFICE MANAGEMENT
(Ntshongweni Secretarial Services - Lynn Stefano)
INFORMATION/ PUBLIC RELATIONS
(Normah Zondo)
DEVELOPMENT FACILITATOR
(Sifiso Ntinga)
ENVIRONMENTAL EDUCATOR
(Nomsa Zwane)

ENVIRO CLUBS MATERIAL DEVELOPMENT/ WETLAND OUTREACH
(Jenny Dean Wildflowers - Jenny Dean) **Roseway Waldorf School**

Tala Valley Associated Project **UMLAAS IRRIGATION BOARD PROJECT** **(Angus Burns)**

Many departments of the University of Natal have also been involved, notably the Department of Geographical and Environmental Sciences and the Centre for Social and Development Studies in Durban and the Agricultural Catchments Research Unit, the Computing Centre for Water Research, the Pollution Research Group, the Dean of Agriculture, the Institute for Commercial Forestry Research and the Institute of Natural Resources in Pietermaritzburg. A number of local companies have also made contributions of finance, expertise or equipment.

Umgeni Water and Mondi Forests have also contributed financially to the NCMP, and both organisations have shared their expertise and information with NCMP staff. We are helping Mondi to redesign 4 000 ha of plantation at their Maybole Estate (Van Heck & Barten, 1997), and Sakhile Ngcobo is working with the Enthembeni community, Mondi Forests and Baynesfield Estates, to find ways of increasing access of local people to natural resources in a mutually beneficial way. Hydrological modelling using ACRU is at an advanced stage, and should serve as a negotiating basis for the various parties once the Mlazi Catchment Committee is formed. The Agricultural Catchments Research Unit (ACRU) at the University of Natal has helped with this and with design of structures for measuring rainfall runoff and wetland characteristics on Bachs Fen.

The Umlaas Irrigation Board is responsible for regulating irrigation in the upper catchment, and after initial contact between NCMP fieldworkers and the Board, I was invited to address the Board in August 1996. Within a month, the Board had appointed a full-time conservation officer to help with catchment management. It has been heartening to note the level of cooperation and voluntary self regulation which has come from farmers and from the Board and from Angus Burns, its conservation officer. He has carried out a survey of local problems and attitudes and developed an action plan for riverine conservation (Burns, 1997). The first sub-catchment committee has recently been formed in the Tala Valley, with little help from NCMP, although I sit on the committee. I hope that there will be about twelve such committees by the middle of next year. Sakhile Ngcobo is also involved in surveying small scale commercial farmers in the Mophela area, at the request of the Umlaas Irrigation Board, who are considering the construction of a fourth irrigation dam which could serve some existing commercial farmers, as well as providing a resource which might help some small scale farmers to expand their irrigation facilities. If secure tenure can be negotiated for some of the farmers along the Mlazi River, we hope to see the resurgence of commercial irrigation in this area.

An additional bonus has been the initiative of the Umlaas Irrigation Board, which invited all the Water Boards of Natal together recently, gave them a presentation on ICM, and has initiated the formation of an Association of KwaZulu-Natal Water Boards. Although it is not clear what the role of water boards will be within ICM, there is great potential, both for positive interaction of the kind reported here, and for negative, protectionist responses by those who feel that they are being robbed of their rights. My meeting with the Umlaas Irrigation Board in 1996 came immediately after their chairman had been to the East London Water Law Review Workshop. The mood in the meeting was not positive, but after we had discussed the options of either taking a confrontational approach or showing pro-actively that the board was helping to ensure that all residents

of the Mlazi Catchment get access to a fair share of the water resources, it was heartening to note the agreement of members that striving for an equitable solution was a more reasonable course of action than agitating for a preservation of the *status quo.* Similarly, the meeting of Water Boards concentrated on the possibilities for introducing ICM in a pro-active manner. Although the Boards are concerned about the changes in the Water Law, they also recognise the need to be more inclusive in resource allocation.

The above activities give an idea of how the NCMP started building interaction with a range of local communities, and why we have had some influence both here and further afield. The Primary Goal of the Ntshongweni Catchment Management Programme is to develop a framework for community participation in catchment management in South Africa. Initially, we defined our goal as encouraging community participation in the management of the Mlazi River catchment, but the Water Research Commission rephrased the goal, asking that we should not only work practically in this catchment, but also focus on trying to understand some of the principles involved in participatory catchment management in general. Setting up frameworks is a dangerous business, as others will find that their situation is totally different to the situation described here. For this reason this report tells how we started and reflects on some of the lessons learned, while the final report will deal with the designs developed with various interest groups within the catchment to deal with their specific problems, as well as the process of setting up an Mlazi Catchment Management Committee.

Our objectives include: assisting local people in implementing ecologically and economically sound land use practices; helping to build the institutional capacity needed for informed local control of the planning and exploitation of natural resources in the catchment; helping appropriate agencies to understand local people's current attitudes to the catchment and its resources, and helping those agencies to develop education programmes which will improve aspects of catchment management; monitoring biophysical factors such as water and vegetation, and also monitoring 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.

The steps from being asked to help with a community garden, to wondering whether an ICM approach was feasible, to asking a lot of people their views and then preparing a proposal happened in 1994. Dr Chris Dickens of Umgeni Water originally prepared the proposal, and WRC responded that they were interested, but that it should be even more participatory than he had envisaged. He then handed it back to me, commenting that I had more expertise in participatory approaches than he did. Umgeni Water generously sponsored an initial workshop in November 1994 (Auerbach, 1994), and provided seed funding to start the programme. Funding was received from WRC in July 1995, and three staff members were appointed in September.

The pilot phase ran until the end of 1996, by which time we had a good idea of what the major problems in the area were. Our budget for the period October 1994 to December 1996 totalled nearly R900 000 including the WRC funds, Umgeni Water's contribution

and Farmer Support Group costs. Initially, the programme operated out of my study on Bachs Fen Farm. The second phase, which is one of consolidation, running from 1997 to 1999, has seen NCMP acquire very accessible offices and an efficient administrative infrastructure. This report includes 1997 activities to date. The organisational structure is illustrated in Figure 2, and shows how diverse the programme has become. In outline, we have concentrated on supporting local organisations and forming sub-catchment committees during 1997. During 1998 we plan to form the Mlazi Catchment Management Committee, and we hope that 1999 will see the formulation of a preliminary catchment management plan.

From the year 2000 onwards, the programme will have to enter an institutionalisation phase. Just where it should be located in terms of an institutional home is a difficult question, which will be addressed in the last section. An annual budget of about R1 million will be required to maintain the programme at its current level.

The progression of activities is illustrated diagrammatically in Figure 3, showing how initial engagement in 1994 was with the Ntshongweni gardeners, spreading to farmers and craftwork groups and nearby Mpumalanga and Hammarsdale urban and industrial areas during 1995. While this work was consolidated, forming the Mpumalanga Environmental Forum, major wetlands in the area were surveyed in 1996, and three local conservancies were helped (Shongweni, Summerveld and Drummond). During 1996, Mondi and Baynesfield became involved, and in 1997 the Umlaas Irrigation Board started its catchment management project. Eight school environmental action clubs were started, five in Mpumalanga, one at Ntshongweni, one at the Nels Rust Farm School near Baynesfield and one at the Roseway Waldorf School in Alverstone. The Peacevale Conservancy was established after we surveyed environmental concerns in the area, and the Conserv organisation brought together a number of local conservancies. Having developed the EZakhiweni Community Garden and the adjacent fields, we have now helped start two more community gardens near Ntshongweni and three in Mpumalanga, and assisted planners in allocating appropriate areas for urban agriculture, and rural community gardens and conservation areas. Three Craftwork groups have been started, and are working with various local craftspeople to establish Ntshongweni as a centre of craftwork excellence. The Outer West Substructure of the Durban Metropolitan Authority has now also asked NCMP to help with several planning, community service, and development matters.

At present, the Outer West has agreed to support the development of an Environmental Education Resource Centre in Mpumalanga and has asked NCMP to administer funds for agricultural development in four local areas (we declined the request for help in two other areas outside our catchment - this highlights the tension between administrative and catchment boundaries). A Craft Centre has been proposed for the Ntshongweni-Mpumalanga area, and several Catchment Sub-committees will soon be functioning. Hopefully, an Mlazi Catchment Management Committee will evolve during 1998.

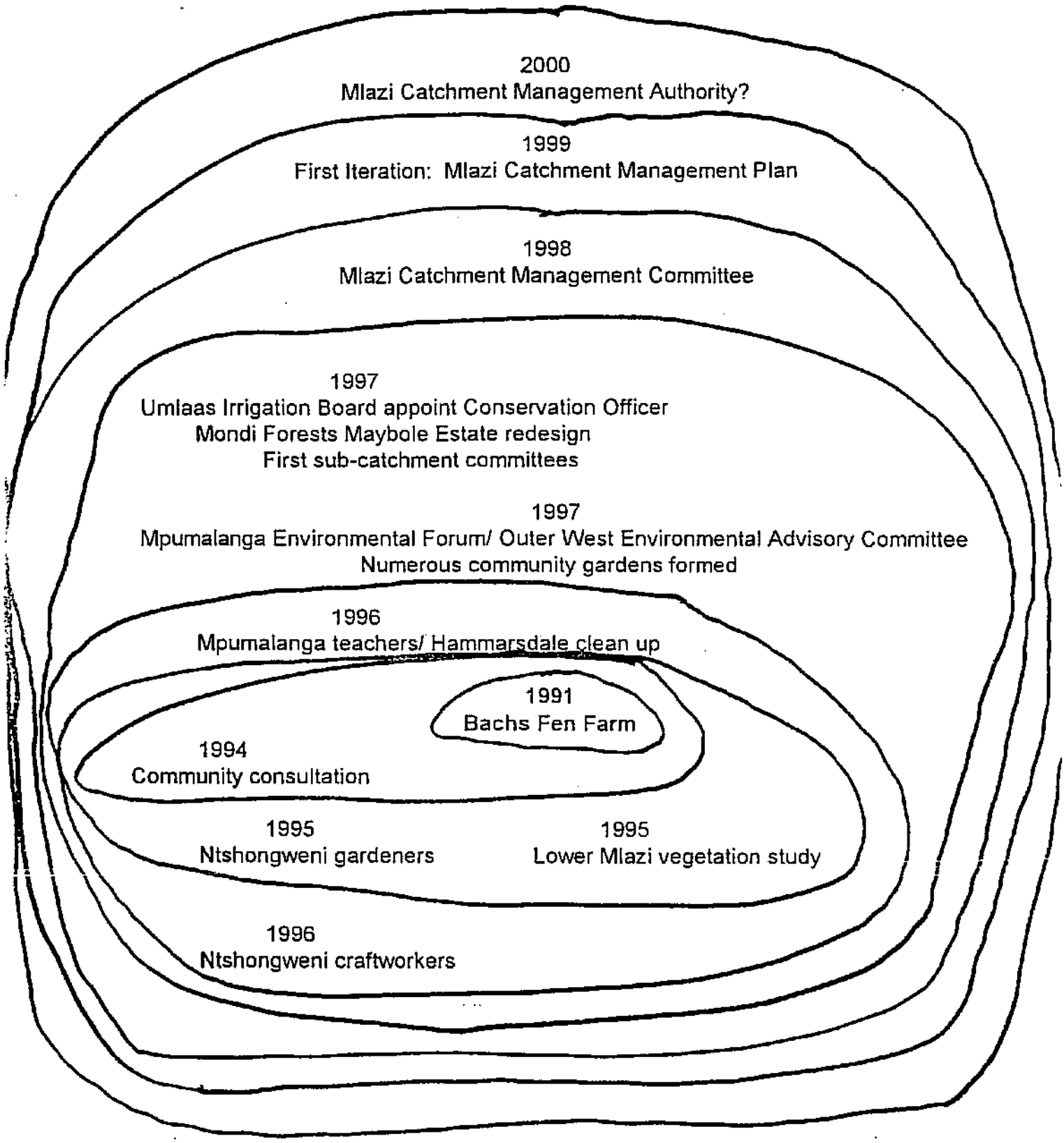

Figure 3: Chronological developments within the catchment

3 What is participatory catchment management?

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, 1996). 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 benefitted from PCM, not one woman attended the workshop, and little quantitative gender-segregated data was available to analyse this aspect.

Some ideas on the philosophy and practice of ICM in South Africa have been brought together in a DWAF/ WRC publication (DWAF, 1996). This publication gives an excellent overview of the challenges of ICM. The White Paper on Water (DWAF, 1997) also provides a proposed framework for the development of Catchment Management Agencies, which should develop into Catchment Management Authorities. It is proposed that authority should be delegated to these agencies and authorities on an incremental basis, as their management capacity develops. The Fourth Draft of the new Water Act also has some very exciting provisions in terms of institutionalising catchment management. 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, local people will need to be intimately involved.

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.

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. 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).

We have used these three steps in programme planning, as discussed in section 1, the pilot phase made up a process of exploratory analysis, though we were already moving towards more desirable solutions. Phase 2 has seen the beginning of platform building, and once there is a catchment management structure, phase 3 will see the implementation of a catchment management plan. Although they do not coincide exactly with our programme development phases, Röling's three stages are probably more broadly relevant as milestones in catchment management:

- First, exploratory analysis for each group: initial intervention, social analysis (Participatory Rural Appraisal, Vision building, Participatory Land Use Planning, as per Figure 1). In our case, the groups are 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, build a catchment identity, develop a newsletter, support conservancies, link groups to local, provincial and national government structures (mechanisms are required to do this).

- Third, drafting and implementing a catchment management plan. This is an iterative on-going process of negotiating, implementing, monitoring, evaluation

and re-planning.

These three steps mark basic stages of ICM. The first does not have to be complete before the second is started, but it is certainly dangerous to start developing 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. 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.

4 What are the limits of participatory catchment management?

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.

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 (p.167) 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.

Unless DWAF recognises that people are not going to apply ICM messages developed in Pretoria, no matter how scientifically valid these may be, and no matter how convincingly and entertainingly they may be presented, ICM will not be applied; local people will implement plans which they have helped develop.

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.

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 two 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 will be followed up by a report of catchment activities, and Normah Zondo, our Public Relations Officer, is in the early stages of producing our first edition of a catchment newsletter, due out in November. We believe that it will be 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. We hope that the newsletter will serve to focus this function, and make it a little more manageable.

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. Our adoption of a farming systems approach has been a key factor in understanding how land use systems operate, as seen from the farmers' perspective (Shaner, Philipp & Schmehl, 1982; Bawden and Valentine, 1994). As Africa Representative of the International Association for Farming Systems Research and Extension, I am at present involved in producing a review of the experience of Southern African countries over the past thirty years (Dr Anandajayasekeram of SACCAR is editing the study). 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 of the major lessons learned through the review 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. 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 all-powerful Minister will have to rule by decree, as there is little provision for regulatory mechanisms in the White Paper on water. 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 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.

5 How can local expertise and enthusiasm be harnessed in service of conservation and development (opportunities and dangers)?

Görgens *et al.* (1997) suggest that initiation could be championed by a few individuals, or driven by a more formal structure. Our experience is that a good approach is to start with a concerned stakeholder group. One can then provide some resources and support, and find local people with a track record of community involvement. Responding to a real need for improved land use management results in engaging from the start with practical people who are usually prepared to take action to improve the situation. The approach outlined in Figure 1 shows a strategy for establishing credibility first, and then undertaking a process of broader engagement. Such a process is required for each group with which a catchment management agency wishes to work. If this groundwork is not given adequate attention, it is likely that yet another bureaucratic organisation will emerge to waste the time of local people with endless discussions leading nowhere.

We started with the most marginalised groups, and were then able to attract the interest of wealthier groups (such as Umlaas Irrigation Board, Mondi and the conservancies). These groups mostly were able to help themselves, and to fit into the bigger picture with a little encouragement, and limited strategically-offered assistance. A stick-and-carrot approach often proved effective: short-comings in management were pointed out, and if there was not a response, negative publicity was generated. In most cases, bigger organisations are sensitive to negative publicity, and respond quickly if positive solutions are offered in a constructive way. In some cases, where there has been flagrant disregard for the law, it has been necessary to report violations to responsible authorities, usually DWAF, and to seek prosecution of offenders.

Görgens *et al.* (1997) point out that one must also balance the need for representativeness with the need for effective management. My personal experiences here were often painful. A local person often has knowledge of other local people who have skills which are needed. However, such people are often friends or family of the person concerned. It is very likely that many ICM programmes will find that there are difficulties of the sort we faced: under what circumstances can I employ my wife? Should I be paid for the use of my home as an office? Since my farm is used as a demonstration site for ecological agriculture, am I entitled to financial support for farm development? Since I operate far away from Head Office, what sort of financial system can ensure that I am accountable, while giving me some flexibility to respond to the ever changing needs of a dynamic programme such as this one? Although it is often frustrating, it is important to have the guidance of a certain amount of procedural structure, together with the transparency and accountability which this brings.

Working for a bureaucratic organisation means that orders have to go through many stages, and it recently took us three weeks to get a box of envelopes through the University system, and our telephones were cut off for the same three weeks until we could get another department to pay the account. At the same time, I must acknowledge that the advice and steadying influence of Noel Oettlé (FSG Director) and Leslie Lax (FSG Financial Manager) often helped me to avoid what could have become compromising situations. It is indeed a vexed question how CMAs could combine the need for accountability with the need for flexibility.

On the other hand, the positive side of local involvement is very clear. Görgens *et al.* (1997) suggest that one should make provision to influence or prevent land-use planning decisions which could lead to unacceptable impacts. This is happening all the time with local involvement in NCMP. Local farmers reported that contractors for Mondi Forests had planted gum trees right through a water course. Angus Burns of the Umlaas Irrigation Project spoke to Mondi staff, and three thousand trees were pulled out the next day. A member of the Shongweni Conservancy noticed that the Sterkspruit was white with chemical pollutants early one Monday morning. He phoned the chairperson, who phoned me. I collected samples and took them to Umgeni Water, where preliminary analysis showed that toxic substances were present. Meanwhile, I had attended a community meeting, and on the way back found youngsters fishing dead Barbel out of the river. I warned them of the dangers, and traced the spill back to Buckman Laboratories in Hammarsdale. Meantime, Umgeni had alerted DWAF, and

prosecution samples were taken. Buckmans management were informed, and a site visit arranged between the authorities and Buckmans. I alerted the press, and with reporters interviewed some local residents who stated that bad-smelling discharges were a regular occurrence, and that they had at last managed to persuade Buckmans management to route the effluent through a furrow, so that the children did not play in it so much anymore. Buckmans claim that the furrow is for stormwater only. The case is currently in court, with Buckmans arguing that this was a one-off spill, and not due to negligence.

Regardless of the result of this case, the publicity generated, and the fact that people know that illegal activities are being observed has had a good effect on reducing discharges into the river. Reporting networks are beginning to form. People are participating in catchment management, as Appendices 2 and 3 show). The Umlaas Irrigation Board's Catchment Management Programme and the emergence of a community monitoring committee for the Shongweni Landfill Site, are evidence of the concern of a wide range of people about environmental management. The voluntary requests from the community for the involvement of NCMP in both committees indicates that NCMP are seen as champions of the environment with a reputation for reasonable, constructive and efficient engagement in conflict management. Being local people, two other members of our team have been nominated by local organisations as their representatives on the Shongweni Landfill Site monitoring committee (Sifiso Ntinga representing Salem community and Jenny Dean representing Summerveld Conservancy, which she chairs).

The catchment as an organism and the role of children

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 authority 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.

We are planning to try to get every stretch of the Mlazi River adopted by a school or group, and to run competitions offering prizes for the best conservation projects. The programme supplies each school with an action kit once they have collected R70 to join the Wildlife and Environment Society. Nomsa Zwane and Jenny Dean, our environmental educators, work closely with Jim Taylor and his Sharenet team in

supporting these clubs, and helping each of them devise an environmental action plan. Zenzele Gumede, our craftwork development facilitator, is also involved in finding local people to teach craftwork skills in the schools, as well as supporting craftworkers in the area, and helping them to market their products. We pay a nominal amount to the ladies for their teaching time, as the school bureaucracies are even worse than our own. Thami Mthembu and Sakhile Ngcobo also help with the establishment of school gardens. Mike Mkhize, Shongweni Landfill Site, Mondi Forests and a number of other organisations are helping with recycling initiatives. As Görgens *et al.* (1997) say, catchment management requires a shift in paradigm. The children have a vital part to play in bringing about this paradigm shift.

6 Reflections on integrated catchment management as a conservation and development strategy

The main difficulties which will be associated with ICM are: getting different authorities to work together, not getting bogged down in endless discussions, and the sheer complexities of relating to thousands of diverse issues in an integrative way.

On the other hand, some of the advantages are: the holistic approach, centred on rivers which are vital for our economy and for our survival and which respond to our care by becoming more beautiful, and to our neglect by becoming poisoned and dying; and the human synergies, especially in this land of contrasts and diversity. If it is possible to bring together agricultural producers, conservationists and water managers, then ICM holds out great promise in terms of more efficient water use in agriculture (Auerbach & Jansen, 1997 [Appendix 4]). Water conservation is intimately related to soil conservation. Equally importantly, water and soil conservation are linked closely to integrated energy management (Auerbach & Gandar, 1994). Providing energy to rural communities before they have water is often far less productive than providing water first. The lack of integration of government departments in meeting the infrastructural needs of rural communities is one of the key areas which could be assisted by an ICM approach.

In terms of the Water Law principles, the national water authority carries a unique responsibility to promote the growth of self-regulating catchment management. Acting as a catalyst in ICM will require an open-ness from DWAF and a change away from the current territorial and possessive attitude often exhibited by officials. Being partners who work with a range of more and less competent people and organisations requires a maturity and tolerance from those who wish to gain credibility in striving for effective participative governance. An implication of down-sizing government in SA is that we need an increasing emphasis on self-regulation. However, this requires the development of an enabling environment, where responsibilities and resources, as well as duties, are delegated to groups who often need training before they can discharge these responsibilities adequately.

An example of this is the process of monitoring the Shongweni Landfill Site (now operating as a H:h site, Appendix 3). The local community have had ongoing input into

the permit amendment process, and now into monitoring the site through the Shongweni Landfill Site Monitoring Committee, which I chair. Input from DWAF was essential in ensuring that a monitoring committee was brought into being, in examining engineering design, evaluating environmental reports, and also in taking action when permit conditions were not followed. The community is essential in seeing and hearing what is actually going on. The company is essential in providing a vital service needed by society in general, but not popular with any community adjacent to such a site. A CMA (in this case NCMP) has an important role to play here as an organisation biased in favour of sustainable management of the environment, but with natural resource management skills, a holistic approach, a network of local contacts and a mandate to help in resolving conflicts. In the case of the Shongweni Landfill Site, NCMP has had to bring to DWAF's attention certain problems on the site, to query the engineering design of the site, although it had been approved by DWAF, and to request that DWAF take the community concerns seriously.

This reflects a major problem in establishing grass roots democracy in the new South Africa. A government department such as DWAF has to balance process and product. DWAF has a better delivery record than most, and has tried on a national and regional scale to consult with communities in the development of its water and forestry policies. As a CMA, we find ourselves in a position where DWAF says that experts are satisfied that the Shongweni site is safe, but locals say that it is not safe. Understandably, DWAF stays with the opinion of its experts unless and until sufficient evidence or public pressure is brought to bear on the issues. Unfortunately, the lack of regional staff means that DWAF does not have the human resources to sit in on every community meeting. NCMP has done its best to obtain relevant information concerning the site, with the help of other community organisations. Both the community (who feel we are being too careful) and the company, Enviroserv (who fell that we are attacking them unfairly) are not totally happy with our role in this committee, but at least we have been able to keep the parties talking and the site functioning. The community recently called for the personal intervention of Minister Asmal in this matter. Effectively, we are acting as agents for DWAF, although we are probably taking a far more flexible stance at this stage than DWAF (as regulator) could take.

In the case of the nearby LTA quarry, significant sedimentation of the Ntshongweni Dam has taken place over a long period of time, and the company has not taken much corrective action in spite of instructions by DWAF staff to do so. However, as a result of joint action by local residents, Msinsi Holdings (the local reserve managers at Ntshongweni Dam) and DWAF, problems were identified and DWAF has instructed the quarry to engage professionals and to implement their recommendations.

In the future, either DWAF will have to take steps to become better informed and more flexible (requiring more manpower), or it will have to delegate some of its authority to CMAs and other local structures. As Görgens *et al.* (1997) point out, the new National Water Policy (April 1997) recommends the establishment of statutory participatory catchment management forums, which should become catchment authorities. However, there is not adequate provision in the new Water Law for the establishment and regulation of such self regulating catchment authorities. Legislation is needed to

guide in establishing, managing, assigning primary functions to and setting criteria for each authority, if conflict and public appeals to the Minister are not to become the accepted ways of interacting with DWAF.

ICM is working well in the Mlazi catchment. Some reasons are that the implementing agents have practical agricultural, ecological and conservation skills, local and regional credibility, and started by working with marginalised communities. Also important is that they have institutional and administrative back-up to ensure transparency and accountability. A well-organised central office located in the catchment, and several local offices scattered through the catchment are now essential, although these were not needed in the early stages of the programme. Adequate resources to employ and manage a multi-disciplinary team starting with four and growing to eleven staff members translated into a total budget starting at R300 000 per year in the second year and growing to about R1 million per year in the sixth year for this programme.

At present, DWAF is driving ICM thinking, the national Department of the Environment and Tourism and the Parks Boards are driving conservation and conservancies, and the national Department of Agriculture is driving the emergence of a national landcare movement. Agriculture and Water Affairs seem determined to maintain their territories. Clearly, there is a need and an opportunity for synthesis, but equally clearly, the line-structures of government militate against inter-departmental networking at local level. Conservancies already exist in many parts of the country, linked through Parks Boards to the Departments of the Environment. They would be a good place to start from, as they include many highly motivated and knowledgeable people, but again, the columnar structure of government makes this difficult.

As stated in the Foreword, outsiders cannot develop anyone: personal growth requires that each of us look into ourselves after looking around us and take decisions involving discipline or indulgence, short term or long term goals, larger or smaller communities, and idealistic or materialistic approaches. An integrative approach can help people in the new South Africa to recognise our interdependence, providing that it is backed by adequate resources, dynamic local leadership and an institutional environment which helps local people and groups to build platforms for resource use negotiation. Local managers of catchment authorities will have to recognise that they have to learn with their clients.

For these reasons ICM cannot work as a government programme. It will only work if it is based on the participation of local people, supported by a broad range of government departments; focused on providing strategic help to local groups without creating undue dependence, adequately resourced financially, administratively and politically, while giving CMAs enough flexibility to meet the changing needs of ICM. Finally, it must be aimed at nurturing a love and respect for the river system which is its life-blood, among the young people who live in the catchment, who are its heart.

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APPENDIX 1: Participatory action research and the Ntshongweni Integrated Catchment Management Programme in South Africa by Raymond Auerbach, University of Natal. (Paper delivered at 14th International Symposium on Sustainable Farming Systems, Colombo, Sri Lanka).

1 INTRODUCTION

The Farming Systems Research approach developed in the mid-seventies in Africa, Asia and Latin America when researchers realised that much of the technology offered to small scale farmers was inappropriate (Shaner, Philipp and Schmehl, 1982). It was recognised that farmer participation is the key to progress, and that understanding the farmers' constraints (the farming system) is essential if researchers are to make any worthwhile contribution at all.

By the eighties, many already saw FSR as having become a way to "sell" green revolution technology. Asia, with its high rainfall and widespread use of rice and wheat, was able to raise *per capita* food production through using some aspects of green revolution technology. Africa, on the other hand, being mainly dry and maize-based, on the whole has not found these high-input systems useful. In most developing countries the impact of technologies on poverty alleviation has anyway been minimal (Conway and Barbier, 1990, Auerbach, 1993).

In post-apartheid South Africa, a small black farming élite is fast developing to join the white élite in commercial agricultural production. While this is good from the point of view of national food self sufficiency, it has little impact on our household food security problems. High-input systems remain out of the reach of the vast majority of rural poor people. The need is to build on local knowledge to identify ways of harvesting water, conserving soil and improving nutrient cycles. Local farming, processing and craftwork skills can also add value to local produce and generate both food for the family and cash income. Participatory Action Research (PAR) techniques are useful in this process of identifying local needs, skills and methodologies upon which innovative strategies can build.

In responding to these trends and pressures, the University of Natal committed itself 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 (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 one practical attempt of our University to serve the interests of poorer rural people which has had a surprisingly large effect, both in practical terms and on policy. We are 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.

One of our action research initiatives is the Ntshongweni Catchment Management Programme. Its primary goal is to develop a framework for catchment management in South Africa. Its objectives are listed in Appendix 1. In adopting a catchment-based approach, Farmer Support Group acknowledged that there needs to be a shift towards natural resource management and a more holistic approach to agricultural planning. Our country has the potential to build mutually beneficial interactions between the developed and developing sectors of the economy, and our job is to facilitate this process, while acting in the interests of resource poor farmers: It is the nature of water to hold things together, and our country, which is semi-arid, needs to bear this in mind, as our aridity in terms of rainfall may be a reflection of our spiritual aridity. The Upanishads tell us:

> This subtle water holds everything together;
> it refreshes and cleanses and carries unwanted matter away.
> It is the great bonding force uniting things as one.
> It is the symbol of grace, life and love.
> Grace is like the dew or rain,
> life is like the flowing river,
> and love is like the ocean.

The common thread within the Ntshongweni Catchment is the Mlazi River. The programme has tried to use it as a unifying factor in the catchment, and to promote participation from local people in caring for the resources of the catchment, rather than plundering them in a selfish and destructive way. Social processes and the building of a sense of ownership among local people are complex. This paper describes progress to date.

2 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 Fig. 1). 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 Amancadodo 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, potatoes, 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 no longer feed themselves
Smaller fields	|	Agriculture less important to the youth
	|	
Violence endemic	1985	
	|	
Mpumalanga Peace Accord	1990	We did this ourselves: Archie Gumede
	|	& IFP helped bring us together
Shongweni Resour Reserve established	1993	Some services through SRR
	⇓	

Figure 1: 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).

Activity profile

The purpose of the seasonal activity diagrams was to understand when various activities take place, when the community is busy, and when possible slack periods exist which could be used in developing new enterprises (see Fig. 2). The ladies told us that they are busy all the time, since they are involved in the community gardens as well as survival activities (such as fetching water and firewood, childcare, cooking and agriculture). The men were busiest in September, October and November (ploughing and planting) and in January and February (weeding and preparing for second bean crop). March to August was a relatively quieter time.

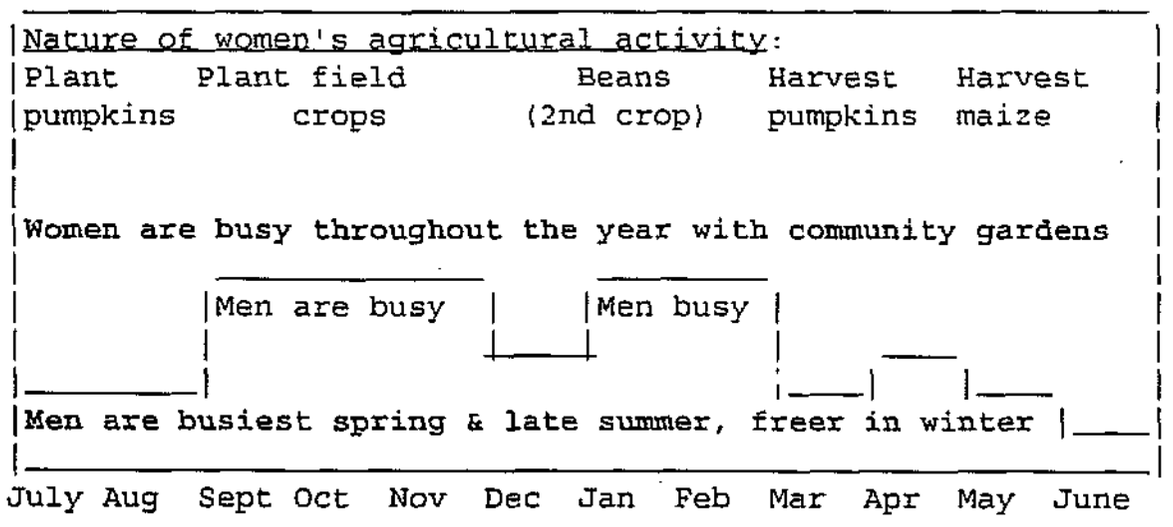

Figure 2: Seasonal diagram for farming activities at Ntshongweni

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 (Tables 1 and 2).

Table 1: Arable priorities

Field cultivation

5	Soil fertility and variable soil types
5	Stalkborer problems
4	Plant diseases and insect pests
3	Animal pests (moles, porcupines and wild pigs)
2	Water
2	Fencing of the fields

Community gardens

6	Knowledge regarding good cultivation
6	Selecting improved seed
5	Water
4	Fencing
3	Pests
2	Marketing outlets for produce

Table 2: 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.

Sources of assistance, agriculture and development (Venn diagram)

People were asked the nature and range of help available to them; their responses were drawn on a diagram (Fig. 3) where the size of the "box" indicates the importance of the organisation, and its location relative to the box marked "Farmers" indicates whether the organisation is "far away" (inaccessible) or "near to us". The boxes above the farmers relate to specifically agricultural assistance, while those below relate to more general help with organisational development and capacity building.

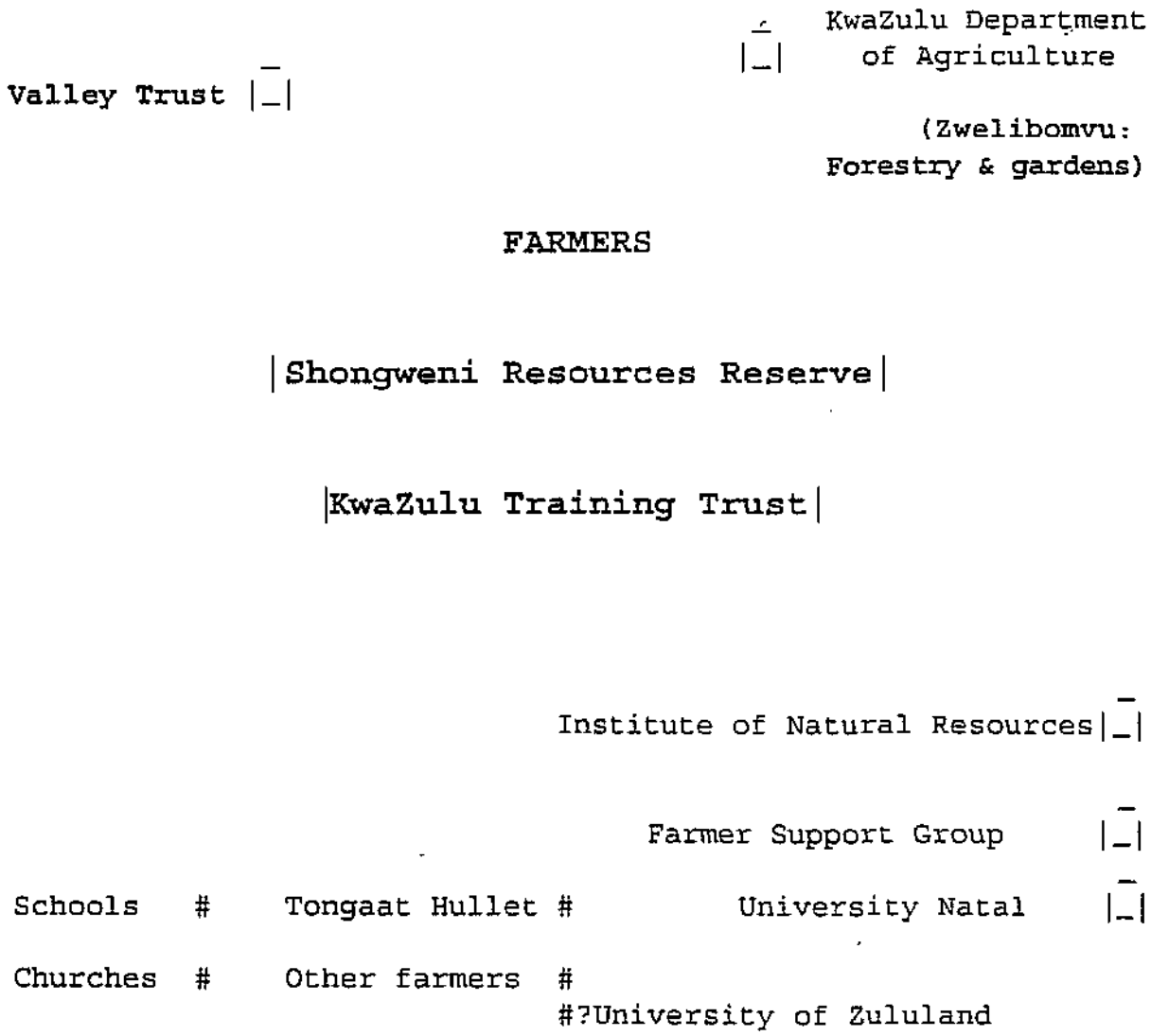

Figure 3: Venn Diagram of institutions offering assistance to farmers at Ntshongweni, showing agricultural (above) and developmental (below); # = no help, small boxes, little help, big box, more help; location near to or far from farmers indicates accessibility to community.

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 the

situation at 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 fencepoles 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 much of 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 three 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 Ingonyama 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 occasionally 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: 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 fact that the land is a Trust Farm, and thus presently is owned by the Ingonyama 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 3: 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 a practical 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 crèche 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 4.

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 4: 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-crèche	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 as part of an MSc study (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).

5 · IMPLEMENTATION AND CAPACITY BUILDING

The process of implementation started before the appointment of Thami Mthembu (the local agricultural facilitator), when Raymond and the gardeners were able to obtain fencing materials from the government's provincial agricultural department. They erected the fence themselves, and once Thami had been appointed (September, 1995), he was able to arrange for further support which resulted in local men and women enlarging the two water storage dams, planting reeds around the dam for craftwork activities, erecting soil and water harvesting swales, collecting money for fencing the fields above the gardens, negotiating for livestock owners to pay two retired local men to act as herdsmen to keep the cattle and goats away from the arable and garden areas, and to start the planning of a small heifer breeding scheme for small-scale dairy production.

Parallel with this process, the EZakhiweni Farmers' Association was being formed. Extensive discussions around the aims and objects of the association and its structure and functions led to a draft constitution being formulated. This was hand-written in Zulu. Some comments were obtained from experienced people, and Sifiso Ntinga, the Programme's Development Facilitator, then ran three constitution development processes. After some modifications, the second draft constitution was distributed widely within the community for comment.

Three months later, the first Annual General Meeting of the EZakhiweni Farmers' Association ratified and adopted the constitution, and the Association was formally constituted on 12th October, 1996 (Auerbach and Mthembu, 1996).

6 A PROCESS FOR SUSTAINABLE DEVELOPMENT

The process adopted for the development of the ecological agricultural activities is summarised in Figure 4. Participatory action research requires that those intervening work together with local people a t finding solutions to local problems. The process started with us agreeing to help with a community garden fence. It then progressed to finding ways of getting this help, to actually working with the gardeners at putting up the fence, to participatory rural appraisal, vision building and participatory land use planning. The community plan was implemented in parallel with a capacity building process which resulted in community training and the establishment of the EZakhiweni Farmers' Association.

The actual farming systems design for EZakhiweni-Ntshongweni was based on the methodology described by Goewie (1995). It is described in a paper by Wisserhof and Auerbach (1995). In summary it recommended:

* Soil and water harvesting using swales
* Soil and water conservation using mulches
* Nutrient cycling using tree-livestock-crop combinations
* Generating income through coffee and wetland crafts
* Capacity building: strengthening local organisations

Figure 4: RURAL DEVELOPMENT: NO MODEL BUT A PROCESS

Credibility — **Community requests help**

⇓

Intervention

⇓

Broadening — **Participatory Rural Appraisal**

⇓

Vision building process

⇓

Participatory Land Use Planning

⇓

Sustainability

IMPLEMENTATION — **CAPACITY BUILDING**

⇓

SUSTAINABLE DEVELOPMENT

7 YOUTH AND ENVIRONMENTAL CLUBS AT MPUMALANGA TOWNSHIP

During the period in which the agricultural development was taking place at Ntshongweni. Sifiso Ntinga was involved with motivating school teachers, school children, young unemployed people and local industrialists to take action in the urban/ industrial area. Local educators, community leaders and industrialists formed the Mpumalanga Environmental Forum, and five schools have started Environmental Action Clubs (a joint programme between NCMP and the South African Wildlife Society). The clubs will be involved with recycling, clean-ups, tree-planting, water harvesting and gardening and soil conservation projects (Auerbach and Ntinga, 1996).

8 ECOLOGICAL FORESTRY AND THE UPPER CATCHMENT

Mondi Forests (South Africa and Baynesfield Estates together own nearly 20,000 ha in the upper Mlazi catchment. Much of this (4,000 ha) is planted to single species pine or gum plantations. Most of the rest is sugar cane, maize or high-value dairy pastures. However, both in the forestry areas and in the intensive arable, there are many patches of grassland, wetland and river margin. Some of these areas have already been dedicated to conservation.

Adjacent to the privately-owned land is the community of Enthembeni, where some 10,000 people live with high rates of unemployment. The NCMP is brokering the development of a system whereby this community can gain access to resources by:

* forming contract teams to counter alien weed infestation;
* rehabilitating wetlands and using the reeds for craftwork;
* using the grassland patches and river margins to plant medicinal herbs; and
* simultaneously beautifying the area for eco-tourism purposes.

At the same time, Mondi and Baynesfield are cooperating in the development of an experimental ecological forestry production system, combining indigenous hardwoods, exotic softwoods and medicinal herbs in a system which will be selectively harvested rather than the current mono-cultural system of clear-felling with windows up and down the slope and timber extraction downslope, followed by burning of the brushwood. Post-harvest management will be integrated with medicinal herb planting.

The Umlaas Irrigation Board and consultant hydrologists are examining ways of improving access to the water resources of the catchment through improved land use, water storage and better management of wetlands and river margins, in cooperation with local conservancies.

The NCMP ecologist, Barry Patrick, together with Wageningen Agricultural University MSc student Peter Verburg, mapped upper catchment wetlands, and made recommendations concerning wetland rehabilitation and management (Patrick &Verburg, 1996) and hydrological planning (Verburg, 1996).

9 PLATFORM BUILDING FOR RESOURCE USE NEGOTIATION

The above initiatives (Ntshongweni farmers, Mpumalanga Environmental Forum, the Upper

Catchment Action Group, the Umlaas Irrigation Board and the local conservancies) all represent local interest groups which are beginning to see the possibilities of a catchment vision, where all people in the catchment can benefit through joint management strategies which could make the area a unique example of unity in diversity (Röling, 1994). As the interest groups develop into catchment fora, we hope that it will be possible to exploit this synergy to develop an Mlazi Catchment Management Structure where the different groups can come together to build a common vision for the future, held together by this subtle water which refreshes and cleanses and carries unwanted matter away - the great bonding force uniting things as one.

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Water awareness in the Umlazi river catchment

by JANIS O'GRADY

THE upper Mlazi River Catchment, along almost 90km of the river, has been the subject of a catchment management project run by the Umlaas Irrigation Board for the past seven months, to promote sustainable river catchment usage by farmers, foresters, schools and communities.

Today, Arbor Day, indigenous tree-planting will reinforce this long-term project. Angus Burns, motivated co-ordinator and environmentalist for the board, is delighted with the response from certain sponsors. Mondi Forests, Jesmond Dene and Silverglen have sponsored hundreds of trees for revegetation purposes.

"We have selected young, frost-resistant species which will grow faster during spring. Square holes have been dug in sections of wetlands on many farms to encourage the roots to spread, thus keeping river banks intact," says Burns.

He has been inspired by similar work done by the Farmers Support Group (University of Natal) for the Nishongweni Catchment Management Programme, co-ordinated by Raymond Auerbach. The Mlazi River is the crucial link between the two projects. Rising in the hills above Baynesfield, it flows through Hopewell, the Tala Valley, south of Mpumalanga into Nishongweni Dam. By this time, it has been dammed three times in Baynesfield, Mapstone and Thornlea dams.

"Both projects aim to increase awareness of the factors responsible for the degradation of the valley water," says Burns. "These objectives will be achieved through active rehabilitation of stream lines and wetlands, proper control of effluent and other pollutants, control of alien weed species, education of user groups within the catchment and the formation of committees to implement these goals." Umgeni Water tests water continuously, advising land owners on certain issues. What one person does upstream affects another downstream. Burns spends hours spreading awareness to farmers, foresters, conservationists and schools about the pending water crisis and what can be done to soften the blow. Nel's Rus School has taken matters into its own hands. Spades, forks and picks, sponsored by Share-net, are being used to hack out the alien plants along the banks of the Mlazi as it flows past the school.

A survey of 48 farms covering some 19 000 hectares resulted in 100% support for the project. Most irrigators are happy to rehabilitate sections of wetlands and rivers on their own

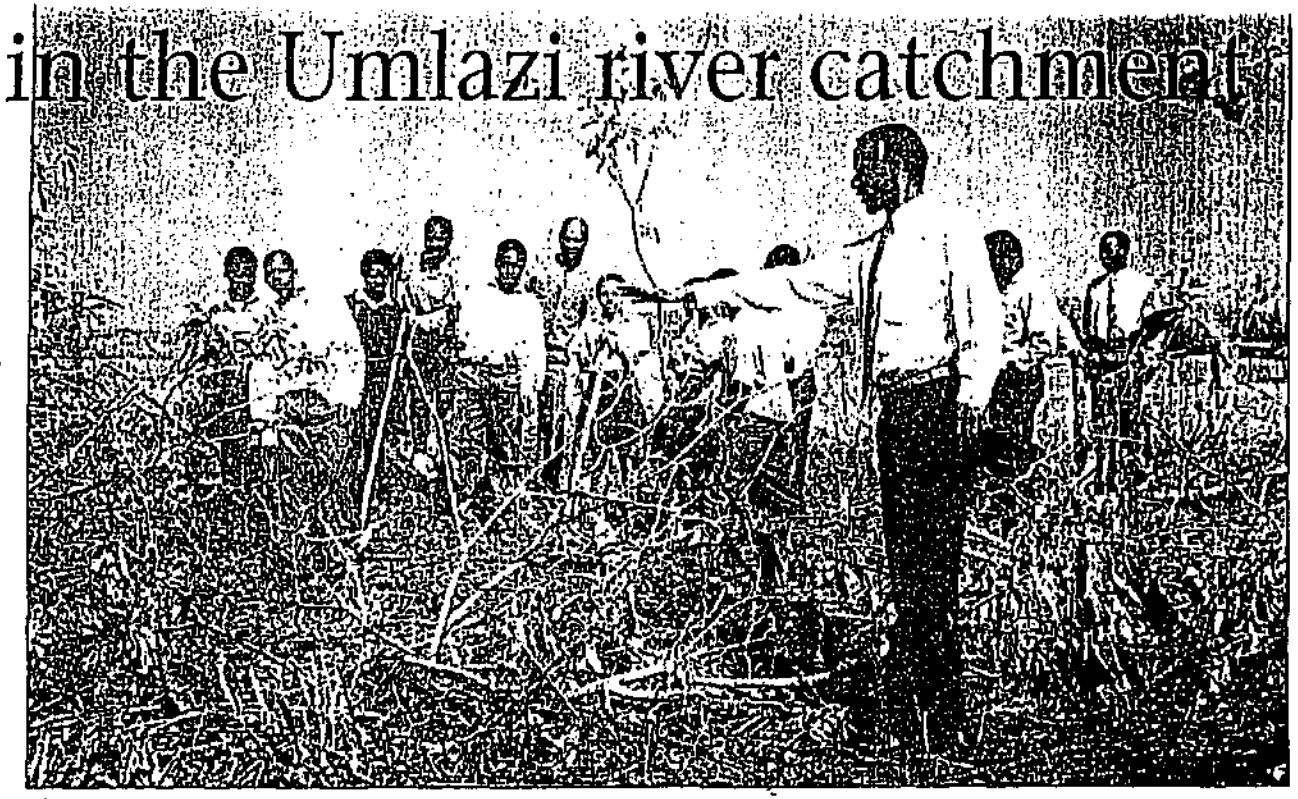
One such farmer is Mike Lowry of Lelani Farms. Eighteen years ago when he moved here, he spent 14 days clearing away alien vegetation with a bulldozer. Slowly but surely, he has decimated patches of weeds in a bid to reclaim and rehabilitate land.

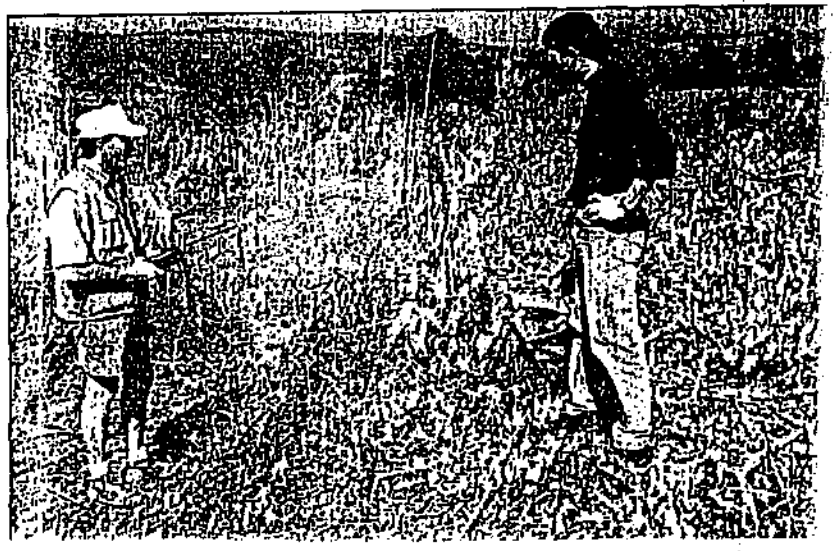
"There are far too many bugweed plants, lantana and syringas blocking the river's flow," he said, pointing out his four-kilometre stretch of river frontage. The reeds act as a natural buffer zone, filtering water at the same time. Already the birds are returning, his record of 190 different species an incentive to continue.

Peter Hilliar hired a contractor to fell all the gum trees on his section of the river. "I think there is great potential here for eco-tourism. We must clean up the invaders and get it back to its natural state," he says, with dreams to utilise his resources as far as possible, be it vegetable farming or eco-tourism.

In fact, the entire Umlazi River Catchment is good for recreation. Thornlea Dam is a venue for internationally competitive water-skiers. The local club is removing pockets of invasive water hyacinth, a costly problem all over southern Africa.

"Those who are helping their environment are also helping themselves — we are not separate from the environment, but a defi-





Above: Nels Rus School Head of Department Nkosi Zuma directs pupils in clearing operations. Below left: Farmer Peter Hilliar and Angus Burns of Umlaas Irrigation Board examine the gum tree stumps after Hilliar had the trees felled.

Shongweni landfill debate

APPENDIX 3

A protective lining is placed on the Shongweni landfill before more waste is dumped. This lining prevents leachate (liquid from decomposing matter) from draining through the soil and into local streams and rivers.

THE Shongweni landfill site may now officially accept low hazardous wastes after being recognised solely as a general landfill since its inception in the early nineties. The Department of Water Affairs and Forestry (DWAF) presented the amended permit to Enviroserve, the waste management company operating the landfill recently.

Before the minimum requirements for waste disposal sites was published by DWAF in 1994, hazardous sites had been referred to as "1" and general sites as "2". The Shongweni landfill was issued with a permit, then "Class 2a", which meant general domestic waste and additional specified low hazardous wastes. Today, the correct terminology is "H:h".

The new cells of the landfill have been lined according to rigid specifications, as part of its upgrading from a general to a low hazardous site. "We are quite happy with the permit as it stands at the moment," said Clive Kidd, landfill operations manager, from his office at the site.

Working closely with Dawn Perry, Enviroserve environmental services manager, he supervises the waste process from the moment the full vehicles enter the premises until they depart empty. Drivers register waste type at the gate; if it needs to be tested, a full-time laboratory assistant takes samples which must correspond with those taken previously (new clients are subject to waste sampling before they get the go-ahead to deposit waste here).

Basic screening for flammability, pH and heavy metals deduces the H:H or H:h status of the waste. If the waste complies to the new permit regulations (H:h), the vehicle is sent to the weighbridge. Wastes that are not neutral need to be treated and neutralised before entering the cells. Any H:H wastes are transported to Holfontein in Johannesburg.

According to Perry, the Shongweni landfill should last 10 years — a ton of waste fills one cubic metre and this site can accept a total capacity of 2.2 million cubic metres. Enviroserve is planning recycling facilities for three schools in the area and the local community will be involved in waste management education.

Chairman of the monitoring committee, Raymond Auerbach, is still concerned about the landfill. "Monitoring of the landfill has begun but it is disturbing to note evidence of leachate (liquid from decomposing waste) from the old cell (a general cell which is not lined) seeping into the Mgoshongweni stream below it," he said. Residents have been voicing their fear and suspicion of pollution ever since the inaugural meeting in May this year.

Three chemicals in particular (propoxur, carbofuran, EPTC) have been detected by Umgeni Water, in small amounts in this stream. According to Bobby Peek of the Environmental Justice Networking Forum (EJNF) the dumping of these wastes at the Shongweni landfill has been happening since 1996. "The fact that these quantities are minute is insignificant — DWAF is not taking participative governance seriously, nor the role of the monitoring committee," he said.

Charles Joubert, of DWAF in Durban, says that leachate is hardly cause for concern. "The matter is being addressed and I can assure you that things are not nearly as serious as they have been made out to be. Enviroserve is committed to preventing any further leachate going into the stream, and rehabilitation."

Supplement to The Natal Witness, Friday, September 5, 1997 –

SECOND DRAFT

WATER HARVESTING IN SOUTH AFRICA

by

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9 October 1997

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1 INTRODUCTION: WETLANDS, CATCHMENTS AND WATER HARVESTING

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. This study looks at two practical attempts to use the purifying, water-storing, ecological and productive characteristics of wetlands in practical water harvesting in the context of ecological agriculture and integrated catchment management. Reij, Mulder & Begemann (1994) touch on some aspects of what they call cultivated reservoirs.

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 more substantially 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.

According to Cleaver & Schreiber (1992), water resources in Africa are under increasing pressure. Causes include rangeland degradation, soil erosion, deforestation, destruction of protective vegetative strips alongside water bodies, indiscriminate drainage, encroachment of farming and poorly conceived irrigation development. Groundwater resources have also come under pressure, especially in the arid and semi-arid regions. Cleaver & Schreiber maintain that improved infiltration and water conservation are likely to be more cost effective and less stressful than construction of water harvesting and storage structures. They support water harvesting and water spreading techniques which make use of simple bunds and water diversions. They conclude that the emphasis should lie on individually or communally managed systems with development costs of US$2,000 or less per hectare, which can be developed or maintained by individual farmers themselves, or by farmers' groups.

Critchley & Siegert (1991) point out that experiences in countries such as Israel, USA and Australia have little relevance to resource-pour areas in the semi-arid regions of Africa and Asia. They show that increased vegetative cover decreases runoff and increases infiltration. High runoff from steep or denuded areas is sometimes concentrated into productive areas to improve water availability, but this approach

carries with it a risk of increased soil erosion. They comment that where possible water harvesting should build on local traditional approaches already in use. Although these and other water harvesting studies have examined farm level interventions, a range of important factors come into play at catchment level.

Integrated Catchment Management (ICM) has been put forward as an approach to the larger scale management of natural resources, and major programmes are underway in Australia, the USA, India and elsewhere (Blackmore, 1987; Dept Water Affairs & Forestry, 1996; D'Souza, 1997). Again, ICM has often adopted a technical, "problem identification" approach. The need for participatory approaches has been highlighted by the difficulties in implementing ICM on the ground (Röling and Jiggins, 1997).

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. Most agricultural resources 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.

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 is possible to help people start with the design process (Röling, 1994).

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.

Returning to the role of wetlands, Breen & Kotzé (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. 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 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.

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.

2 WATER HARVESTING IN SOUTH AFRICA

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. More than half of this land is already under irrigation. 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. Only along the east coast is the ratio between the potential annual evaporative loss and the annual rainfall as low as 2:1. In the NW Cape, potential evaporation is 2,800 mm per year, while mean annual rainfall is about 100 mm.

Because of low 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 in turn has implications for the establishment of 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 a hazardous undertaking 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 an hour or two. Unless mechanisms exist to slow down the flow of this water and store it on the farm, its main effect is negative, in that it leaves the farm rapidly with valuable topsoil in suspension, eroding the most fertile soil. If local water harvesting programmes, or larger scale integrated catchment management can be shown to be viable in these areas, however, the situation outlined by Huntley *et al.* could change dramatically.

Research into water harvesting in South Africa 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 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 appears to be in agreement 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, Breen & Kotzé (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. It may be that a combination of relatively small dams below wetlands could 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 visited Australia to learn "Keyline" water harvesting techniques (Yeomans, 1954, 1968). The system is often used in pasture production, and uses 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". This is combined with chisel ploughing on the contour to increase water infiltration and slow down rainfall runoff.

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. Following this enormous disruption, the white colonists effectively destroyed what was left of balck 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. Raymond Auerbach learned some water harvesting techniques working with the late James Rennie, pioneer of rotational grazing, whom he first met while visiting a keyline farm in Australia's Kiewa Valley. While working for James, he developed a vegetable garden making use of an old water furrow to take water from a spring and wetland to what he had assumed was virgin land. Old Philemon ....., who had lived grown up on the farm, explained to Raymond that when he was a child, the land had been irrigated by Samuel Gwiji, who dug the furrow and used the wetland and spring. At the turn of the century, Gwiji had been a large scale commercial farmer, delivering ox-wagon loads of beans and wheat to the Kokstad market.

At that stage Raymond had already been mentored by a more well-known black South African conservationist, the late Robert Mazibuko. Mazibuko had 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 acknowledges what he learned from Father Bernard Huss at the St Francis Teachers'

Training College at Marianhill in 1928. 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 water harvesting strategy, having met and learned from Richard St Barbe Baker (1944).

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. However, without water harvesting in areas of low rainfall, most of the effort which goes into crop production is wasted, as regular crop failure has made many communities abandon crops such as maize and beans.

3 INTEGRATED CATCHMENT MANAGEMENT IN SOUTH AFRICA

Because of widespread awareness of the fragility of soil and water resources in South Africa there are currently major efforts to introduce integrated catchment management (ICM), and several initiatives are currently underway (Auerbach, 1997). The National Aquatic Ecosystems Biomonitoring Programme of the Department of Water Affairs and Forestry and of the Environment and Tourism, together with the Water Research Commission, are attempting to monitor river health nation wide (Hohls, 1996). The Mhlali Catchment programme in Zululand was able to demonstrate some of the principles of riverine revegetation (Mander, Quinn and Mander, 1993). The Kruger Park Rivers Research Programme in Mpumalanga Province is trying to bring a range of water users together to negotiate the use of water in the catchment (Breen, Quinn and Deacon, 1994). In KwaZulu-Natal, Umgeni Water is working on a Catchment Plan for the Umgeni catchment (Umgeni Water, 1997), and the Farmer Support Group is working on two major integrated catchment management programmes, one on the upper Mkomazi River catchment at Stoffelton (Versveld, Oettlé and Kruger, 1995), and one in the Mlazi River catchment above Ntshongweni Dam (Auerbach, 1996 & 1997).

This Ntshongweni Catchment Management Programme (NCMP) is also funded by the South African Water Research Commission. It has attempted to bring together industrialists, urbanised communities, commercial foresters, large scale commercial farmers, small scale farmers and conservationists 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 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. At the heart of the programme are school environmental action clubs, each of which is being encouraged to adopt a section of the Mlazi River (Auerbach, 1997).

A range of other activities within the NCMP aim to build a recognisable identity within

the catchment which can serve to focus attention on the need for platforms for resource use negotiation. A process of institutional development is underway, in tandem with an educational programme, as envisaged by Röling (1994). 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 social engineering in this coutry to counter the disintegrative social engineering of the *apartheid* era.

In South Africa, we also have the potential to build mutually beneficial interactions between the developed and developing sectors of the economy. Integrated catchment management can facilitate this process, while acting in the interests of resource poor farmers. It is the nature of water to hold things together, and our country, which is semi-arid, needs to bear this in mind, as our aridity in terms of rainfall may be a reflection of our spiritual aridity. The Upanishads tell us:

> This subtle water holds everything together;
> it refreshes and cleanses and carries unwanted matter away.
> It is the great bonding force uniting things as one.
> It is the symbol of grace, life and love.
> Grace is like the dew or rain,
> life is like the flowing river,
> and love is like the ocean.

The common thread within the Ntshongweni Catchment is the Mlazi River. The programme has tried to use it as a unifying factor in the catchment, and to promote participation from local people in caring for the resources of the catchment, rather than plundering them in a selfish and destructive way. Social processes and the building of a sense of ownership among local people are complex. The experience of the NCMP has been that people are remarkably ready to take responsibility for long-term pro-active actions if they can see that there is a general willingness of their neighbours to be responsible. Creating this climate of co-operation is one of the keys to integrated catchment management. Involving young people is probably one of the key strategies which can lead to collective action. Young people are of the future generation, and their involvement awakens the sense of responsibility for the future in older people. Those who might tend to be selfish about short term exploitation of resources often become more responsible when confronted with the enthusiasm of young people, and the moral open-ness of young people towards building a sustainable future.

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, 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, which Raymond Auerbach owns and run together with his wife Christina, and their partner, Mabuye Ngubane. The development of water harvesting systems on Bachs Fen has ocurred over a period of six years, and is described in the first case study (see Figure 2).

The development of water harvesting techniques in the nearby Valley of a Thousand Hills has happened over a longer period of time, as the dryness of the valley has made the uncertainties of production through rainfed agriculture a major risk factor. As mentioned, water harvesting here was pioneered by Robert Mazibuko thirty years ago (Bloch, 1996). The second case study looks at strategies which women in the Nkululeko Community Garden in the Valley of a Thousand Hills (see Figure 2), have adopted to reduce risk, harvest water and increase soil fertility. An analysis of some of the social and economic costs and benefits at Nkululeko and Bachs Fen forms the major focus of this study. Technical aspects are being intensively studied based partly on work already completed on the farm and in the catchment (Wisserhof, 1995; Verburg, 1996; Patrick & Verburg, 1996; Auerbach, 1997), and will be reported on in detail by the end of 1997 (Jansen, in preparation). The study concludes with recommendations to make water harvesting practices more accessible to resource-poor farmers in semi-arid and arid areas.

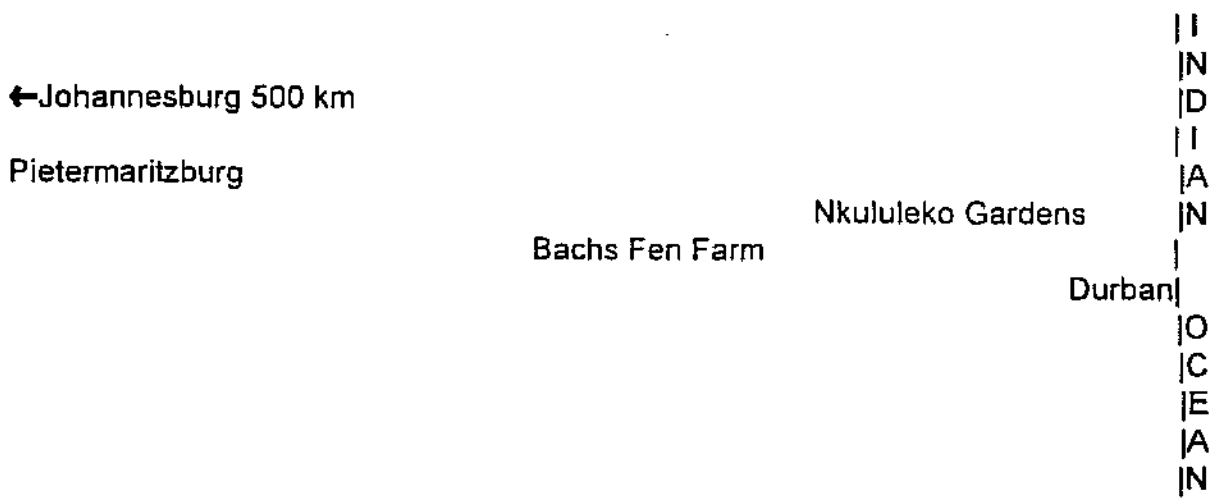

Figure 2: Locality map of the Case Study areas in South Africa's KwaZulu-Natal

4 BACHS FEN FARM

4.1 The area, farming systems and water harvesting techniques

Climate, area and soils

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. Longitude and Latitude co-ordinates are about 30.5° east and 29.5° south, elevation is about 650 m above sea level. Mean annual rainfall for the farm is 797 mm (determined by interpolation of long term measurements, Dent *et al*, 1989), falling mainly in the summer months. Average rainfall is 828 mm/yr. Temperatures are lower than those of subtropical Durban, although there is only occasional frost, and summer temperatures often reach over 40°C. 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. Soils in the vegetable cropping area of the farm are mainly sandy loams characterised by an orthic A horizon with a lithocutanic B horizon, and with underlying saprolitic material. They are classified as "Glenrosa" 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.

The areas adjacent to streams are mainly sand and alluvium derived from sandstone, while the wetland areas are hydromorphic soils with some concretions. These soils are deeper (0.4 -1.2 m) and are classified as "Cartref" form with an ortic A horizon, an underlying E horizon and a lithocutanic B horizon. The clay content of the E horizon is low (6-15 %). The total area of the farm is 7 ha, of which (approximately) 0.4 ha is irrigated vegetables, 1 ha is coffee, 3.6 ha are grazing land, 1 ha wetland and 1 ha buildings, roads and orchards.

Land use, farming practices

Farming systems in the area have been described by Wisserhof (1995), who also analysed Bachs Fen production systems intensively. While local farming is mostly either sugar cane or intensive vegetable production, Bachs Fen farming systems have been designed to be mixed and as ecologically sound as possible. All land is cultivated and planted in small sections (usually about 20 m x 10 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 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 poultry farms.

In addition to organic vegetables for home consumption and sale, the vegetable gardens also produce winter feed for the animals. Coffee trees were planted in 1992, and are approaching maturity. A fodder bank is being developed using multipurpose tree species to produce high protein seeds, so that a drought reserve is available.

Many indigenous trees have been planted, some with medicinal uses, some to screen the national highway which forms the farm's southern boundary. Fruit trees and a small forest of Saw-tooth Oaks have also been planted. Wetlands form a source of craft work material as well as providing winter grazing with a range of nutritious sedges and grasses.

Water resources, runoff and erosion

Rain water running off from a steep sandstone hill above the farm (with a total area of approximately 0.2 km²) feeds a small stream which runs into a small dam and through the wetlands on the farm. Another main resource of water running on to the farm is runoff from the national highway between the farm and the hill. Peak flow discharges onto the farm are 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 is estimated with the SCS model (Schulze *et al*, 1992) to be 0.5 hours after rain. Road engineering resulted in the re-alignment of one of the water courses running off the highway, causing the formation of a substantial erosion gully, and some scouring of the other water course after concentration of runoff at one point. Remedial measures included the construction of a re-diversion furrow to bring the water back into the original waterway, stilling ponds at the entrance point of each waterway, planting of vetiver grass to hold the soil together and the construction of a cut-off furrow to channel all runoff above the vegetable area into the waterway. 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. A third water resource on the farm are two boreholes used for irrigation and domestic water supply (see below).

Domestic water supply, irrigation and soil and water management practices

Domestic water comes from a borehole, 25 m below ground, equipped with a three-phase electric submersible Mono (screw) pump. This water is pumped twice daily into two storage tanks. No water treatment is undertaken as water quality is excellent. Water gravitates to reticulation systems for all dwellings, stock water and a nursery. All water for irrigation has been drawn from a second borehole, some 45 m below the ground, similarly equipped. Irrigation (by micro-jet sprinklers) of the vegetables is regular , and coffee is watered strategically during fruit formation. The irrigation application losses caused by evaporation and interception loss are about 10% of the applied amount (Lecler *et al*, 1995).

Because water resources are limited in the area, water conservation measures are taken on the farm. Swales (level bunds) were constructed and planted with vetiver to slow down, spread and sink water falling on the vegetable garden. Mulches are extensively used (mainly vetiver derived), as is compost, to improve the soil structure and decrease the soil evaporation. Wetland areas are developed and carefully maintained to maximise their flood attenuation and water storage potential.
A lower dam has been constructed, and a solar pump will be installed to harvest the water from the wetlands, thus dramatically reducing borehole use for irrigation.

Farming systems, labour and economy

The partnership between Raymond and Christina Auerbach and Mabuye Ngubane sees Raymond responsible for financial planning and administration, Christina for vegetable planning and vegetable and coffee processing and marketing, and Ngubane for practical farm management. Both Raymond and Christina have outside employment - Christina also runs Nogwaja Cottage Crafts, which processes and markets Angora wool products. Four women are employed full time on the farm, and two young men help on weekends and school holidays, while Ngubane receives a salary in addition to a share of the profits. The farm thus provides a living for five people, and contributes to the Auerbach household economy. As coffee production increases, the profitability of the farm should improve further.

Constraints

The fact that Raymond and Christina have off-farm employment means that their 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 Raymond, Christina and Ngubane moved from a larger farm, once the coffee was established, it was decided that they were no longer necessary. Although soil was initially hard 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. Given the spiralling costs of maintaining tractors, we were not sorry to see them go.

Groundwater in the area is a major constraint. 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. 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. It is essential to find better ways of managing surface water.

4.2 The water harvesting system at Bachs Fen

Problem analysis: Why was water harvesting chosen?

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. The hill (and highway) above the farm shed a good deal of water, and the wetlands have been developed to catch and store as much water as possible. The approach is: slow down, spread and sink. The channels, stilling ponds and wetlands as well as the soil erosion problems have been described under water resources and soil and water management practices. Slowing down, spreading and helping the water to infiltrate affected the choice of swale design. Given a small farming unit like Bachs Fen (7 ha), 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 a farm which previously could irrigate only 0.4 ha of land can expand the irrigable area to approximately 2 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 return.

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 estimated that the mulches and compost already reduce evaporation by approximately 40%. However, he also emphasised that although the vegetable cropping area only occupies a small part of the total farm area, the abstraction of ground water for irrigation is much larger than can be recharged over the whole farm area. 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 (Verburg, 1996). Jansen (forthcoming) is designing a system for measuring the components of the water balance at Bachs Fen accurately.

Costs, materials, labour

Since boreholes and reservoirs were in existence when the farm was purchased, there were not additional capital costs for these items. Costing is addressed under the economics of production section. 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 four swales, which took about 80 man hours to construct, using picks and shovel. Planting of vetiver and watering it twice took a further forty 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. The solar pumping system will cost about R15 000 to install (which is less than the cost of developing a borehole, but is an expense which is hard to justify economically, since as the farm is already equipped with boreholes). Rehabilitating the wetland and veld required cutting back stocking intensity from eight mature livestock units to four, and resting each camp for at least one month per year. The farm is now understocked, and the intention is to build up numbers again to a final figure of ten cows.

Integration with other practices

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 carftswomen make use of the wetland reeds, as part of the Ntshongweni Catchment Management Programme. Trees, cattle & 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.

Monitoring data available

The Agricultural Catchments Research Unit (ACRU) from the Agricultural Engineering department of the University of Natal, Pietermaritzburg, is working with Raymond on the programme, together with Hilke Jansen, postgraduate student from Wageningen Agricultural University in The Netherlands. Three v-notch water flow measures are being set up, as well as three water flow gauges to measure the water flow through the farm accurately. Rainfall records and production records are kept and the water use efficiency will be carefully monitored and modelled once the system is set up.

4.3 Economics of production

In practice, the value of vegetables produced on our 0.4 ha is approximately R570 per week plus R60 home consumption, or R33,000 per year, plus R6,000 worth of cattle feed; total R39,000 per year.

The main borehole pump delivers about 600 *litres* per minute to reservoir tank. Uses 42 kWh over 11 hours at a cost of R60 to fill the 400,000 *litre* tank (R13 for electricity and about R47 for installation cost - the total monthly installation cost for our 25 kVa three phase transformer is R93). Cost of pump and motor about R8,000 with a maintenance cost of R2,500 over 20 years lifetime, which at one tank per fortnight average, is about 500 tanks full. Add cost of reservoir (R13,000), reticulation and sprinklers (R4,000). Total capital cost R25,000 per 500 tanks full. Add interest on R25,000 over 20 years at 10% gives R50,000. Gives capital cost of R150 and electricity cost of R60 plus R5 maintenance, total R215 per tank full.

Table 1: Economics of water harvesting and conventional irrigation

(Present economic analysis)

Irrigation cost on the basis of a quarter tank per irrigation, three irrigations per week in summer, twice a week spring and autumn, and once a week in winter: R215/4 = R54 per irrigation on 0,4 ha or about R5,000 per year for 0,4 ha.

Thus irrigation costs per year are R5,000 of 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.

Without irrigation, the land would produce approximately 5 tonnes of maize grain per ha x 0.4 = 2 t. This could yield a gross margin of anything between R100 and R1,000 depending whether one costs the maize at official bulk price, farm gate price or replacement value for own consumption after milling, calculated at the costs of maize sold in the stores in small packets (Auerbach 1993 with roughly updated input and return costs).

It is difficult to quantify the value of the water harvesting in such a situation. If one accepts Verburg's estimate (1996) that evaporation is reduced by 40%, one could argue that even without irrigation, it would be possible to produce crops more intensively, as the annual rainfall of 820 mm would become far more effective. The value of the land would thus be equivalent to land in an area with rainfall of over 1,000 mm, so that a crop such as dryland potatoes could be tried in our area if mulch, swales and compost were used even if there was no irrigation available. In our situation, the marginal cost of additional water is very low, as all the infrastructure was designed for a higher output system, and the only direct extra costs would be more electricity and higher pump maintenance.

However, many of our customers buy from us because they know that the farm is run ecologically. This has to do both with our organic production techniques, and with our emphasis on wetland conservation and water harvesting. We retail most of our produce and sell the rest to a health food shop. We keep our prices competitive, based on quality, and the price we receive for our retail sales is comparable to the supermarkets, while wholesale is a little higher than top market price.

Components of water balance

The area has most of its rainfall in the summer months (September to February). During this time, the wetlands consistently yield more than 40 *litres* per minute. The dry months are June and July, during which in some years there is no flow out of the wetlands. For the months of March, April May and August, the flow is approximately equal to the estimated water requirement for the garden.

According to Verburg's rough estimate (1996), the farm requires 130 mm for the summer and 60 mm of irrigation water for the winter, giving a total of 190 mm or approximately 2×10^6 *litres* per year to irrigate the 0.4 hectares of vegetables. It is estimated that the wetland water harvesting system yields 7×10^5 *litres* through the eight months of summer and 0.5×10^9 *litres* through the four months of winter, so that even without storage capacity over 80% of the water requirement can be met using the wetlands. This means that the groundwater, which is already severely over-exploited at present, will hardly be required at all to irrigate the crops, while the wetland will certainly contribute to the recharge of groundwater, although it is difficult to quantify the extent of the contribution, as well as the extent of the increase in contribution due to improved wetland conservation, veld management, water conservation using mulches and compost and water harvesting using swales.

If we accept that water is limited in the area, then the value of using 40% less water to irrigate our land adequately, is that some extra water is available to irrigate extra land because of the use of mulches. In addition, because the wetlands slow down the passage of the water through the farm, groundwater recharge would still be greater, even if more land is irrigated. Add to this the extra water harvested by the swales, and the water from the wetland, and one can estimate as follows:

The potential available for irrigation through water harvesting from wetland (if all excess water could be stored) is approximately 5×10^9 *litres*.

Reservoir capacity is 0.4×10^6 *litres*; garden area is 4,000 square metres (0,4 ha).

Each tankful will thus irrigate the entire area of the garden with the equivalent of 100 mm rain, or four irrigations of 25 mm each. If we use a tankfull every fortnight (irrigation weekly during summer, and less frequently during winter), this gives a total water requirement of $26 \times 0.4 \times 10^6$ *litres*, or about 10×10^6 *litres*.

4.4 · Impact of water harvesting, benefits as perceived by farmers?

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.

If less water is pumped, pump lasts longer, but reservoir does not, though could have constructed a smaller reservoir and used a smaller pump. Another possibility is to extend the area under irrigation, which we are doing (planted and planting it to coffee, strategically irrigated - estimate with careful management we can irrigate 2 ha of coffee, yielding 300 to 2,000 cherries per tree at spacing 1.5 m x 1.5 m). We planted 1 ha in 1991, and are at present planning the planting of the second hectare. Yield components for home processed coffee: assume 500 viable cherries x 2 coffee beans each gives 1,000 beans per tree. After roasting, this gives 100 g processed roasted coffee per tree per year, population of about 4,000 trees per ha gives 400 kg marketable coffee on each hectare. Value at R50/ kg is R20,000. Costs of irrigating, manuring, pruning, picking, pulping, fermenting, drying, hulling, roasting, grinding, labelling and packaging about half of that, or R10,000 nett per ha per year. So if one ha coffee not irrigated produced one quarter of the quantity, as predicted by coffee growers, this would only do a little better than break even.

The benefit to us as farmers of our water harvesting set up is that we are able to produce probably two ha of coffee, giving work to six people instead of three, and yielding R20,000 (plus R8,000 for the vegetables) gross margin instead of only the R8,000. This gives us a total projected nett farm income on our 7 ha of just over R50,000 per annum, including dairy income and rent of the old farmhouse, instead of R30,000 without the coffee. Essentially, this is the difference between a viable small farm for a full-time small scale farmer, and something which is a part-time occupation. If the farmer had to go off to work elsewhere, then the farm would become a subsistence maize and vegetable producing area, simply feeding and housing the family, and giving paid employment to nobody.

5 NKULULEKO COMMUNITY GARDEN

5.1 The area, farming systems and water harvesting techniques

Climate, land and soils
Similar to Bachs Fen, but drier and with steeper, more broken topography. People traditionally have built their houses on the tops of the hills, partly for security and communication reasons, and this makes it even more difficult to get water, which has to be fetched from the valley bottoms. The area falls intc the Umgeni River catchment, a larger system which has been extensively studied as part of an integrated catchment management study (Umgeni Water, 1997).

Land use, farming practices
Traditional approach to subsistence farming.

Water resources, runoff and erosion
Erodible soils, steep slopes, tendency to cultivate valley bottomlands and wetlands where possible.

Soil and water management practices, irrigation
Drinking and irrigation water carried from springs in 20 *litre* containers on the heads of women - sometimes for several kilometres.

Domestic water supply
Has been carried from springs on the head. In recent years, treated water to standpipes. Plans for water reticulation to individual homesteads.

Farming systems, labour and economy
Many people are working in town. Agriculture in these areas is mainly carried out by resource poor farmers, including women, and old people (not necessarily poor).

Crops at Nkululeko include cabbages, beetroot, swiss chard, carrots and onions, as well as some maize (for corn on the cob) and a little sugar cane for home consumption.

Crop production problems: usual insect and pest problems, and diseases. Most use "Blue Death" (an organo-chlorine with gamma-bhc as the active ingredient) against pests, which is the only commonly available pesticide which is packaged in small enough quantities to be available to small-scale producers.

Soil fertility: All of the gardeners use cattle manure, which they get from local cattle owners,and crop residues. Because there are many gardeners, and manure is also used for the floors of houses, manure has become a relatively scarce resource, although it is not yet scarce enough to be purchased - it is still given away to those who use it. Recently, they have started with composting in order to use the nutrients more efficiently, as they have heard from their adviser that this will also help with moisture conservation as well as nutrient cycling. One gardener used to use some fertiliser mixed in with the manure, because she was advised by an extension officer to do this,

but all agree that fertiliser is too expensive to use, and does not seem to give a response over and above the manure.

Constraints
Little money for inputs, high risk of crop failure in rainfed agriculture, labour limited, many old people.

5.2 Why was water harvesting chosen?

Problem analysis
Need for "valleys on the hills": create an artificial wetland situation - Mazibuko. Outline of Mazibuko's approach.

The garden is on a steep slope down to a wetland area. The bottom lands are heavier soils and sometimes waterlogged. Each of the members has a plot about 10 m across by 20 m down, divided into three or four terraces, each of which is divided into beds. They tend to plant more or less the same crops at the same time to allow for combining in the purchase of seeds and seedlings.

The upper plots are lighter soil, and some of the gardeners have not taken up water harvesting or mock trenching. The main reasons seem to be that they are older, have less access to resources, and find the physical effort which needs to be invested in the above processes more than they can manage. They are aware that the practices do bring about lasting benefits, and "intend to do something about it" as soon as possible. They are very much aware that there is also much extra effort involved in carrying more water up from the valley to water their crops more often.

Economics
Changes the production possibilities from high-risk rainfed farming in 700 mm mar to low-risk irrigation-supplemented cropping equivalent to 1200 mm mean annual rainfall.

5.3 The water harvesting system at Nkululeko Community Gardens

Most of the gardeners remove a layer of topsoil and layer manure and organic residues into the bed before re-covering the bed with the soil. They say that this provides adequate soil fertility improvement and also allows all moisture to infiltrate the soil, so that it is very rare for the beds to have any run-off.

Mock trenches and deep trenches were introduced to the Valley of a Thousand Hills by the late Robert Mazibuko, KwaZulu-Natal's Tree Man (Bloch, 1996). His approach to rural development was to start by affirming whatever could be found that was good in the systems of local people, and to build on that. He advocated organic farming methods, because, as he pointed out, Zulu people did not have money for expensive inputs, nor did he consider the Green Revolution particularly green. He pointed to the dangers of poisons, and the need for people to recognise the sound common sense of

traditional methods. The old people, he said, knew how to make the soil fertile, not simply to feed plants. When soil organic matter is built up, the water holding capacity of the soil increases. The need to increase plant available water was well-recognised by Mazibuko. His ambition was to create "valleys on the hills" by means of digging trenches a metre deep and half filling these with compostable material. Topsoil and then subsoil were returned to the bed, and the result is a trench bed which acts as a water-harvester, almost an artificial wetland. Soil conditions are obviously important in bringing this about, but the deep red well drained dystrophic soils of the Valley are generally well-suited to this approach. We hoped to find one of the old gardens which Mazibuko had started years ago. At Nkululeko, only MaNdlovu Madlala remembered the old man, and it is not clear whether they originally learned their water conservation from him. The Valley Trust no longer knows of the gardens he used to work with 30 years ago, but these should be traced to evaluate theri effectiveness as water harvesting systems.

5.4 Impact of water harvesting, benefits as perceived by farmers?

MaMiya Margaret Mvubo -
Water is a major problem especially during the winter dry season and during droughts. She makes little basins around each plant to conserve all the water which is used in hand irrigation. She has not used mock trenches, but has seen the positive effects in the plots of others who have used them - she would like to implement mock trenches, but unless she gets some help from younger women, she will find it difficult to do this. She would also like to use mulches, but again, they are labour intensive. Diamond back moth is a problem - how can we control it without expensive chemicals?

MaMiya Mvubu (Sample No 1) is the only one who is not using the adapted mock trench method. She uses cow manure and carries water from the lower part of the garden. Her plots are severely affected by drought during the summer, and because of the difficulties of carrying water, she is resolved to adopt the more labour-intensive practice of digging in grass and manure this year.

Elsie Majola -
Her garden is low down near the wetland area, and the soil is very heavy cracking clays. As there is some waterlogging in her garden during the rainy season, she uses raised beds and planting holes, and incorporates a lot of dry grass into the soil with the manure and crop residues. She uses mock trenching, which she regards as a worthwhile long term investment in soil and water conservation. She has just started with swale construction, which she hopes will further improve water use efficiency, and consreve soil. They intend to plant Vetiver grass on the swales which they are constructing, as has been done at Bachs.Fen Farm. Would like more vetiver planting material.

The others (not MaMiya) have been following this grass and manure practice for at least three years. Previous to this, they were using this mock trench approach for many

years, but it then lapsed until Richard Haigh started encouraging them recently to use traditional methods. They all seem convinced that it is worth the extra work. All the crops including MaMiya's were of a high standard, with few signs of nutrient deficiencies. However, Mrs Madlala's crops were of an exceptionally high standard, especially her very large cabbages. The other practice which some gardeners have adopted is supporting the bottom edge of the terrace with maize stover or wooden pegs. Both methods seem to help to give form to the bottom of the bed and stop it from collapsing.

Elsie Majola (Sample No 2) makes planting dishes in which two beetroot or one cabbage are planted. This catches some water during rain, but also and probably more importantly, it holds the water and promotes infiltration when she waters her crops using a watering can. She has developped a shallow well using a 210 litre drum in her plot, which is graced with a small spring which runs almost perennially.

Catherine Mgadi -
She uses 210 l drums sunk into the ground at a wet point in her plot to develop a water reserve for the dry season, and channels water to each plant using a network of micro-catchments. Also uses grass, residues and manure in her mock trenches. Has problems with cutworms, aphids and moles.

Catherine Mgadi (Sample No 3) is just above the maize stover terrace plot. She has left some of the sugar cane which was there before at the end of the beds - others have removed the cane because they say that it attracts children who eat it and then also eat carrots.

Elda Sishi -
She has a small field as well as her garden plot, where she grows maize - this field has lower fertility and is more subject to drought than the garden plot, and she has not really applied water harvesting techniques to this field. She also uses some water channels to direct water to each plant, and planting holes for each plant. She does not use mock trenches

Elda Sishi (Sample No 4) has a very wet garden, and she has more problem getting rid of water than conserving it. However, during the summer her heavy clay soil dries out rapidly into a very tough protective layer.

MaNdlovu Madlala -
She has sometimes mixed a little fertiliser with her cattle manure. She has made extensive use of mock trenching in her garden plot, and has started developing a similar garden around her home. She also makes compost, and comments that compost is the key to good crops. She believes that feeding the soil rather than the plant is the best way to ensure production wich is sustainable in the long term. She wants to start with swales, when she can get her youngsters to help with the physical

work. Her children have all left home and she is widowed, but some of the grandchildren who live with her are getting old enough to help with gardening. She is also positive about mulching, but has not yet experimented much with this, although she believes that it will help with weed control. She hopes to use some of the vetiver in the community garden for mulching, as she has heard that this is an excellent plant for mulch.

She is experimenting with swales for soil and water conservation, but they are a lot of work, and may be more used by the younger women. She has problems with aphids and moles.

We talked with Mrs Madlala, who lives above the garden, after we left the garden, where we had seen her plot (Sample No 5). She also has a large and productive home garden, which we visited but did not sample. She is clearly a stalwart of the community garden, but is getting old, and lives alone except for numerous grandchildren. She has started to mulch her fields at home, and uses compost when she plants her field crops and her home garden, as well as her garden plot.

Mrs MaNdlovu Madlala's garden is a picture of fertility (Sample No 5). Her enormous cabbages attracted many "oohs" and "aahs" and one of the ladies afterwards asked whether she could buy a few.

General observations

All of the ladies were against the use of fertiliser. Most of them gave as the reason the expense - "we have no money for fertiliser". Two also mentioned that fertiliser disappears quickly. There is a quick result, but only as far as the plant is concerned. There is no residual effect in terms of soil fertility build-up. They all agreed that manure and organic matter help to build the soil and increase water infiltration. Although it is a lot of work, they feel that this investment is the best guarantee of stability in yield at a high level, and also of crop health. Apart from moles and a little scale and caterpillar damage, no nutrient deficiencies or pest damage was noted in the garden. It was in fact a remarkable picture of fertility and health. The amazing thing was to note how little outside input was required. People were not using fancy hybrid varieties, and yet the quality and quantity of yields were highly respectable. A little manure from neighbouring cattle owners, weeds from their plots, grass from the neighbouring road verges and wastelands, a few seeds and seedlings purchased. The main input is labour, and they agreed that this was a major factor, and probably the big obstacle to others adopting their organic methods.

They were watching with interest a trial using vetiver as a terrace edge which Richard had planted, and seemed very positive about peliminary results. Garden compost heaps were in evidence, but most favoured digging in manure and grass rather than composting as a method of improving soil fertility.

Two possible innovations which have not been tried are using furrows to lead water from above the garden into a dam, and using mulch to reduce evaporation. These were discussed briefly with those present.

6 CONCLUSIONS

1 Wetlands are an effective and under-appreciated water harvesting mechanism.

2 Using wetlands in water harvesting is likely to lead to increased groundwater recharge, as well as reducing soil erosion and increasing biodiversity.

3 It is not clear whether mock trenches or deep trenches are effective measures for water harvesting, but they probably improve the structure and organic matter content of soils, and thus their water holding capacity.

4 Small scale farmers are prepared to invest extra effort into setting up water-efficient crop production strategies, because they have confidence that production risks are reduced and yield potential increased.

5 Economically, harvesting surface water by means of wetlands and other soil and water conservation measures is likely to increase the productive value of arable land significantly.

6 Water harvesting can play an important role in the development of ecologically sound farming systems, especially with regard to the role of wetlands in natural integrated ecosystems.

7 For both small scale and larger scale agriculture, water can be more productively used in terms of integrated catchment management if water harvesting is combined with measures which ensure the good management of surface water and groundwater recharge.

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ECOLOGICAL AGRICULTURE IN EUROPE: ÁN OVERVIEW

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INTRODUCTION

In discussing agriculture in the European Union (EU), I want to talk about four issues:

- what are the problems of European agriculture. in particular of The Netherlands.
- is ecological agriculture anractive enough to meet those problems.
- what is ecological agriculture and
- what are the limitations of ecological agriculture?

I shall finish with a concluding statement.

PROBLEMS OF EUROPEAN AGRICULTURE, IN PARTICULAR OF THE NETHERLANDS

Agriculture in most EU countries is very much in transition. The protectionism of the past is giving way to a free market economy. That transition is inducing changes which especially farmers hardly acccept. Prices drop, so profitability of farming drops as well. Sustained by EU subsidizes. decreasing profitability induces yield increases. as farmers scale up production in order to meet their costs. The resultant over-production forces farmers to compete even at distant markets. That induces more costs and less income for farmers, because exporters also demand their part of farmer's profits. There are two other problems. First: in the days of protected markets, farmers were heavily subsidized for their production. So, the higher the yields the higher the subsidies. At the moment. about half of the EU budget accounts for subsidies in agriculture, i.c. about R 2000 per European per year. In order to get rid of over-production and pollution as well, politicians start to debate about the sense of such expenses. Second: within the framework of the World Trade Organisation (WTO), non-Europeans are allowed to enter European markets without tariff barriers. That implies that Europeans have to compete with world market prices[1]. Because of economics of scale. we expect that only large farms will survive.

In general in many European countries, agriculture appears to become a non-profitable sector. Family farming is in danger. Industrial farming is in favour. However is that what Europeans want?

THE NETHERLANDS

After the US and France. The Netherlands (40.000 km^2, less than 1/25 th of the size of SA) is the third largest exporter of agricultural produce. About 60 % of Dutch agricultural produce goes abroad. The Dutch system seems to be efficient and productive. However cracks in that almost perfect system have started to damage its carefully developed success story.

[1] E.g. SA wines are welcomed in EU markets because of their good quality/price ratio. Much to the irritation of French producers. French wines face many troubles.

The Netherlands is densely populated. The country has a delicate environment (water) and the very limited available natural resources must also be used by other polluting sectors such as industries, service sector, recreation and urban areas.

Dutch agriculture occupies about 75 % of the land. So, its quality will undoubtedly have a major impact on the quality of the Dutch environment. Some examples:

- 25 % of nitrate pollution of the North Sea comes from Dutch agriculture;
- 40 % of arable land is phosphate-saturated, which endangers surface and ground water;
- rehabilitation of deteriorated natural resources costs more than the total profits obtained from export of agricultural produce;
- export of agricultural produce requires more fuel energy than that same agricultural produce had fixed from solar energy through photosynthesis;
- since there are more pigs in Holland than there are Dutchmen, the country suffers from enormous quantities of poor quality manure; to get rid of the slurry, farmers inject it into their soils, which give negative effects on soil structure and its self-regulating characteristics;
- Dutch cattle farmers need seven times more than the total of Dutch arable land abroad in order to be able to feed their animals; so the country suffers from a continuous nutrient inflow, which over-enriches ecosystems and thus levels all biodiversity, eliminating organisms which thrive in low-nutrient environments;
- the Dutch farming sector only contributes about 3 % to the Dutch Gross National Product (R750 billion); profits are for exporters and trade, not paying according the "polluter pays principle;
- antibiotics for husbandry are causing alarming levels of human resistance against antibiotics for human medicine;
- not with standing the fact that The Netherlands is almost the highest user of pesticides, animal medicines and chemical fertilizers per hectare agricultural land of the world, the number of diseases increase yearly;

In conclusion. Dutch agriculture is overheated. Dutch agriculture, however successful, could only achieve its success by neglecting the quality of life. Consequently, the Dutch Parliament decided that the quality of natural resources of the country must get the same priority as production has. Short term interests of today's investors must be balanced against long term interests of future generations. The Dutch Parliament is therefore striving to develop a sustainable form of agricultural production systems. The result is that land issues enjoy a higher priority on the political and scientific agenda and Governmental investments are more and more assessed with regard to their impacts on ecosystem sustainability. An example of this is that the Wageningen University has recently changed her mission and as a consequence has started to refurbish all its educational and scientific programmes.

The following table shows the effects of conventional farming in The Netherlands, compared with recent calculations from sustainable forms of agricultural production carried out at the experimental farm of the Wageningen University. Results as mentioned in the table, have led the Dutch Government to develop the following criteria for developing a new agricultural policy which addresses:

- market-orientation,
- better income for farmers,
- effective protection of nature and environment,
- more attention for animal welfare,
- regional development,
- public health.

From the table it can be seen that Dutch agriculture is inefficient (25 %) in terms of effective nitrogen use. More efficient nitrogen use would save the farmer money and reduce pollution at the same time. The Wageningen University has established two large farms to test,among others, nitrogen efficiency in practise. The table shows that integrated farming very rapidly raised the efficiency from 25 % to 75 %. Ecological farming has already raised efficiency to 50 %, and on the basis of our models we are confident that the ecological system will become as efficient as the integrated one. That can be understood when we realize that the eco-farm started just three years ago. That includes that nitrification of organic manure has not come to equilibrium yet.

	Ecological farming	Integrated farming	Conventional farming
Input (kg N/ha/yr)			
* fertilizers	0	70	248
* atmospheric deposition	34	34	23
* N_2 fixation	64	9	4[a]
* purchased concentrates	0	16	65
* others	32[b]	0	14
TOTAL	130	129	353
Output (kg N/ha/yr)			
* crop products sold	34	64	48
* milk sold	27	30	35
* livestock sold	4	3	4[a]
TOTAL	65	97	87
Input - Output (kg N/ha/yr)	65	33	266
Efficiency ratio: Output/Input (%)	50	75	25

[a] estimated value
[b] green waste composted

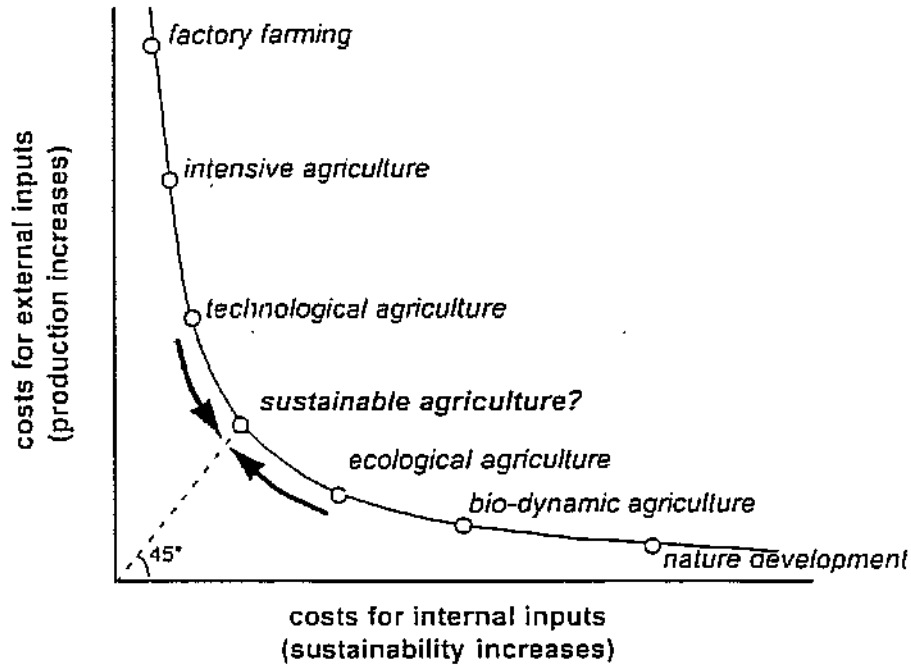
Dutch Government has decided that their scientific research institutes should pay more attention to sustainable farming. Integrated farming systems will concentrate on production by "best technological means", while ecological farming systems will look at "best ecological means" of production. Danish and Austrian Governments chose for ecological systems and Germany chose for a mixture of systems leaving the individual states within German federation to decide according to their own priorities. Let's consider potentials of eco-farming: agriculture by best ecological means.

IS ECOLOGICAL ATTRACTIVE ENOUGH TO MEET THE PROBLEMS?

What are the opportunities for getting solutions? The following figure shows a range of profitable kinds of agricultural production systems. All those systems are viable in The Netherlands. Those are listed in the figure in order of decreasing potentials for self-regulation. As we select systems with higher external inputs, so their self-regulating capacities drop, although yields increase.

The figure shows that eco-farming is efficient, profitable and effective as all the other kinds of land-use. At issue is only what society is happy to accept: an emphasis on short-term or longer-term invesments? The figure also shows that agricultural systems closer to the ordinate are more specialised, more capital intensive and fragile. Agricultural systems closer to the abscissa however are less specialised (more multi-functional), oriented towards management of natural resources and stabile in themselves. Thus, it might be understandable that Dutch Government has opted for a dual focus to increasing the sustainability of Dutch agriculture. On the one hand, integrated farming systems research should try to optimise nutrient use and to use "best technological means" to improve the efficiency of agriculture; on the other, research into ecological farming systems should try to optimise land use from natural resources perspective. Both research directions will contribute to the increased sustainability of future agricultural production.

The EU recently accepted that agricultural development must include regional and farmer development ("Agreement of Cork"). The result is that eco-farming is receiving more and more attention.



The costs of external inputs (Ce) graphed against the costs of internal inputs for a farm system in NW-Europe.

Explanation. When a European farmer decides to stop using agrochemicals, he also starts to rely on natural resources available in the local farm environment. The resources concerned are (a.o) N-fixing and P-defixing organisms. In the very first seven years of eco-farming in Europe, the farmer must manage natural resources in such a way that natural cycles on the farm, or between the farm and those of others, will be restored as much as possible. This implies that yields will drop in the transition period. A European farmer must accept that, which is why the EU helps farmers to cover their yield gap by means of subsidies during the conversion process. The difference between the actual yield obtained by eco-farming and actual yield obtained by chemical farming expressed in current market prices is refered to as costs for internal inputs.Costs for internal inputs are higher when farmers, very much dependent from agro-chemicals, decide to change to ecological farming. That does not imply that small holders in the tropics, who currently use few or hardly any external inputs, are in the best position. Certainly not. Such small holders usually exhaust their local natural resources, because their way of farming is not rational at all. Rational eco-farming, that is to say application of natural inputs for improving system stability, will enhance small holders production without loosing availability of their local natural resources.

WHAT IS ECOLOGICAL FARMING?

In addressing this question it is apparent that exist many misunderstandings. Eco-farming is sometimes labelled as unproductive, liable to exhaust natural resources, representing a step back from technological attainments or even a potential cause of hunger as the world population increases. However, from many scientific and carefully controlled practical experiments, we have learned that eco-farming is in principle as productive as agro-chemical-dependent agriculture. Here are three broad principles underlying ecological agriculture.

- All needs for nutrients are covered by natural methods. We substitute chemical fertilizers with organic ones. At the moment we can put more nitrogen (from the air) into the soil than plants need. With Mycorrhiza we enhance phosphate dynamics in the soil and with returning sugar beet residues Dutch eco-farmers maintain effectively all potassium needs of plants.

- Diseases appear less frequently, because management in eco-farming avoid risk. And whenever diseases occur then biological control systems are applied.
- Biodiversity clearly enhances levels of natural predators, which helps to control diseases in space and time.
- Decision making by the farmer is risks avoiding.

Ecological farming systems are highly productive systems with multi-functional objectives. They are able to meet needs of strategic food reserves, as well as of maintaining environmental quality. Eco-farming aims practically:

- to create multi-functional crop and animal rotation systems,
- to develop multi-functional disease prevention in plants or animals,
- to enhance biodiversity in space and time.

Those requires a whole range of new skills for farmers. So, the next aim concerns:

- to develop farmer entrepreneurship (learning by own experiences and on farm experiments).

THE LIMITATIONS OF ECOLOGICAL FARMING

Now you might question "if eco-farming is potentially so successful why is its success so limited by then"?

To finish, I want to give some attention to this question. In The Netherlands we have identified four critical obstacles to the development of eco-farming.

- Dutch consumers will not pay high food prices. Dutch people only spend approximately less than 10 % of their family income on food. They are accustomed to such expenses. Any increase of that kind of expenditure causes irritation.
- Dutch agriculture is highly specialised. Eco-farming implies de-specialisation. So transition to eco-farming might imply erosion of capital. As about 60 % of agricultural capital is in the form of bank loans, with farmers land as capital security, it is very difficult to motivate farmers, even where they are keen to convert.
- Suppliers of production inputs such as agro-chemicals, seeds and insurance companies, banks and processors of agricultural produce are not happy with multi-functional farming systems. Such systems imply for them loss of markets.
- Institutional research and extension organisations might lose an important part of their (knowledge) market. Eco-farming implies tailor made knowledge, where farmers and consumers within a region determine what to research and what to include in extension programmes.Eco-farming means enhancing of farmers skills, restoration of interaction between farmers and consumers, more on-farm research, more hands-on involvement of farmers in the region in stead of rigidly-controlled experimental conditions at uniform laboratory-oriented national research stations.

Prices, specialisation, suppliers, industries and research institutes are the obstacles with which eco-farming has to struggle. The Dutch Government has started to address some of them. Whether they will all be overcome is dependent on the consumer. From experiments in Germany, The Netherlands, Denmark and England, we have learned that when prices of organic products come near those of conventional products (country wise), there is a massive demand for organic food. From production experiments we know that that amount of food can be achieved.

CONCLUDING STATEMENT

This overview could only touch on few principles and examples to illustrate these in order to answer the questions with which I started. I would like to end by stating that agriculture in a modern society should be multi-functional, because maintaining the quality of life for present and future generations is just as essential as peace and security. We as consumers of natural resources think it quite normal that governments should uphold peace and security; so why not also support food production and farmers, in such a way that it becomes possible for farmers to contribute more effectively to enhancing the quality of human life?

I thank you for your attention and wish the NCMP a lot of success.