TECHNICAL REPORT No. 27

FARMERS' INITIATIVES IN LAND HUSBANDRY

Promising technologies for the drier areas of East Africa

Kithinji Mutunga
and Will Critchley

with
P. Lameck,
A. Lwakuba and
C. Mburu

Published in partnership between:
UNDP – Office to Combat Desertification and Drought (UNSO/ESDG/BDP)
and Sida's Regional Land Management Unit, 2001

FARMERS' INITIATIVES IN LAND HUSBANDRY

Promising technologies for the drier areas of East Africa

RELMA Technical Report Series no. 27

The Technical Report Series of the Regional Land Management Unit

1. *The Revival of Soil Conservation in Kenya.* Carl Gösta Wenner's Personal Notes 1974–81. Edited by Arne Eriksson. 1992. ISBN 9966-896-00-7
2. *The Wild Lake.* By C.A. Gerden, G.M.O. Khawange, J.M. Mallya, J.P. Mbuya, R.C. Sanga. 1992. ISBN 9966-896-01-5
3. *Miljöprofil Kenya* (in Swedish). By Lill Lundgren. 1992. ISBN 9966-896-04-X
4. *Lake Babati, Tanzania, and Its Immediate Surroundings. Part I—Baseline Information.* By James Kahurananga. 1992. ISBN 9966-896-05-8
5. *Lake Babati, Tanzania, and Its Immediate Surroundings. Part II—Management and Action Plan.* By James Kahurananga. 1992. ISBN 9966-896-06-8
6. *The Catchment Approach to Soil Conservation in Kenya.* by Yeraswarq Admassie. 1992. ISBN 9966-896-08-2
7. *Parks and People: Pastoralists and Wildlife.* By Jones R. Kamugisha, Michael Ståhl. 1993. ISBN 9966-896-09-0
8. *Improving Livestock Production in Babati District, Tanzania.* By Josef Jonsson, James Kahurananga, Augustine Macha. 1993. ISBN 9966-896-10-4
9. *Twenty Years of Soil Conservation in Eastern Africa.* By Lill Lundgren. 1993. ISBN 9966-896-12-0
10. *Environmental Education: Experiences and Suggestions.* By V. Lindhe, Miles Goldstick, Stachys N. Muturi, Paul Rimmerfors. 1993. ISBN 9966-896-13-9
11. *Management of Natural Resources aned Environment in Uganda: Policy and Legislation Landmarks, 1890–1990.* By Jones R. Kamugisha. 1993. ISBN 9966-896-17-1
12. *The Hand of Man: Soil Conservation in Kondoa Eroded Area, Tanzania.* By Carl Christiansson, Alfred C. Mbegu, Anders Yrgard. 1993. ISBN 9966-896-18-X
13. *Changing Environments: Research on Man–Land Interrelations in Semi-Arid Tanzania.* By Carl Christiansson, Idris S. Kikula. 1996. ISBN 9966-896-25-2
14. *Twenty Years of Soil Conservation in Ethiopia: A Personal Overview.* By Berhe Wolde-Aregay. 1996. ISBN 9966-896-26-0
15. *Zero Grazing, an Alternative System for Livestock Production in the Rehabilitated Areas of Kondoa, Tanzania.* By G. Tekie, A.P. Masaoa, C.M. Shayo, H.A. Ulotu, E.J.M. Shirima. 1996. ISBN 9966-896-27-9
16. *Land Husbandry Education in Agricultural Colleges of Eastern Africa: An Overview.* By Tesfaye Abebe. 1997. ISBN 9966-896-28-7
17. *Parks and People—Conservation and Livelihoods at the Crossroads: Four Case Histories.* By J.R. Kamugisha, Z.A. Ogutu, M. Ståhl. 1997. ISBN 9966-896-29-5
18. *Participatory Planning and Implementation: Experiences with Farmers from Nyandarua District, Kenya, 1992–1995.* By Christine Holding, Kiunga Kareko. 1997. ISBN 9966-896-30-9
19. *Evolution of Provision of Tree Seed in Extension Programmes: Case Studies from Kenya and Uganda.* Edited by Christine Holding, William Omondi. 1998. ISBN 9966-896-34-1
20. *Traditions and Innovation in Land Husbandry: Building on Local Knowledge in Kabale, Uganda.* By Will Critchley, Dan Miiro, Jim Ellis-Jones, Stephen Briggs, Joy Tumuhairwe. 1999. ISBN 9966-896-38-4
21. *Application and Utilization of Agroforestry Extension Manuals Produced in Kenya.* By Stachys Muturi. 1999. ISBN 9966-896-41-4
22. *We Work Together: Land Rehabilitation and Household Dynamics in Chepareria Division, West Pokot District, Kenya.* By William Makokha, Samwel Lonyakou, Monicah Nyang, K.K. Kareko, Christine Holding, Jesse T. Njoka, Aichi Kitalyi. 1999. ISBN 9966-896-42-2
23. *Soil Conservation in Eritrea: Some Case Studies.* By Amanuel Negassi, Bo Tegngäs, Estifanos Bein, Kifle Begru. 2000. ISBN 9966-896-43-0
24. *Estimating Costs and Benefits on Crop Production: A Simplified Guide for Smallholder Farmers in Ethiopia.* By Takele Zegeye, Abdurahim Ali, Admasu Kebede, Katarina Renström, Gedion Shone. 2000. ISBN 9966-896-50-3
25. *Development of Agricultural Education in Kenya and Tanzania (1968-1998).* By George Okwach (ed). 2001. ISBN 9966-896-58-9
26. *Marketing of Smallholder Produce: A Synthesis of Case Studies in the Highlands of Central Kenya.* by Stachys N. Muturi (ed.) , Julius K. Kilungo, Kavoi M. Muendo, Zacharia Mairura and Joseph G. Kariuki. 2001. ISBN 9966-896-56-2

FARMERS' INITIATIVES IN LAND HUSBANDRY

Promising technologies for the drier areas of East Africa

By K. Mutunga and W. Critchley

with P. Lameck, A. Lwakuba, and C. Mburu

This publication received outside funding from the UNDP Trust Fund to Combat Desertification through a contribution by the Netherlands Government, also from Sida's Regional Land Management Unit and from the World Overview of Conservation Approaches and Technologies. Citation is encouraged. Short excerpts may be translated and/or reproduced without prior permission, on condition that the source is indicated. For translation, and/or reproduction in whole, UNSO should be notified in advance. Responsibility for the contents and for the opinions expressed rest solely with the editors: publication does not constitute an endorsement by any of the institutions represented by the editors, or by the funders.

Regional Land Management unit

UNDP - Office to Combat Desertification and Drought (UNSO/SEED/BDP)

Vrije Universiteit Amsterdam Centre for Development Cooperation services

World Overview for conservation Approaches and Technologies

Published by
Regional Land Management Unit, RELMA/Sida, ICRAF House, Gigiri
P. O. Box 63403, Nairobi, Kenya.

Front cover photographs by
Will Critchley

Top:	Grace's son and daughter-in-law
Middle:	Ali examines his mulch
Bottom:	Susanna makes 15 tonnes of compost each year

Design and layout except front and back cover by
Logitech Limited
P. O. Box 79177
Nairobi

Editing by
K. Mutunga and
W. Critchley

Cataloguing-in-Publication Data
Farmers' Initiatives in Land Husbandry: Promising technologies for the drier areas of East Africa. K. Mutunga and W. Critchley, Nairobi: Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency (Sida), 2001. (RELMA Technical Report Series ;27).

Bibliography: p

ISBN 9966-896-63-5

Printed by
Colourprint Limited
P. O. Box 44466
Nairobi - Kenya

Table of Contents

Abbreviations and Acronyms

ASAL	Arid and Semi-Arid Lands
CCD	Convention to Combat Desertification
CDCS	Centre for Development Cooperation Services, Vrije Universiteit Amsterdam (*now known as* CDCS-International Cooperation Centre)
FAO	Food and Agriculture Organization
FFS	Farmer Field Schools
FI(s)	Farmer Innovator(s)
FI-FI	Farmer Innovator to Farmer Innovator (*visits*)
IFSP-E	Integrated Food Security Programme (Eastern)
IK	Indigenous Knowledge
INADES	INADES-Formation (*an NGO*)
ISWC	Indigenous Soil and Water Conservation
GOK	Government of Kenya
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MOARD	Ministry of Agriculture and Rural Development
NALEP	National Agriculture and Livestock Extension Programme
NGO	Non-Governmental Organization
PE	Participatory Extension
PFI	Promoting Farmer Innovation
PFIA	Promoting Farmer Innovation in Africa (*proposed new phase*)
PRA	Participatory Rural Appraisal
PTD	Participatory Technology Development
QA	WOCAT's Approach Questionnaire
QT	WOCAT's Technologies Questionnaire
RELMA	Regional Land Management Unit
SWC	Soil and Water Conservation
TLs	Trash Lines
TOT	Transfer of Technology
UNDP	United Nations Development Programme
UNSO-UNDP	UNDP's Office to Combat Drought and Desertification
WOCAT	World Overview of Conservation Approaches and Technologies

Foreword

The 'farmer innovator approach' to improved land husbandry that was introduced in the publication *Promoting Farmer Innovation*[1] has matured from a promising initiative into a programme which has captured the imagination of farmers, scientists and policy makers alike. In the semi-arid areas of East Africa, there are farmers who are innovating in all sorts of ways – combining conservation with production. What is more, these farmers have proved to be excellent sources of learning. Simply speaking, they get their message across to their fellow farmers better than outsiders can. The problems of land degradation and poverty in those areas are acute, and we must continue to seek to tap into – and actively support – the wealth of human resourcefulness in those needy areas. Mark Malloch Brown[2] UNDP's Administrator, recently highlighted the potential of the approach:

'……. a growing body of experience around the world points to significant 'win-win' opportunities for reducing poverty while addressing urgent environmental concerns. What we now have to do is to help governments and civil societies develop their capacity to pursue these opportunities systematically. And, in particular, there is an urgent need for more effective partnerships with the poor, to empower them to implement their own solutions. We know this approach can produce exciting results. For instance the United Nations Development Programme's (UNDP) Promoting Farmer Innovation pilot programme in Kenya, the United Republic of Tanzania and Uganda has demonstrated the potential of local knowledge and creativity to improve both rural livelihoods and the environment…..'

This book does not dwell on methodology, but concentrates on documenting specific innovators and their initiatives. Here is evidence of the creativity mentioned above. Above all it is impressive that local men and women using their own resources have devised the systems described in these pages. The technologies may not be technically perfect - but they work. It is our job now both to stimulate the process of innovation, and to provide the technical support required.

The technologies documented in the publication are locally important, but PFI has had impact at a broader level also. There have been notable achievements in demonstrating a new paradigm shift and approach to extension to the extent that new policy initiatives in all three countries have internalized the PFI approach. The programme has also demonstrated how grassroots experience can influence policy, a process which is central to work of the new UNDP.

1 Critchley et al, 1999. *Promoting Farmer Innovation*. RELMA Workshop Report no. 2
2 Extract from article entitled *Empowering the Poor* by Mark Malloch Brown - Administrator, UNDP (UNEP Newsletter *Our Planet*, Vol 11 No 2, 2000)

Finally, we believe the PFI is an excellent demonstration of the value of different partners working together. PFI is a programme of the UNDP's office to Combat Desertification and Drought and has actively sought collaborative partners at all levels. The Sida-funded Regional Land Management Unit (RELMA), has been staunch supporter of PFI through its East African network, and has contributed to PFI's documentation process. PFI has also joined hands with the World Overview of Conservation Approaches and Technologies (WOCAT), which is rapidly becoming accepted as the standard tool for recording and evaluating soil and water conservation. Joining in this way strengthens each, and most importantly, there are added benefits to pass on to the target groups in the field.

Philip Dobie, Director, UNSO
Åke Barklund, Director, RELMA
Hans Hurni, Core Group, WOCAT

Preface

This publication is a testimony to the collaboration RELMA has maintained with UNDP-UNSO, Vrije Universiteit in Amsterdam, the Ministries of Agriculture in the Eastern Africa region and the World Overview of Conservation Approaches and Technologies (WOCAT).

The first ventures between RELMA, UNDP-UNSO, and Vrije Universiteit involved the production of two publications namely, "*Traditions and Innovation in land husbandry: Building on local knowledge in Kabale, Uganda*" and "*Promoting Farmer Innovation: Harnessing local environmental knowledge in East Africa*". The latter culminated in a video version, both being highly on demand necessitating two reprints. It is hoped that the current one, having built on the core areas of the second of these previous books will address pertinent issues that form contemporary concerns to the extension fraternity.

The entry of WOCAT deserves particular recognition as they have brought in a technical dimension that will make local experiences available at a global level through the print media. In the past, this has hitherto been in electronic media via compact discs, which is still not accessible to the majority of intended readers.

Farmers' initiatives and innovativeness are superbly exemplified in this publication fitting pretty well with RELMA's thematic focus of dryland management and its core motto to cross-fertilize knowledge, skills or experiences among the actors in the land management sector. The practitioners and partners of different kind should therefore find this publication useful.

Åke Barklund
Director, RELMA

Acknowledgements

The editors specifically wish to thank those who took part in the intensive exercise of data collection on which this book is based. These are:

PFI National Coordinators
Patrick Lameck (Tanzania)
Alex Lwakuba (Uganda)
Charles Mburu (Kenya)

Others
Hamidu Dumea
John Erabu
Mary Gitau
Charles Imoko
Stephen Kameti
Patrick Kirimi
Jacqueline Kiio
Bernard Kyavoa
H. Dan Miiro
Peter Mukungi
Tom Musili
Stanley Munyithya
Linus Mwendwa
Mbuvi Ngati
Sammy Nzevu
Obanya Obore
Emasu Ogwella
Muthiani Wambua

We would also like to express our appreciation to the Government of the Netherlands (for their funding of PFI), the Regional Land Management Unit (RELMA), and the World Overview of Conservation Approaches and Technologies (WOCAT) who have jointly sponsored this publication, and given support throughout.

Finally we thank the 18 innovators highlighted in this book – and the others who have taken part in the PFI project – for their efforts in sharing their initiatives with others. That is the spirit upon which the project is based.

Kithinji Mutunga
Ministry of Agriculture and Rural Development, Kenya

Will Critchley
CDCS – International Cooperation Centre, Vrije Universiteit Amsterdam

Chapter 1

Introduction

This publication, *Farmers' Initiatives in Land Husbandry* documents and describes a series of technologies which have been developed – or at least adapted to their own requirements– by farmers themselves in Kenya, Tanzania and Uganda. The selected 18 technical initiatives[1] have been identified under the project Promoting Farmer Innovation (PFI). Together with around one hundred others, these technologies are the nucleus of a joint programme between farmers, researchers and extensionists.

The initiatives have been chosen on the basis of their potential for improving conservation through production, and their potential (already being fulfilled in many cases) for rapid spread to other farmers. It must be recognized that, at this early stage, none of these initiatives has yet been technically validated according to a full range of strict criteria. A number may have flaws, and no doubt improvements could be made to each. In some cases, specialists may say that the technology is not 'the best' for a given situation. It is also true that several are merely variations on quite well known techniques. But what is important is that they have been developed by farmers using entirely their own resources. And, in their specific local context, they work. We have taken six technologies from each country. These span a broad range of interventions – from gully harnessing to organic matter management to local forest management practices. Some have been developed by men, some by women. It should be noted here that these technologies are usually only part of an individual's overall *system* of innovation. The presentation of isolated technologies here does not, therefore, do full justice to the integrated package of initiatives that many farmers are developing.

The methodology and early results of PFI have already been described in a previous publication (Critchley et al, 1999a). Although 12 innovations were presented in that booklet (8 of which are featured again here), those descriptions were very brief and merely illustrative. The current booklet has a more detailed, technical nature. Its primary aim is to document and analyze specific land husbandry initiatives on the basis of data collected, measurements taken, and estimates made. It hopes to help technicians and managers of projects (as well as literate farmers) to review a range of alternative practices for the drier areas in the region. It is *not* a technical cookbook recommending validated and well proven practices. However, enough technical information is given for the concepts to be understood, and in most cases for these technologies to be tried out and adapted to different environments, through a farmer/extensionist/researcher

1 note we use the word 'initiatives' in the title, as an umbrella term as suggested by Thomas and Mati (1999) in an external review of PFI. While the term 'innovations' has been used widely under the PFI project, many of the technologies are realistically only innovations *in local terms.* The two terms are used interchangeably in the text

partnership. No doubt the question will be asked: *what about documentation aimed at farmers themselves?* This publication does not claim to fulfil that important function.

Box 1: *Target Audience*

The *primary target audience* of this book comprises field technicians and project managers who have at least a basic understanding of natural resource management in semi-arid areas, and who are involved in day to day field activities.

Secondary audiences include: literate farmers; national decision makers; international SWC and rural development specialists.

A second aim behind the booklet has been to test and assess the utility of WOCAT (the World Overview of Conservation Approaches and Technologies) as a standard methodology in collecting and evaluating data about soil and water conservation technologies, based on the use of the WOCAT technologies questionnaire (QT). As a matter of principle, as well as for pragmatic reasons, PFI seeks to collaborate with other relevant initiatives in East Africa: WOCAT is one such programme. A common weak point in farmer participatory programmes is technical description of the systems developed. Reports are characteristically strong in qualitative description of methodologies and experience, but weaker in *quantitative* terms. WOCAT provides a format for data collection that has usually been employed as a discrete 'WOCAT exercise' at National or Regional levels, using specifically earmarked funds. We have used WOCAT as a tool *within* a project, using the project's own resources[2]. A specific database, and this document are the results.

2 for details of how WOCAT was used, and what was the experience, please see chapter 5

Chapter 2

Background to PFI and WOCAT

2.1 Introduction

It is not the purpose of this publication to describe in detail the methodologies of the projects 'Promoting Farmer Innovation' (PFI) or the 'World Overview of Conservation Approaches and Technologies' (WOCAT). For that information the reader is referred to other publications. PFI is covered in a booklet published recently (Critchley et al, 1999a), and a concise introduction to WOCAT can be found in a new brochure (WOCAT, 2000). Nevertheless, it is our intention that the current document should be self-standing. This chapter therefore introduces the two projects, based closely on material from the two publications cited above.

2.2 Promoting Farmer Innovation (PFI)

2.2.1 The project

PFI's primary objective, as its name implies, is to stimulate technical innovation, in the field of land husbandry, by farmers. This process is facilitated through a partnership of researchers, extension workers and, of course, farmers themselves. Box 2 gives the basic organizational framework of PFI.

Box 2: *Promoting Farmer Innovation (PFI)*

PFI is funded by the Dutch Government and co-ordinated through UNDP's Office to Combat Drought and Desertification (UNSO). It is active in East Africa. Technical support is through the Vrije Universiteit Amsterdam's International Cooperation Centre, CDCS. Field activities of the first phase were conducted beginning early in 1997 until the end of 2000. The project falls within the context of the Convention to Combat Desertification, with its emphasis on the drylands, on the role of indigenous knowledge, food security and the rural poor. UNSO has overall responsibility for the programme, and at a country level, UNDP offices provide administrative support. The focus is on the drylands of sub-Saharan Africa. Within each of the three countries involved, Kenya, Tanzania and Uganda, there is a Governmental executing agency and an implementing agency which co-ordinates and facilitates the day to day activities. The total budget of the first phase was just under US$1million.

2.2.2 Farmer Innovation in context

Farmer innovation has been, historically, the means through which technological advances have been made and traditions developed. This process, however, has been masked by the emergence of a more structured, scientific paradigm involving researchers and extension agents termed the 'transfer of technology' (TOT) approach. While TOT flourished in the higher potential parts of the tropics in the 1960s and 1970s, it has largely failed the small-scale farmers of drought prone sub-Saharan Africa. Nowhere is this truer than in the field of soil and water conservation or 'land husbandry'. Currently there is growing attention being paid to the importance of indigenous knowledge (IK) and indeed, indigenous soil and water conservation (ISWC). Much of that attention begins and ends with admiring and romanticizing IK and ISWC. But the crucial question is: *how can IK/ ISWC be harnessed constructively?* In the specific context of farmer innovators we are asking: *can farmer innovation be stimulated to provide a source of adoptable technologies?* and: *can farmer innovators constitute a useful means of helping to disseminate these ideas?* If we believe the answer to be 'yes' to these last two questions then we must find a way of translating this concept into practice.

2.2.3 Rationale for harnessing innovation

What, in summary, is the basic justification for using farmer innovators creatively in a research and extension process? 'Promoting Farmer Innovation' is based on the hypothesis that farmer innovators potentially:

- *comprise a storehouse of existing knowledge and ideas;*
- *provide a fast track towards successful and adoptable land husbandry systems;*
- *provide a direct and quick entry into a community;*
- *constitute a pre-selected team with which to work;*
- *respond well to recognition through positive feedback;*
- *network well together;*
- *make good on-farm researchers;* and
- *enjoy spreading knowledge.*

Box 3: *Objectives of PFI (from project document)*

1. Promote Farmer–Farmer exchange for diffusion of SWC/NRM practices;
2. Build capacity of farmers and supporting organizations to experiment and innovate;
3. Promote policy dialogue to build on innovation in order to create a favourable environment for rapid adoption of improved resource management techniques.

2.2.4 Limitations and threats

However optimistic we may be about the potential of the approach, we must avoid hype. In other words we must beware of the danger of creating another 'development narrative', that is fabricating a myth of success based on initial over-enthusiasm. There are some obvious, and other less obvious, limitations and threats. These include:

- *tradition and innovation are often not enough alone, but need to be potentiated;*
- *FIs have magnetic qualities: some attract, some repel;*
- *some innovations are very labour intensive; some 'labours of love' are not economically valid;*
- *innovativeness is not equally spread amongst communities;*
- *many innovations are market-driven, and local markets can become easily saturated;*
- *attention to farmer innovators may create a 'favoured-farmer syndrome' and thus jealousy;* and
- *radically new roles need to be adopted by researchers and extensionists.*

2.2.5 Methodology

PFI follows the process approach of *learning by doing*. Thus, methodology is being developed and clarified as the programme moves forward. From the beginning it was clear that PFI would take its lead from the participatory group of approaches (participatory rural appraisal (PRA), participatory technology development (PTD) and participatory extension (PE) etc) but none of these covers the whole, and neither are these approaches strong in *institutionalization* and scaling up which are key components of PFI. The approach which has taken shape can be summarized in two diagrams, namely *Programme Development Processes* and *Field Activities* (see Annex One). As part of the PFI-WOCAT exercise, PFI has been described under WOCAT, through the 'Questionnaire Approaches' (QA). Together with the data on the 18 technologies, this has been entered into WOCAT's global database.

2.2.6 Experience from PFI

Experience from nearly three years of PFI in East Africa demonstrates that there is indeed a considerable wealth of local land husbandry practices, and also a continuous process of farmer innovation – the dynamic that leads to improved systems. Innovative farmers gain inspiration typically from a mix of what they have seen outside their home areas, and their own creative ideas. Farmer innovators tend to be imaginative, and demonstrate pride in their achievements when these are recognized. They apparently visualise patterns of integrating resources and intensifying production that escape others. Chapter 3 explores PFI's experience more closely – country by country.

2.2.7 Outstanding Issues

The first phase of PFI has demonstrated considerable tangible achievements (see Chapter 3). Likewise, strides have been made with respect to development of methodology and conceptual issues. Experience has also helped pinpoint several issues where there is still debate – or room for improvement - in farmer innovator (or related) projects. These include:

- *Who is a true innovator and what is a true innovation?* Does an innovation have to be absolutely unique? Or unique to a locality? Does it have to be new, or can it be an established tradition? These are questions of where to draw the line, but there must be a clear and stated policy.
- *Monitoring and evaluation/impact assessment.* There is a very real need for participatory programmes to improve their hitherto feeble record on monitoring and evaluation and to bring farmers actively into that process. This is not just to satisfy the demands of the funding agencies, but for enhanced internal learning also. WOCAT clearly has an important role to play in the context of programmes, like PFI, that focus on SWC.
- *Gender mainstreaming.* It is difficult in all projects of this nature to make sure that both sexes are adequately represented in the programme. It may be necessary, as PFI has found, to conduct gender studies, and hold sensitization workshops and even carry out specific campaigns to make sure women innovators are identified and involved. An alternative (where this is relevant) is to count families as 'innovator units'.
- *Role of researchers and hard science.* A true partnership is required between the different stakeholders - and not merely empowerment of farmers, which is anyway a simplistic interpretation of the term *participation*. Researchers must not be alienated and hard science must not be lost. Research is needed both for 'validation' of, and to help in 'adding value' to, innovations.
- *Intellectual property rights: sharing or stealing?* While water harvesting or soil conservation techniques are hardly likely to become marketable products in the way that indigenous medicinal remedies can be, there remains a question of 'ownership'. Farmers' individual (or communal) creativity must be respected.
- *Cost-effectiveness.* There are two aspects to cost-effectiveness. The first is simply: is the individual innovation a cost-effective measure? The second concerns the intervention itself: we must not establish a methodology which is potent, but too costly to justify expansion.
- *Scaling-up and institutionalization.* Enclave projects with a narrow focus in terms of area of intervention, duration and with purely tangible targets are becoming, rightly, discredited. The ultimate objective should be to internalize the methodology into existing Government/ NGO systems, either as a stand-alone programme, or perhaps more appropriately as a supplement to broader programmes that already exist.

2.3 World Overview of Conservation Approaches and Technologies – WOCAT

2.3.1 Introduction

The World Overview of Conservation Approaches and Technologies (WOCAT) was established as a long-term programme, and a global network, in 1992. The vision sprang from a realization that sharing of knowledge about soil and water conservation was generally poor. Knowledge was there, but often locked away in individuals and in 'grey literature'. Furthermore, what was described was often done so according to widely different formats making comparisons difficult. Finally there was very little known about the extent of conservation: how widespread were various technologies (and approaches), and how much vulnerable land in each country had actually been protected from degradation? WOCAT's challenge was to tap that knowledge systematically, and to develop a system of managing the information, so that it could be used constructively in helping guide choice about technologies and approaches. Up to present, the major focus has been on data collection and data base management.

A recent brochure explains the basis of WOCAT. The following text is extracted from that document (WOCAT, 2000).

2.3.2 Efficient management of existing knowledge

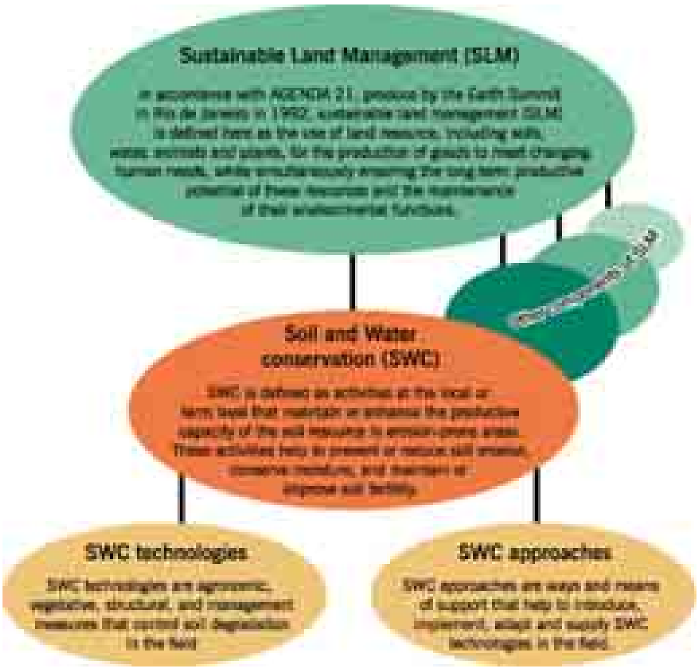
Every day land users and soil and water conservation (SWC) specialists evaluate experience and generate know-how related to land management, improvement of soil fertility, and protection of soil resources. Most of this valuable knowledge, however, is not well documented or easily accessible, and comparison of different types of experience is difficult. WOCAT's mission is to provide tools that allow SWC specialists to share their valuable knowledge that assists them in their search for appropriate technologies and approaches, and that supports them in making decisions.

In the context of PFI this is precisely the situation: potentially valuable knowledge is being uncovered, and should be described and shared.

2.3.3 Making local experience available at the global level

There has been a heavy focus on assessing soil degradation in the past, but documentation of sustainable land management practices – which is much more complicated – has not yet been undertaken. WOCAT has developed tools to document, monitor and evaluate SWC know-how and to disseminate it around the globe in order to facilitate exchange of experience. WOCAT results and outputs are accessible via the internet, in the form of books and maps, and on CD-ROM. The WOCAT process ensures systematic recording. This standardized method facilitates the transferability of knowledge to other areas of need.

Perhaps the key here is the systematic, standardized system of data collection. What data there is, is scattered, and both recorded and presented in ways that make it not directly comparable.



2.3.4 Collecting and documenting SWC knowledge

WOCAT is a tool for documenting and evaluating SWC activities. Collection of information involves personal contact and sharing of knowledge between land users and SWC specialists. A set of three comprehensive questionnaires (on Approaches, Technologies and Areal Extent of conservation) and a database system have been developed to document all relevant aspects of SWC technologies and approaches, including area coverage. WOCAT's standard tools and procedures, including training workshops, help to maintain the consistency and quality of data.

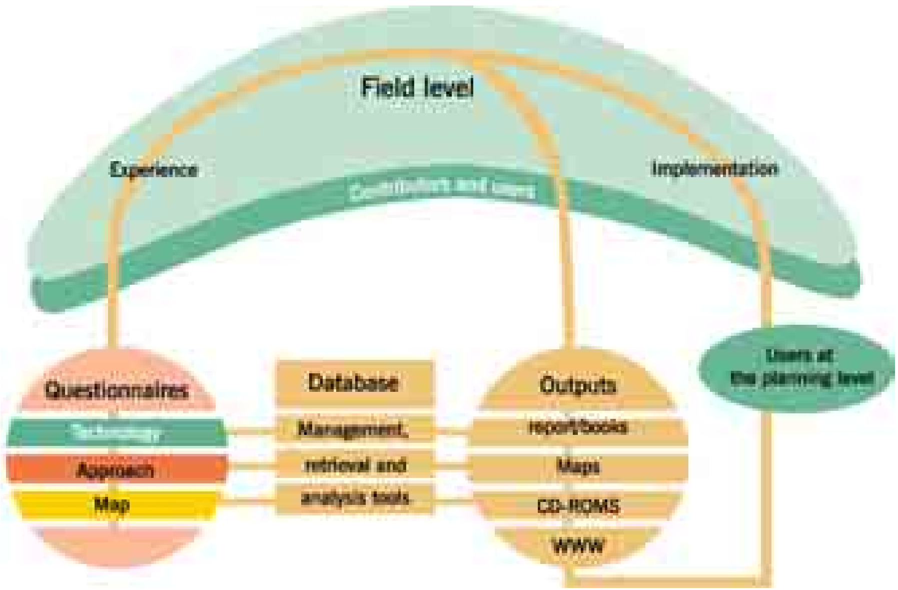
The questionnaires covering technologies (QT) and approaches (QA) are those which have been used by PFI in the current context. Although normally one QA is associated with each QT filled, in this case one approach (therefore one QA) covers all 18 technologies.

2.3.5 Using WOCAT outputs at the field level

At the field level, SWC specialists work under very different bio-physical, socio-economic and institutional conditions. They search for technologies and approaches that are adaptable to their specific situation and meet their specific demands. The digitized

WOCAT query system therefore provides access to information at various points. The search criteria, for example, include agro-ecology, climatic and slope conditions, degradation processes to be tackled, farming systems, the desired level of costs and inputs, etc. Thus a choice can be made among relevant SWC options. Those who do not have access to a PC or the internet can use WOCAT books and maps.

Many amongst the target group of this Publication (see Box 1) do not, at least yet, have access to the internet. And the added value of such a publication as this is that information is presented in an analytical fashion. But this book is not meant as a model for the proposed standard series of 'WOCAT Overview of Technologies'. It is an example of a tangible product produced for a project's own purposes, making use of WOCAT methodology.



2.3.6 Using WOCAT outputs at the planning level

At national and regional levels, the WOCAT database, overviews and maps help planners, co-ordinators and decision-makers to document, monitor and evaluate what has been achieved in SWC. These tools help to make appropriate plans, set priorities for future investments, and maintain contact with other institutions that have similar responsibilities. WOCAT can be used as an instrument for monitoring the efficiency of investments in SWC. It can help to assess whether SWC activities lead towards or away from sustainable land management.

Much of what is written in this paragraph is still to happen, but this indeed is the ultimate purpose of the WOCAT programme and network.

2.3.7 A global network with decentralised organization

WOCAT is a network of soil and water conservation specialists from all over the world. It is organized as a consortium of national and international institutions and operates in a decentralised manner. At the global level, WOCAT is co-ordinated by a management group, assisted by the global secretariat. Annual international workshops and steering meetings provide a basis for exchange on progress and for directing future activities. There is considerable experience available on how to start, organize and maintain national and regional initiatives. This experience is made available in the form of guidelines and through the personal support of members of the WOCAT consortium.

One of the strongest features of WOCAT is the network of individuals and organizations who are already involved, committed and interacting together.

2.3.8 More WOCAT initiatives are welcome

The WOCAT network is open to all individuals and organizations. The core of the network consists of specialists, programmes, projects and NGOs. The WOCAT knowledge base is in the public domain: anyone is invited to share and use it. Newcomers can use the WOCAT database and WOCAT products to gain better understanding of SWC, make better decisions in the field, and enhance planning at the regional or national level. The feedback they provide to WOCAT is greatly appreciated. WOCAT network collaborators contribute relatively little in relation to what they gain.

In a way this last sentence has yet to be widely demonstrated, and many contributors (of data) have wondered how and when they will benefit. It is through rapid feedback of 'hard' products – as well as access to the database that this objective will be achieved.

WOCAT thus is an ambitious programme, but one with a weight of professional commitment and personal dedication behind it, and with considerable institutional backing. As in all programmes of this nature there are complications (terminology; language; consistency in answers, need for maintenance of standards etc) which mean that progress has been, inevitably, steady rather than rapid. Nevertheless WOCAT has made strides in data collection (from Africa, Asia, Latin America and Eastern Europe), in setting up a database and query systems. By mid 2001 over 180 SWC technologies, and more than 100 approaches have been documented. WOCAT has produced two CD-ROMs with databases of technologies, approaches and images. An external evaluation in 1998 gave considerable support to the concept, and to the project itself, while making constructive suggestions for the future. One of the recommendations was for the rapid development of products – of which this document is an example.

Chapter 3

Experience in East Africa: PFI and WOCAT

3.1 PFI's experience in Kenya, Tanzania and Uganda

Introduction

While WOCAT is a worldwide exercise, PFI is restricted to East Africa. Below there follows a summary, by country, of the main tangible successes of PFI. Viewed as a whole, the project has several overall achievements to report. Perhaps the most important of these is the field-testing of a workable 'farmer innovator methodology' (Annex One). PFI has produced a book on farmer innovation (Critchley et al, 1999a) and a broadcast quality video – in English, French and Kiswahili - to complete a two-part module covering methodology, early experience and lessons learned. An external evaluation in 1999 concluded that PFI was making good progress, and recommended an extension phase after 2000 (Thomas and Mati, 1999). In addition to the current publication, a review of PFI's experience with gender will shortly be forthcoming (Ongay'o, M, in press).

PFI: the book


PFI: the video

PFI in Kenya

In Kenya, the focal district was Mwingi, and the implementing agency was IFSP-E, a GOK/GTZ project, to whom a project coordinator was seconded from the Ministry of Agriculture and Rural Development (MOARD). 11 extension agents, from both Government and NGOs were involved in day to day activities. Laikipia Research

Institute and Jomo Kenyatta University of Agriculture and Technology were identified as research partners, and drew up work plans to ensure that activities were well underway before the end of 2000. Technical oversight was provided by the MOARD's Soil and Water Conservation Branch. Of particular interest in this respect is that fact that this branch helped guide the new national extension programme – NALEP (National Agricultural and Livestock Extension Programme). PFI is quoted as 'an approach of importance' within NALEP's design, and NALEP will strive to tap into the positive elements of PFI.

After two years of field work, an overall total of 59 farmer innovators (36 men, 23 women) were identified. They were grouped into 4 clusters and interaction between the FIs has progressed systematically. There were also 5 study tours to neighbouring districts. Two farmers presented their innovations to a huge audience at the 1998 CCD –National Action Programme forum in Nairobi.

Monitoring and evaluation made a hesitant start in Kenya, and it was only after two years that a handful of innovators (7) began to keep regular records, some comparing their innovation plots with controls. A gender study's creative recommendations were followed up by a gender sensitization workshop. There is now a systematic programme of visits by women's groups to FIs. After less than 3 years over 4,000 farmers (nearly 60% of them, women) had already visited an average of 3 innovators each, and many had adopted what they had seen. What helped FIs in getting their messages across was the organization of 'training of trainers' courses for them.

The promise of the programme in Kenya has been recognized by the commitment of UNDP to a collaborative PFI –Farmer Field School initiative entitled *'Farmer innovations and new technology options for food production, income generation and combating desertification'*. This project has attracted funding from UNDP for the first two years of a five year initiative. The idea is to make use of PFI's expertise in identifying new technology to provide input into FAO's farmer field school (FFS) programme in Kenya, under which farmer groups test technologies and disseminate them. This project which began in mid 2001, may prove to be a model that can be copied widely elsewhere.

PFI in Tanzania

In Tanzania the agency that implements was INADES, an NGO with its national base in semi-arid Dodoma. PFI fitted INADES' profile very well, espousing a similar philosophy and approach. Dodoma was the region of concentration, within which four districts were covered. Technical oversight was the responsibility of the Soil Conservation and Land Use Planning section of the Ministry of Agriculture. Despite the late start in that country, 35 male and 25 female innovators had already been identified after just two years of activity. Farmer innovators were organized into groups of 10. Each group was offered the choice of which other group to visit, and a first round had already been accomplished by early 2000. Innovations in Tanzania showed the richest variation of any of the three countries.

In Dodoma there was an especially interesting development. Of the 60 FIs, over half acted as resource persons - receiving training assignments from NGOs and Government organizations alike. Regular farmer innovator 'networkshops' were held. There were a sensitization workshop for extension workers. About half of the FIs began to monitor their innovations, and a Research Institute at Mpwapwa participated in three joint experiments with innovators. Each FI agrees to sensitize his/her neighbours, and the result was that, each innovation was adopted by between 5 and 100 (or even more) people.

The programme in Tanzania was the least accessible to PFI's nodal point in Nairobi (and a long and arduous journey from Dar-es-Salaam). Inevitably it received less direct help and guidance than the others. Nevertheless it has achieved a substantial amount in difficult circumstances, and is well respected locally. The Regional Commissioner is a committed advocate of the programme and (having visited several innovators) has even taken part in producing a joint description of a particular innovation (planting cassava in pits) which he believes is important in terms of food security in the Region.

PFI in Uganda

In Uganda the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) implemented PFI in the three districts of Soroti, Kumi and Katakwi in eastern Uganda. The co-ordinator was seconded on a part-time basis from the Ministry. The Ugandan component was the first of the three to start, and pioneered most aspects of the methodology. From a selection of 100 'potential' innovators, this number was trimmed down to 27 'genuine' innovators – of whom 8 were women. In addition to identification of farmer innovators and holding two FI networkshops, the process of exchange visits between FIs was successful – as were systematic visits of other farmers to the FIs. The range of innovations in Uganda were more limited than in the other countries, probably due to the flat, non-gullied nature of the area, but nevertheless there were some important technologies to be seen (see Chapter 4).

Uganda held a high profile launch of the PFI video in Kampala in February 2000. The guest of honour was the Minister of State for Agriculture. The press and TV were present and reported the event. The national co-ordinator has also been on TV describing PFI and its methodology. Furthermore, on invitation, PFI-Uganda held an orientation workshop for staff from 9 other drought-prone districts. To continue the theme of recognition at the highest levels, the President himself visited (and rewarded) one of PFI's key innovators in Soroti, and the Vice–President was apparently very impressed when she witnessed a presentation by FIs during a world food day event. In collaboration with a project in Kabale district, PFI began a newsletter called 'The Innovator', but this has recently been dropped in favour of a regular contribution to the Ugandan 'Agricultural Review'.

A gender study and a sensitization workshop were conducted. Training has been held in monitoring and evaluation. Of the 5 farmers who carried out M&E, 3 of them had control plots for comparison. NARO (the National Agricultural Research Organization) and Makerere University were involved, respectively, in research on technical and socio-economic parameters of the innovations and innovators. Two successful study tours for FIs to western Uganda were accomplished, and there was a reciprocal visit to PFI by farmers from the Indigenous Soil and Water Conservation (ISWC) programme in Kabale, Western Uganda[1]. In addition to FI-FI exchange visits, more than 1,000 farmers visited FIs (through formal or informal visits) and an impact assessment exercise demonstrated that a half had adopted the innovations seen. As in Kenya, there is a PFI-Farmer Field School link-up, though this time it is informal. FFS make use of PFI innovators as 'resource persons'. Finally, four FIs in Uganda are voluntarily teaching others in personal 'outreach programmes'.

3.2 WOCAT's experience in Kenya, Tanzania and Uganda

WOCAT's experience in East Africa is largely limited to Kenya – though there has been some data collected from the other two countries. Indeed WOCAT began its fieldwork with a first regional workshop for East Africa (training and filling in questionnaires) in Machakos, Kenya in 1995. That pioneering workshop was attended by 26 SWC specialists from Ethiopia, Eritrea, Kenya, Tanzania, Sudan, Uganda and Zambia. The total number of technologies recorded by Kenya, Tanzania and Uganda was 15. The same three countries documented 10 approaches to SWC.

In Kenya, WOCAT is active with a core team of three persons (amongst which a co-author of this publication, Kithinji Mutunga, is one). This team organized a Kenyan national workshop in May 1999 in Ruiru. In addition to the members of the core team, 7 SWC specialists were invited. The output of this workshop was the completion of questionnaires covering 12 technologies and 7 approaches (none overlapping with those recorded in 1995). It was noticeable that the level of accuracy was greatly enhanced compared with the earlier efforts. As a result of this meeting, an analytical textual overview of soil and water conservation in Kenya was started in 1999 (Thomas, Mutunga & Mburu, in preparation).

WOCAT has expanded its East Africa programme through training workshops held

[1] One farmer from that programme is featured amongst the 18 described in this booklet

in Ethiopia (April 2001) and Tanzania (June 2001). Following these, a concerted effort is being made to collect a broad base of data from those countries based on the three questionnaires. As a final note, RELMA, which is the regional node for WOCAT, is the host of the 6th annual WOCAT workshop in 2001.

Chapter 4

Initiatives in Land Husbandry: The Case Studies

4.1 Introduction

In this chapter, 18 technical initiatives, and the innovative farmers associated with them, are described. Six come from each country - Kenya, Tanzania and Uganda. The initiatives represent a selection of the 'best bet' technologies uncovered by PFI. In other words these are initiatives of particular relevance to the drylands, and simultaneously demonstrate the potential of local innovation. We have tried to cover a wide range of types of land husbandry initiatives, and have spotlighted male and female, old and young, innovators. Once again it is necessary to point out that these technologies are all still in the process of being technically validated. However several have passed the ultimate test of farmer approval, judging by uptake rates. But despite the fact that improvements could be made to many, the important thing is that they work in the local situation. It is also important to reiterate that variations of several practices have been described in other publications, before. What distinguishes this selection of technologies is that they have been developed as innovations - in local terms - by farmers, using their own initiatives and resources. The descriptions here differ in degree of detail, and all are weak, not surprisingly, in terms of input-output data. But our intention is to provide enough information to allow a technician, or a literate farmer, to understand the concept of the systems, and to be able to try them out for themselves with confidence.

The layout of each case study requires a little clarification. These are not the WOCAT summary sheets that can be automatically retrieved from the global database, although there are basic similarities. For PFI's purpose that would not give enough of the detail required: a considerable amount of the information is simply not recorded in the WOCAT questionnaire. The latter were not designed with individual's technologies in mind. The first page is a general *introduction* comprising three subheadings. The *background* introduces the innovator and the initiative. Most of this material was picked up outside the WOCAT questionnaire, as were the notes on the interactions between *the farmer and PFI*. The third subheading, *importance of the initiative*, is a guide to why we consider it to be particularly relevant in the context of PFI and this publication. The second page with the overall heading of *technical description* is built up on data directly gathered from the WOCAT questionnaire. That includes the sketch/technical drawing on the third page. The last sheet builds on information from WOCAT and other sources as it attempts an *assessment* of the technology.

4.2 Kenya

The six initiatives described here reflect how land users can use their knowledge to tame and manage their environment for survival in harsh environmental conditions, where famine years are a constant threat. Two comprise different forms of gully rehabilitation/ harnessing, using different designs and materials. Gullies are common in Mwingi, and represent both a threat, and as we shall see, an opportunity. Two further initiatives tap into, literally, the water table associated with sand riverbeds in the arid north of the district. Also featured is an innovator who has used the main tar road to Nairobi as a runoff catchment for his annual crops. Finally, and quite different from the rest, is a case of agroforesty in grazing land management. This is based on the selective removal of one particular tree species that suppresses grass.

The featured district is Mwingi in Eastern Province, Kenya. It was formerly the northern part of Kitui District, which was sub-divided in 1993. Most of the district lies within the agro-ecological zones LM4 and LM5[1]. The average annual rainfall ranges from 500 - 800 mm. The climate is sub-humid to semi-arid. Altitude is from 500 - 1000 m a.s.l, and the topography comprises plateaux /plains with generally moderate slopes of 3-5°. The soil is generally coarse textured sandy, shallow (0.2 - 0.5 m deep), of moderate to low fertility, with loose stone in places. It is low in organic matter, but with generally good drainage, a low soil water storage capacity, and is highly erodible.

Typical household size in the area is around 8 persons and there is an average population density of around 35 persons per km^2. The arid north is sparsely populated. Land ownership is individual, but not titled. Land use is for both subsistence and commercial production, with the main crops being annual grains (maize, sorghum, millet) as well as legumes (pigeon pea, cowpea) with fruit trees and bananas in places. Livestock are common throughout. Soil erosion/ land degradation and, particularly, low rainfall and drought are major constraints to crop production.

[1] LM = 'Lower Midland Zones' with annual mean temperatures between 21° and 24° C;
LM4 = 'marginal cotton zone' and LM5 = 'livestock-millet zone' source: Jaetzold and Schmidt, 1983.

Kenya map showing
location of Mwingi District

Mwingi District map showing location of farmer innovators

4.2.1

Case study No. 1: Road runoff harvesting

MUSYOKA MUINDU
Kyethani Location, Mwingi District

INTRODUCTION

Background

Musyoka Muindu, nicknamed *Nzamba Nguu* ('old cock') in the Kikamba language, is about 70 years old. He was previously employed as a driver, but retired some years ago to concentrate on farming. He was fortunate enough to have inherited a sizeable piece of land, which he added to by purchasing a further plot, making 10 hectares in total. The farm lies by the side of the main Nairobi tarmac road, some 10 km out of Mwingi town. In his endeavour to ensure family food security after retirement – and to boost his pension - he embarked on what other land users in the area considered impossible at first. That is harvesting runoff from the road and distributing it round his cultivated fields using modified and enlarged *fanya chini* and *fanya juu* terraces.

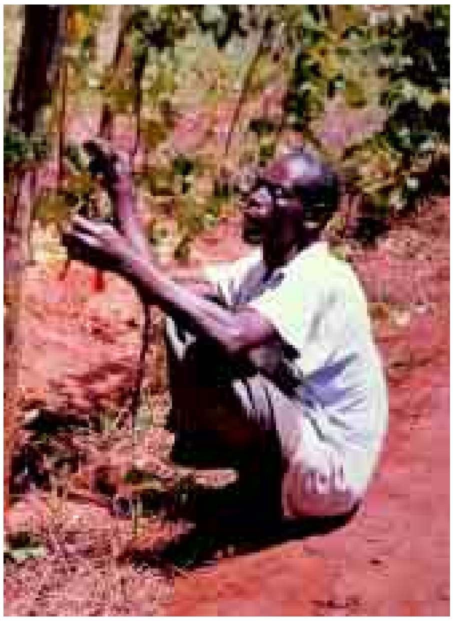
The original source of his idea was a combination of seeing the potential of runoff, and receiving training from the Ministry of Agriculture and Rural Development (MOARD) in soil and water conservation. His experience has sensitized him to the impact of extra moisture. He is very concerned when he sees runoff not being utilised. Musyoka grows maize as a main cereal crop, intercropped with pigeon peas or beans, and has diversified into a wide range of other crops including citrus, bananas, and grape vines. He also has livestock.

Musyoka and PFI

Musyoka has been steadily developing his system since he began in 1993. This is largely as a result of hands-on experience and observations, but with some help from the MOARD. He had come to the attention of MOARD before the start of PFI. Indeed his technology was reported by Mwarasomba and Mutunga (1995) in their survey of positive experience in Kenya's ASAL (Arid and Semi-Arid Lands) areas. Visits outside the district organized by PFI have inspired him to improve his system. His proximity to the tarmac road means that his farm is very accessible to visitors. PFI has taken around 800 farmers to visit *Nzamba Nguu*, and he welcomes visitors with open arms – and with his visitor's book.

Importance of the initiative

The significance of this initiative is that Musyoka has managed to adapt MOARD soil conservation techniques (terracing using *fanya juu* and *fanya chini* methods) and to modify these into a viable water harvesting system, suitable for dry areas. There were – and still are - no precise technical guidelines for this type of water harvesting in Kenya. Here then is a model that is worthy of detailed study, while already acting as a stimulus to other farmers to innovate.



Musyoka Muindu

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This technology is categorized under WOCAT as a combined structural / vegetative measure. Bunds and channels are stabilized with perennial grass. Its purpose is primarily to increase soil moisture for crop production, and it achieves impact through water harvesting. In soil conservation terms it reduces land degradation and soil erosion by water.

Musyoka in his farm

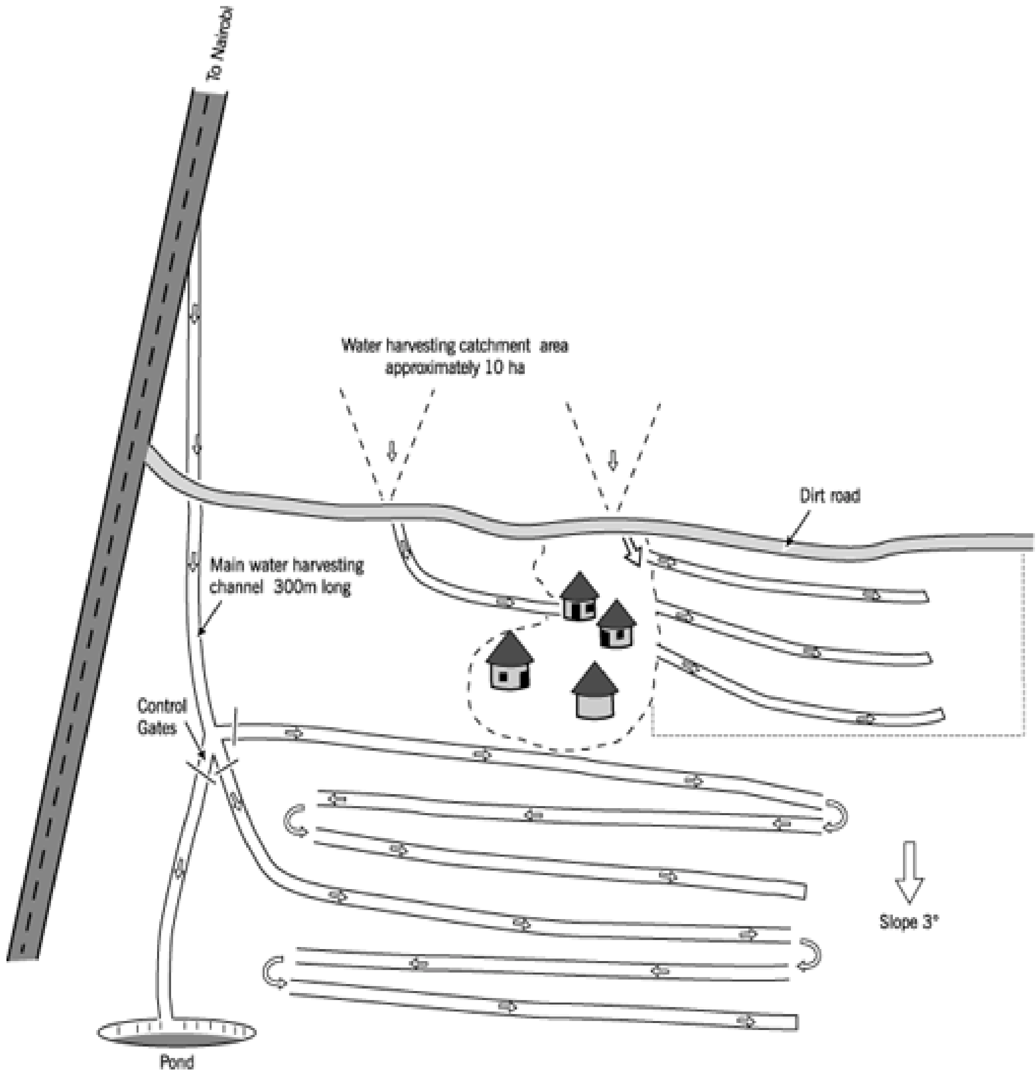
Technical details

Runoff is led to the farm from the tar road in a main excavated channel of about 300 metres length, which cuts through a neighbour's farm. There are also supplementary channels which lead runoff from a hillside. The estimated catchment area is (at least)10 hectares in size. This supplies water to a cultivated area of about 5 ha. The main channel leads runoff into the farm through an initial *fanya chini* structure (a channel with the earth thrown downslope). When the runoff reaches the end of the channel it is diverted round into a similar structure, which leads the water in the opposite direction. To make a simplification, runoff water is conveyed in a zigzag fashion, or 'reticulated', through the farm. At certain points the farmer has put water control gates in specific channels, to select the direction of the flow.

The structures that transport the water within field are mainly *fanya chini* but some are *fanya juu* (embankment above the channel). In all cases the embankment is made of earth, excavated from the channel. The channel's dimensions are (approx) 1.0 m deep and 1.0 – 2.0 m wide; with embankments that are 1.5 m high and spaced at 18 m apart. These dimensions are well above those recommended for standard *fanya juu* / *fanya chini* design (Thomas, 1997). The structures are on a slight grade (sited by eye) to allow the water to flow. The average field slope is 3°. The approximate vertical interval between structures is thus 0.9 m. The embankments are stabilized with grass or perennial crops such banana or sugar cane.

Operation and maintenance

Maintenance involves frequent sediment removal to maintain channel capacity, repair of broken channels and embankment sections and replanting grass or dried-up fruit trees along the embankment where necessary.



Plan of road runoff harvesting system

ASSESSMENT

Costs and benefits

Musyoka calculates that production of his main crop, maize, doubled after the runoff harvesting system was introduced – due mainly to the extra moisture available. Increased farm income is an associated benefit. It is estimated that soil loss approximately halved. Supplementary benefits recorded include increased fodder production.

An approximate construction input of just over 100 days per hectare is stated for the hand labour involved. That represents the infrastructure of bunds and channels. Other costs (equipment, seedlings etc) are minimal. The annual requirement for maintenance is estimated at 10 person days per hectare. This is less in a dry year, but can be much more due to damage caused by extra runoff during heavy rains. Clearly, while it is a low external-input system, this is a relatively expensive technology, and particularly demanding on labour. Nevertheless because the system is directly linked to increased production, these are costs which can be recovered quickly. The benefits compared with investment costs are recorded to be 'positive' in the short term and 'very positive' in the longer term.

Adoption

The farmer has designed systems for two neighbours: indeed the main channel from the road passes through the farm of one of these, with whom he works co-operatively. The total adoption is recorded to be around 40 farmers. They are all now harvesting runoff from tracks or hillsides in this vicinity. However, several of those who have taken up his initiative have not managed to guide the runoff water through the farm as effectively as Musyoka has done.

Research needs/ possible improvements

One improvement regarding adoption of the system would be to assist farmers in layout and design. These road runoff harvesting systems can be very effective, but if not well designed or managed may lead to high maintenance requirements and an increased erosion hazard. An idea for improving Musyoka's system, from the WOCAT data collectors who visited him, is that he could make his channels shallower to allow more water to spillover into his fields, rather than it being lost through deep infiltration. In terms of research, this is one of the systems most in need of validation and full description, as water harvesting is extremely important in the drylands of Kenya. And here is a system that works.

Concluding comments

In conclusion, this is an initiative that demonstrates the great potential of runoff harvesting in semi-arid areas. It has been designed, put into practice, and further improved by a farmer on his own. There have been plenty of project initiated water harvesting systems promoted in semi-arid regions of Kenya (and sub-Saharan Africa more generally: Critchley et al, 1992), but these have often been criticised for being outside the capacity of the land users. Musyoka has demonstrated that this need not be the case.

WOCAT data collection:	Patrick Kirimi; Peter Mukungi, MOARD
Extra Information:	Kenya PFI team; Mwarasomba and Mutunga (1995)
WOCAT Reference:	KEN 22

4.2.2

Case study No. 2: Riverbed reclamation and silt trapping for sugar cane

KAMUTI NTHIGA

Tharaka Location, Mwingi District.

INTRODUCTION

Background

Kamuti Nthiga's farm is in the arid far-north of Mwingi District. The journey to his farm takes almost half a day from Mwingi town by 4-wheel drive vehicle. During the rains it can be inaccessible. Kamuti, who is over 60 years of age, lives with his wives and children in what effectively forms a mini-village. The annual average rainfall in this area is barely 500 mm, and famine years are common. Temperatures are consistently high.

His farm borders a dry sand riverbed. Some two decades ago, after observing that the flow of the river was limited to brief episodes in the rainy season, and that the bed was dry on the surface for long periods, he felt that he could utilise the moisture *under* the surface for productive purposes. He started this work on experimental basis. By 1999 he had reclaimed an area of about 250 m long by 40 m wide from the riverbed, and was farming it sustainably. In Kikamba he refers to the technology as *kyanda* (meaning simply 'riverside'). Although, strictly speaking, farming in a riverbed is against the conservation law, this practice helps protect the riverbed from scouring and the bank from erosion, rather than presenting an erosion hazard in itself.

The initiative first involves fencing off part of a riverbed with cut thorn scrub in order to keep livestock away. The enclosed area is then mulched with brushwood and herbaceous materials in places. Sugar cane is planted and harvested piecemeal when mature. Kamuti plants a perennial grass (*Cynodon dactylon)* between the canes to help bind the sand. This exercise has been done, incrementally, over a series of seasons, enclosing an increasingly large area. When the rains return and the river flows, floodwater passes through and over the sugar cane and silt is deposited as the flow is slowed. The cultivated, reclaimed area stands a good metre above the original bed.

Kamuti and PFI

Despite the remoteness of his farm, over 500 farmers have been taken to visit Kamuti by PFI. Enterprisingly, his extensive family, who make baskets from *Doum* palm leaves (*Hyphaene compressa*), look upon these visits as excellent marketing opportunities. Only a few farmers are recorded as having copied Kamuti over the years: of course this innovation is very location specific. Kamuti himself, as a result of a farmer innovator to farmer innovator exchange visit under PFI, has successfully tested Kakundi Kateng'u's system of planting sugar cane in deep holes to hasten establishment (see 4.2.5). He has also brought bananas from another farmer which he is trying in the Kakundi-style pits.

Kamuti Nthiga

Importance of the initiative

This innovation demonstrates how productive use can be made of sub-surface moisture in sand rivers in arid areas while simultaneously protecting the riverbed and bank from erosion. Indeed this initiative can be considered a form of land reclamation. However, Kamuti is not alone in developing this technology. PFI-Tanzania has identified, and works with, Sister Martha Mwaso in Mpwapwa District of Dodoma Region, who, in a case of parallel development of the same concept, combines sugar cane with napier grass to reclaim dry riverbeds and gullies.

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This initiative is categorized as an agronomic/vegetative measure, for reclamation of land. Its purpose is to increase water stored in the soil and to increase fertility by sediment harvesting, as a way of making land productive, while simultaneously addressing riverbed erosion.

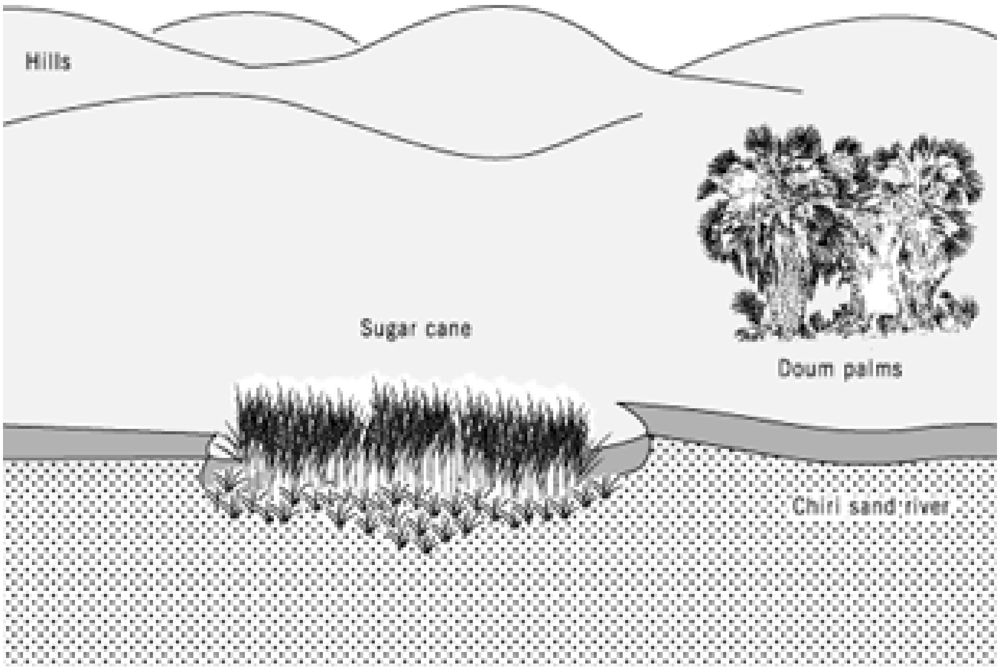
Kamuti and his sugar cane

Technical details

The action involves cutting tree branches, trimming pegs about 1m long, and hammering these pegs into the bed of the sand river, parallel to the bank, enclosing a long narrow strip. This initial strip may be 10 metres wide in a riverbed of 100 meters wide. The tree branches and trimmings are used to form a brushwood-netting barrier, which protects the area from livestock, and simultaneously slows the river flow and traps sediments. To further strengthen the barrier, star grass (*Cynodon dactylon*) is planted along the line of the fence. Inside the fenced-off area, sugar cane cuttings are buried at a depth of 0.4 m, and the same grass planted between the canes. The area is mulched with brushwood, which rots down to increase organic matter in the soil. These cuttings sprout and an intercrop of grass and sugar cane is the result. The grass is cut and fed to livestock, while the sugar cane is used for home consumption and sale for cash. The effect of the vegetation is sediment accumulation within the fenced and planted area. A sediment depth of up to 0.5 m can be achieved in a single season.

Operation and maintenance

Maintenance comprises repairing the fence and cutting grass for mulching. No special tools are required. To be effective, the technology requires mulching every season, as the old mulch is covered by the silt load during the rainy period. The perimeter fence is maintained seasonally and requires considerable material. Occasionally when the rainfall is heavy, the sugar cane is swept away by floods and needs replacing.



Reclaiming part of sand river bed with Sugar cane

ASSESSMENT

Costs and benefits

Farm income increase from the sale of sugar cane is the main production/ socio-economic benefit, while the ecological benefits include sediment accumulation, soil (ie riverbed and bank) loss reduction, soil cover improvement, increase in soil moisture and increase in soil fertility. The production value is estimated to have increased by about a half in the last three years (mainly due to an expanded area enclosed). In the long term the farmer considers the benefits to be very positive compared with the high initial labour demand - particularly in cutting and transporting grass for mulching.

Adoption

At least five farmers had adopted the innovation by the beginning of 1999 (exact figures not available). This is a particularly site-specific system, and thus wide replication is simply not possible. It is only relevant to those who have farms bordering sand rivers with wide beds.

Research need/ possible improvements

A live fence is recommended as an alternative to constantly having to replenish the fence with cut thorn bush. The fence is required to avoid grazing of the cane by domestic livestock. One specific role of research in this situation would be to look into how far it is possible to reduce the width of the riverbed without causing flooding and associated problems.

Concluding comments

Here is a system that defies the theory that planting in, or near to, a riverbed is automatically bad for the environment. While it is common to see agropastoralists planting sorghum in sand riverbeds to make use of residual moisture (eg the Turkana in northern Kenya), that is quite different to this example of combined reclamation and production. *Warning: As has been already mentioned, planting within a riverbed is, strictly speaking, against regulations. Such technologies should not be attempted without consulting the local agricultural office.*

WOCAT data collection:	Mbuvi Ngati; Linus Mwendwa, MOARD
Extra Information:	Kenya PFI team; Dr Bancy Mati
WOCAT Reference:	KEN 23

4.2.3

Case study No. 3: Gully rehabilitation

Ms KALEKYE MUTUA

Kyuso Location, Mwingi District

INTRODUCTION

Background

Kalekye Mutua is a single household head in her mid thirties. Although she has no partner to help support her three children, she manages quite well through farming her 6 hectares of land - where she grows various crops and keeps a few local cattle. She had a small trading venture but has recently abandoned this. Kalekye is not amongst the poorest in Mwingi, but represents a number of female-headed households who prosper through hard work and enterprise. In fact she even employs labourers part-time to help with the farming activities.

Kalekye started innovating in the early 1980s. She decided to tackle a gully that was threatening her land. This gully was growing too big to cross, and was a source of frustration. There is no loose stone available locally, and thus Kalekye was obliged to work out a system of controlling the gully with earth check dams. The essence of her system is to excavate pits just to the side of the gully to provide the material for check dams across the gully bed. The check dams allow overflow around their tips. This flow continues through the pits and back into the gully bed. According to her, she had seen a 'similar' gully control method put into action by a friend of hers who lives quite a distance away. Nevertheless the specific design is Kalekye's own, and has been developed through trial and error.

Kalekye and PFI

PFI has strategically used Kalekye to demonstrate that women can find answers themselves. Her farm has been a favourite for organized visits by women's groups. As a result of visiting another farmer innovator, Kalekye has recently adapted her pits to act as planting locations for bananas.

Kalekye Mutua

Importance of the initiative

This initiative of Kalekye's is one of several similar examples of gully harnessing uncovered by PFI. It is important therefore as a representative of these systems, all of which contrive to turn an 'enemy' into a productive 'friend'. There are specific technical points of note also, but most of all it demonstrates how one female-headed household has managed to be creative, and how useful this example is to influence other women.

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is a structural measure that is vegetated for stabilization. Its purpose is to rehabilitate a gully bed, through control of concentrated runoff by reduction of slope length and both trapping of runoff and sediment harvesting. The productive use of the innovation is mainly for perennial crops (fruit trees and bananas) and for fodder production.

Kalekye and her rehabilitated gully

Technical details

The innovation comprises control of gully erosion by use of constructed barriers (check dams) combined with vegetative materials. The end result is a stabilized gully that is prevented from advancing further. The system also involves fruit trees/banana establishment and fodder grass planting for structure stabilization. Establishment of the technology involves excavation of pits, planting fruit trees/bananas and grass cuttings.

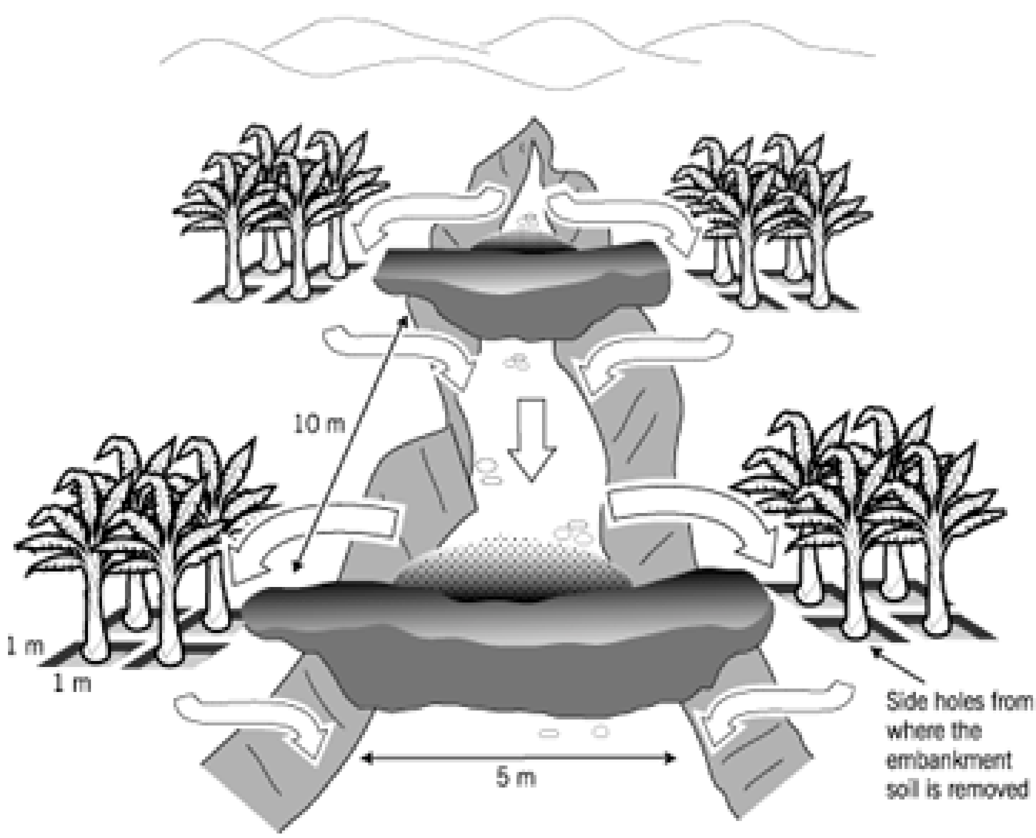
Earth check dams are constructed in the gully, using borrow spoil from square pits in the walls of the gully (see diagram). The earth embankment of the dams are then stabilized with grass. Pawpaws are planted on the original gully floor. Initially the innovator left the pits empty: now she plants bananas in them.

The 5 check dams, each 1 m or more in height, are spaced at about 10 m apart in the gully. The excavated pits are about 1 m x 1 m wide and 1 m deep. Four pits are dug separately on each side of each check dam (see diagram). Makarikari grass (*Panicum coloratum var. makarikariensis*) is used for stabilization, while bananas and pawpaws are planted within the rehabilitated area.

When it rains, runoff generated from the neighbouring plots upstream flows down and is slowed by the check dams. The runoff passes around both wings of each embankment, filling and flowing through the pits. Sediment is trapped in the pits. Excess runoff flows on to the second embankment, then through the second set of pits and so on. Only during heavy rains does water pass through and out of the system, though its velocity is reduced. Thus the gully heals slowly with time and vegetation becomes established.

Operation and maintenance

Regular maintenance work is required, involving repair of broken sections from time to time, using manual labour with a *panga*, shovel and *jembe*. Also of importance is manure application every season to the planted areas before the rains to sustain fertility and thus productivity.



Kalekye's gully under reclamation: note flow of runoff

ASSESSMENT

Costs and benefits

It is not possible to quantify costs and benefits, as no records have been kept by Kalekye. Production improvements include increase in fodder and a significant farm income increase from sales of bananas. Kalekye considers the benefits to be 'very positive' in the long run compared with initial construction costs. Apart from reclamation of land for production (a total of about 250 m_) , and an associated decrease in soil erosion, ecological benefits within the farm include soil cover improvement and an increase in soil moisture. There are also minor offsite benefits resulting from the control of runoff and sediment flow though the gully system. The main cost involved (again difficult to quantify) is hire of labour for construction and maintenance of the check dams.

Adoption

Kalekye only started the innovation two years ago, and while there has been a policy of taking women's groups to visit Kalekye, this is a relatively recent occurrence (starting approximately a year ago). Despite the visitors obviously being inspired, there have been no reports as yet of direct adoption of the technology.

Research needs/ possible improvements

The lack of input-output data mean that this technology cannot yet be accurately validated. That exercise in itself could constitute a micro-research project. It would be relatively simple to compare costs and benefits in order to substantiate what the innovator and visitors instinctively believe to be worthwhile. It would be helpful to know how often breakages in the embankments occur, and to test various alternative grass species for effectiveness in stabilization. In this respect, drought tolerance would be an important characteristic. Possible improvements would include planting improved fruit trees that are rapidly maturing and yield more: grafted mangoes for example.

Concluding comments

There are multiple ways of controlling gullies, and Kalekye has developed her particular style, making a productive virtue of the necessity to dig pits for construction material. Technical information is, as yet only sketchy. Despite this the key issue here is that PFI-Kenya has turned Kalekye's farm into a focal point for visits by women's groups.

WOCAT data collection:	Jacqueline Kiio; Patrick Kirimi; Mary Gitau, MOARD
Extra Information:	Kenya PFI team; Dr Bancy Mati
WOCAT Reference:	KEN 24

4.2.4

Case study No. 4: Grazing land improvement through selective removal of *Commiphora africana* trees

ONESMUS MUSEE KIVUNZI

Thaana Nzau Location, Mwingi District

INTRODUCTION

Background

Musee Kivunzi retired from the army some years ago and now supplements his pension with farming. He is 65 years of age. Musee is wealthy in local terms, owning around 50 hectares of land and running a herd of local cattle. Any visitor to Musee's farm will note that he is an imaginative and dedicated land user, constantly trying out new ideas. The innovation described here, the selective removal of Commiphora trees from his grazing land, is just one of his initiatives. For example he also has a carefully terraced field, 6 hectares in size, which he ploughs with his own oxen. At the head of the field is an infiltration ditch, protecting the field from damaging runoff from outside. He supplements moisture by leading runoff water from paths and small gullies into the field, where it is held by the *fanya juu* terraces. Careful examination of the crops in the field will reveal trials – of his own design – comparing local and hybrid maize varieties. Furthermore, within his grazing land, Musee is testing terraces to control runoff. He is a local source of many herbal remedies for cattle diseases.

However he is featured here because of his systematic ring-barking of indigenous *Commiphora africana* trees which are a weed in this area. Ring-barking causes the trees to wither and die, stimulating grass species to flourish where before they were suppressed. In the Kikamba language he refers to the technology as '*kumya makuu*'. Musee has been gradually clearing Commiphora for 10 years. As an observant herdsman, he differentiates between useful and problem trees. Commiphora falls into the 'problem' category here, though it is a useful browse species for goats and camels in the arid north of Kenya (ICRAF, 1992). His system is, in fact, a form of applied agroforestry.

Musee and PFI

Musee has offered himself to PFI to host farmer visits. This role is not new for him however: he has been known to the District Agricultural Office for a number of years. The difference now is one of emphasis – concentrating on his innovativeness, rather than simply his adoption of sound husbandry practices. Musee is open to new ideas: since joining a PFI cluster of innovators he has experimented with a stone gully check, designed for him by a fellow innovator, Mwaniki Mutembei [see 4.2.6].

Onesmus Musee Kivunzi

Importance of the initiative

This initiative shows that innovation in land husbandry doesn't only take place on cropped land, but on rangeland as well. It also helps to demonstrate the folly of those development agents who promote tree planting without discrimination. What is important on grazing land for cattle is productive and protective cover. Grass, where it can grow, is supreme. That is recognized, and actively promoted by Musee Kivunzi.

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is a management measure that involves area closure, land use change and specific pasture practices. The technology is dedicated to pasture improvement. It achieves reduction of soil erosion and increased production through increase in ground cover and promotion of more palatable species.

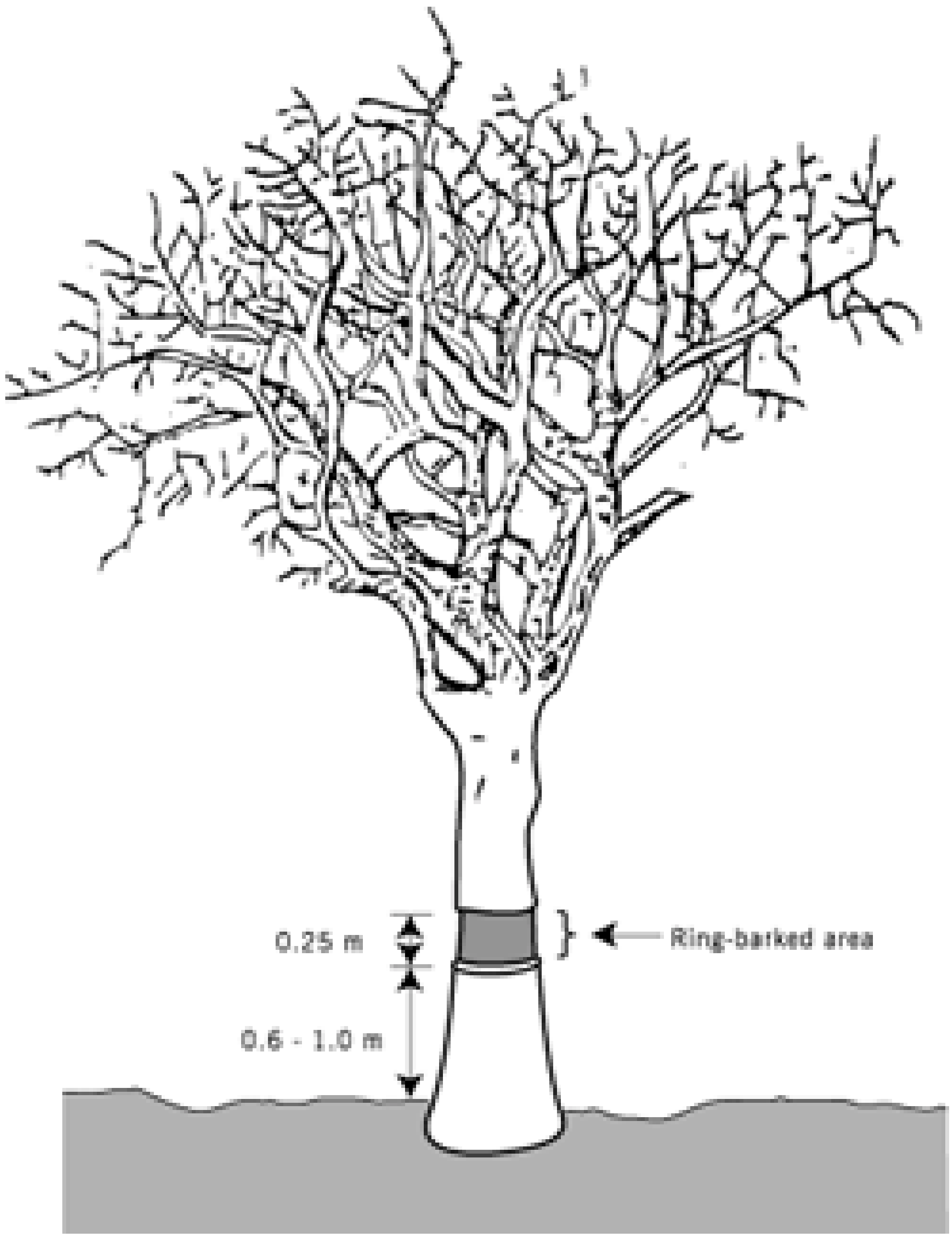
Commiphora suppresses grass growth

Technical details

The technical details are simple. First the trees to be removed are identified. This is not difficult as Commiphora is very distinctive. Note that useful species, such as *Balanites aegyptiaca* are left standing, and indeed the removal of Commiphora stimulates the growth of these beneficial trees. The main activity comprises ring-barking of *Commiphora africana* at between knee and waist height (0.6 – 1.0 m) and waiting for the tree to die. Ring-barking is achieved by making a broad, shallow cut around the trunk of the tree, using a *panga*. Simply cutting the trees does not have the same effect, as they sprout again. While waiting for the trees to dry and die, livestock grazing is restricted to allow regeneration and establishment of grass species. Where necessary, the land can be given surface treatment by shallow ripping and then reseeding with grass.

Operation and maintenance

Maintaining and ensuring restricted / controlled grazing is a continuous process. Controlled grazing before the grass is fully established is a challenge to proper maintenance. Repairs to broken fences are carried out on demand. No special tools are required.



Ring-barking of Commiphora stimulates grass growth

ASSESSMENT

Costs and benefits

Fodder production / quality improvement and farm income increase are the main production and socio-economic benefits – though not yet quantified. Ecological benefits include: soil cover improvement, increase in soil fertility, and soil loss reduction. According to estimates provided by Musee, the initial labour requirement for treating a hectare infested with Commiphora would be in the order of 30 person days. Musee reckons the short term benefits (in relation to the initial costs) to be only slightly positive. The long term benefits he assesses to be very positive.

Adoption

Only a few land users have adopted this technology from Musee: two are recorded, but there could possibly be a few more. There has not yet been a study of dissemination. Once again this is a highly site-specific practice.

Research needs and potential improvements

A simple study of edible biomass production comparing 'before' and 'after' suggests itself as a means to validate the practice. It would be interesting to explore – elsewhere – which other tree species (if any) are selectively removed from grazing land. Most agroforestry research has to-date focussed, not surprisingly, on planting multipurpose trees and the protection of productive species. Here is a new angle for agroforestry research. There are no obvious improvements to Musee's system of selective deforestation that spring to mind, other than adding other well known range management practices, such as rotational grazing to optimise the use of his improved pasture.

Concluding comments

Musee Kivunzi is an example of an innovator who is constantly testing and trying new ideas. Unlike other innovators however, he has not been isolated from the Ministry of Agriculture, and many of his practices are minor adaptations of well known recommendations. His *fanya juu* terraces are an example of this. But his selective deforestation of Commiphora is a true innovation in local terms, though not a practice that is relevant to many others. It does add evidence to show that grazing land is not necessarily a 'lost cause' in semi-arid regions. It also demonstrates that trees can be foes as well as friends. *Warning: cutting trees may be prohibited by local by-law, and should only be done after consulting the local forestry office. Note Commiphora africana can be a useful tree in many situations: see for example 4.3.6.*

WOCAT data collection:	Muthiani Wambua; Bernard Kyavoa; Sammy Nzevu, MOARD
Extra information:	Kenya PFI team
WOCAT Reference:	KEN 25

4.2.5

Case study No. 5: Sugar cane planting pits

Ms LUCIA KAKUNDI KITENG'U

Tharaka Location, Mwingi District

INTRODUCTION

Background

Kakundi is a married woman of about 50 years old, living in a remote part of Tharaka location, in the arid north of Mwingi District. Her farm of just over 20 ha is larger than the average for the area and she owns several cattle. She is therefore relatively resource-rich compared with her neighbours. Her initiative spans from the 1980s when she gained her inspiration by observing the movement of the water table in holes dug in the banks of a sand river. Kakundi decided to plant sugar cane cuttings in wide, deep holes just above the moisture line, so that the roots could reach the water. She found that the cuttings did well even in the driest of seasons, and grew into strong canes. Kakundi sells the sugar cane locally. Despite being only partly literate, she has begun to keep simple records with the help of her husband and children. Her family supports Kakundi in her work. She has started measuring the inputs and outputs related to her innovation, and systematically compares these with an adjacent control plot where she has planted cane in the locally common way. Kakundi plays a key role in a local women's group, where her farm is the site of their tree nursery.

Kakundi and PFI

PFI has benefited very much from Kakundi as a training node for other farmers. It is estimated that, in less than 3 years, around 2,000 farmers have been taken to view Kakundi's enterprise, and to hear her story. Despite her natural shyness she explains her technologies with a will to be heard. She was filmed in the PFI video, so her innovativeness – previously hidden away - is now widely known. In 2000 she received international recognition. She was selected as one of 34 women worldwide to be awarded US$ 500 and a gold badge, from the Geneva-based World Women's Summit Foundation, for her innovative work and inspiration to others. Kakundi used the money to buy a plough, an ox and a dairy cow. It should also be noted that Kakundi has adopted at least one new technology from a fellow innovator: she has recently dug a *fanya juu* terrace in her home garden.

Lucia Kakundi Kiteng'u

Importance of the initiative

The beauty of this system is its simplicity and adaptability. Moisture limits production in this area, so why not dig a hole in the loose soil on the river bank and tap into the water table? Although this is a location specific innovation, it is adaptable to a range of crops. Interestingly a very similar technology has been developed by an innovator who was discovered by PFI in Dodoma, Tanzania. There, Jonas Makali digs pits to plant cassava by a dry riverbed - with great success.

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

The technology comprises a combined structural/agronomic measure, primarily for crop production, but with a secondary purpose of reclaiming land and improving its fertility. Its impact on soil and water conservation is achieved through improving ground cover and harvesting both runoff and sediment.

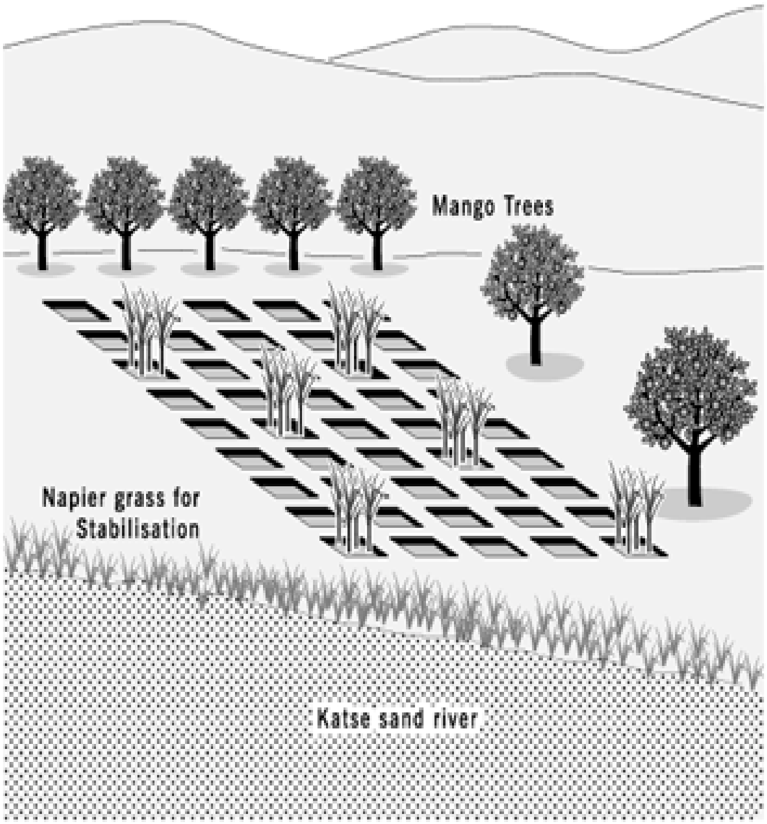
One cutting is planted in each corner of the pits

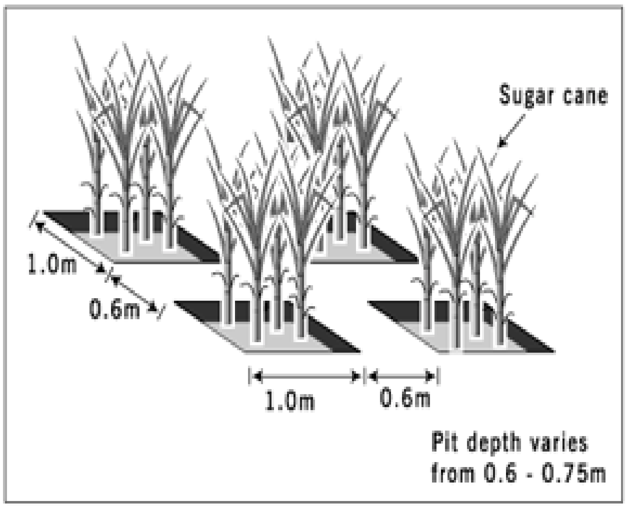
Technical details

The technology involves planting sugar cane in square holes, excavated to a point where moisture can be sensed. Each hole is up to 1 x 1 metre at the top, and from 0.6 to 0.75 metres deep. The closer to the river bank, the shallower the hole needs to be. The holes are spaced about 0.6 metres apart within rows (edge to edge) and 0.6 metres between rows (edge to edge). Small ridges are formed between pits by the excavated material. All work is done manually using hand hoes and shovels. Along the river bank there is a band of vegetation left for protection from flooding. Construction work is carried out in the dry spell before the rains, when the water table is about 2 m deep. Thereafter, a single sugar cane cutting is planted in each corner of every pit, and manure applied during planting. Harvesting of the sugar cane continues for a period of about 3-5 years. During this time the pits gradually fill up with sediment. A new cycle then begins with the digging of fresh pits and the planting of new cuttings.

Operation and maintenance

There is very little maintenance work required, other than that associated with the regular requirements of sugar cane husbandry.





Kakundi's sugar cane pitting system

ASSESSMENT

Costs and benefits

Despite the relatively large investment in terms of labour to establish the pits (not yet measured, but certainly above 100 person days per hectare, and clearly articulated by the farmer), Kakundi considers the long term benefit to be 'very positive' in relation to the costs. The production value from the farm has about doubled in ten years, and sales of sugar cane provide Kakundi with an estimated income of KSh 40,000 (US$ 570) per annum, which is an excellent return from the (approx) one hectare cultivated in this way. There have been problems with theft of produce, however (the farm is several hundred metres from the household compound) and long term profitability will depend on the local market for sugar cane, which presumably could rapidly become oversupplied.

In ecological terms the benefits include soil cover improvement. The system could contribute (potentially, if adopted on a large scale) to riverbank stabilization.

Adoption

According to the Kenya PFI team, Kakundi's technique is the most adopted under the programme. While PFI cannot claim direct credit for stimulating all, Kakundi and the local field staff estimate about 75 men and women have mimicked her technology. One example, cited already in this book, is Kamuti Nthiga, who has adapted the technology with success to plant bananas [see 4.2.2].

Research needs/possible improvements

At the moment it is impossible to answer, quantitatively, the question: *what is the increase in production associated with pits, compared to the extra costs?* Kakundi has, however, recently started keeping simple input/ output records based on treatment versus control plots. Another interesting research question would be: *to what extent, and how, have others modified her basic system to suit their production needs?*

In terms of possible improvements to the system, it is noted that floods can damage the structures and thus either protective dykes along the riverbank, or dense planting with perennial grasses as a buffer strip, could be helpful. In terms of sugar cane production, Kakundi admits that she lacks knowledge and skills for pest and disease control.

Concluding comments

In many ways, Kakundi's initiative typifies what PFI has been looking for. It is a simple innovation which has proved popular in terms of adoption. It is directly related to increase in crop production and farm income, yet has associated environmental benefits as well. Above all, the innovator herself, despite being illiterate and reserved, has proved to be persuasive ambassador for her system.

WOCAT data collection:	Stanley Munyithya; Tom Musili, MOARD
Extra information:	Kenya PFI team
WOCAT Ref:	KEN 26

4.2.6

Case study No. 6: Gully harnessing

MWANIKI MUTEMBEI

Migwani Location, Mwingi District

INTRODUCTION

Background

Mwaniki Mutembei is a young family man, who took the decision some years ago to devote his energies to farming. As he expressed in his interview in the PFI video, he became disillusioned with casual contract labour, and decided to work for himself instead, on his own land. Although he has 4 hectares of farmland, it is situated in one of the driest sub-locations of Migwani, namely Thitani, and the land itself is infertile and shallow. Mwaniki is certainly resource-poor.

Through his farm runs a gully. Instead of seeing this as a threat, Mwaniki viewed it as an opportunity. His initiative is special: it is rare to find a land user in this particular area with his drive. He got inspiration in 1990 from a distant friend who was undertaking 'ordinary' gully control. Mwaniki developed his own system from what he had seen. He uses stone barriers, piled-up gradually, step by step, to trap silt and encourage infiltration of moisture. Between barriers, he has planted pawpaws and bananas as well as annual crops. As the video shows, he has created a green ribbon of productivity running through his farm.

Mwaniki and PFI

Probably the most significant development from Mwaniki's relationship with PFI is that two farmers (one a near neighbour, the other, Musee Kivunzi, from several kilometres away) have independently hired Mwaniki to design similar structures for them. This was the first direct evidence of the 'tenth step' in PFI's field activities methodology being reached [see Annex One]. It is an example of a farmer innovator reaching out, in response to demand, to teach others.

Importance of the initiative

The significance of Mwaniki's innovation lies partially in the observation made above. But also, from a technical point of view, he has demonstrated how to creatively manipulate a gully. Gullies, by definition, are concentration points for runoff. And with the runoff comes organic matter: goat droppings and so forth. In a landscape where moisture and fertility are limiting, it is easy to see that these are potential resources which can be captured. Soil conservation books preach about the importance of controlling gullies to reduce erosion. Mwaniki controls a gully for more immediate and important reasons.

Mwaniki Mutembei

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is a structural measure. Its purpose is primarily for perennial (and annual) cropping. With respect to soil and water conservation, impact is achieved through control of concentrated runoff, by retention/ trapping of sediment, by reduction of slope and thereby reclamation of land within a gully.

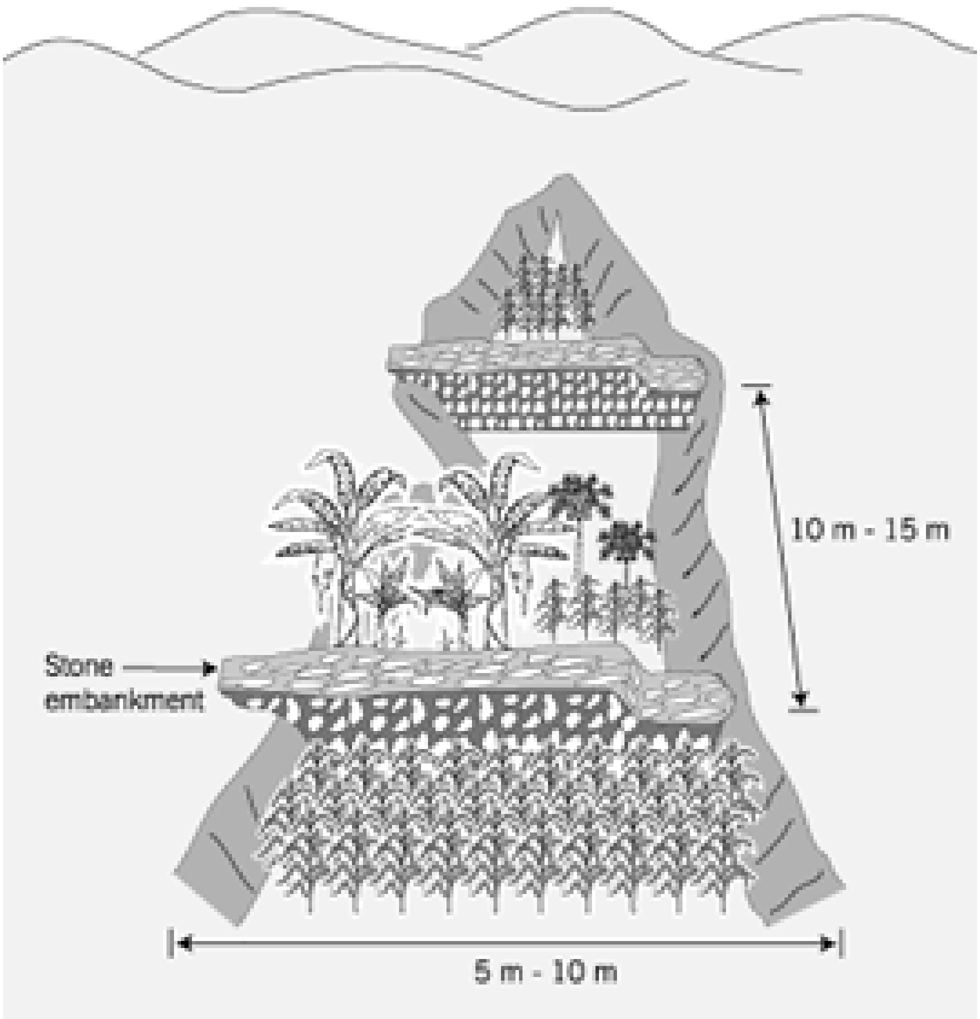
Mwaniki's gully garden

Technical details

Stone checks are constructed across the gully at horizontal intervals of 10 - 15 m. The check dams vary in size, but are generally 1- 1.5 m high, 1 m wide at the top (base width is greater) and stretch for some 5 - 10 metres across the gully. The checks are flat across the top, except for one end which is lowered to act as a spillway for overflow. As has been pointed out already, these are constructed in stages every rainy season, keeping pace with the rate of siltation. Stone for construction is collected from around the farm. These checks slow down runoff, encourage sedimentation of organically rich deposits and create a moist and fertile gully bed, suited to crop production. Bananas, pawpaws and annual crops are planted between the stone checks.

Operation and maintenance

Maintenance is a continuous process. There is a regular demand for adding more layers to the check dams as they silt up, and an occasional need to repair broken checks.



Stone checks in the gully: note side spillways

ASSESSMENT

Costs and benefits

Mwaniki had reclaimed about 500m^2 of the gully by early 1999. He harvests pawpaws over an eight month period, and estimates his banana harvest at over 50 bunches per season. He recognizes the benefits of increased production (in terms of food and, particularly, farm income). There are also the ecological benefits of reduced soil loss and slowed and decreased runoff, leading to increased soil moisture. However, a major disadvantage with this technology is the high labour demand (not yet quantified) both initially and recurrently. While other innovators tend not to mind a heavy burden of visitors, Mwaniki recognizes that this takes away a significant amount of his time. The programme has thus reduced these visits.

Adoption

As the main work of construction, involving superficial quarrying of stone, is very labour demanding, it makes the technology expensive to undertake. Because of this, and also due to the fact that it is a very site specific technology, adoption has so far been limited to a handful of farmers locally.

Research needs/ possible improvements

Mwaniki is keeping simple records of the depth of sedimentation, but it would be important to monitor inputs and outputs closely to enable us to relate actual costs to output. In terms of potential improvements to his system, it may be useful for a technical discussion between a soil conservation specialist and Mwaniki about reducing the danger of collapse of structures. In this regard the spillways could be a focus of attention.

Concluding comments

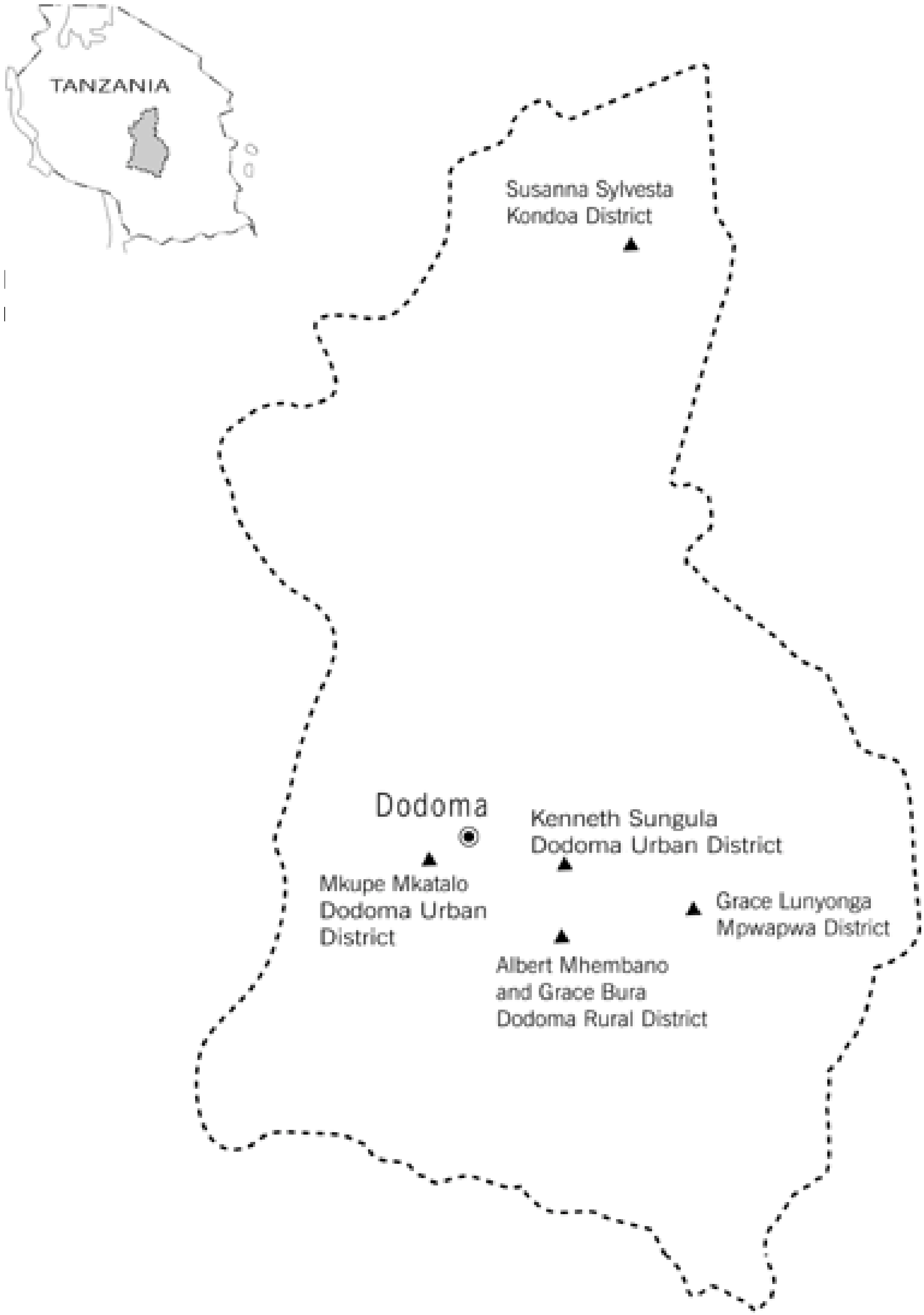
Mwaniki Mutembei has demonstrated both dedication and technical skill in taming a gully and making it productive. It may not be a technology that many others will find appropriate, and is certainly labour demanding, but it is remarkable that one man can turn his life around, as he professes to have done, on the basis of a gully.

WOCAT data collection:	Stephen Kameti; Charles Mburu, MOARD
Extra information:	Kenya PFI team
WOCAT Ref:	KEN 27

4.3 Tanzania

The six initiatives/ innovations described here are from Dodoma Region in central Tanzania. Four districts are covered, namely Dodoma Rural, Mpwapwa, Dodoma Urban, and Kondoa. Of the initiatives featured, two are concerned directly with increasing organic matter in the soil – one through making compost and the other through adding undecomposed organic matter directly into trenches. A further initiative is reclamation of land from a gully, by a woman, who uses a vegetative means to achieve her objective. Another idea, which has remarkable similarities to systems popular in the West African Sahel involves low-cost planting pits for cereals. One technology described here is more of an agronomic technique (earthing up of groundnuts) than a conservation measure. There is also an intriguing case study of protection of a naturally regenerating tree.

The predominant land use system in the region is annual cropping and grazing. Average annual rainfall ranges from 400-750 mm, and the agro-climatic zone is semi-arid. Much of the land is flat or comprises rolling slopes. The generally shallow, medium textured loam soils are of low organic matter status, low fertility, and are erodible. There is loose stone only in some locations. Typical household size in the area is 6-8 persons. Land is owned officially by the state, while individuals have land use rights.



Dodoma Region map showing location of farmer innovators

4.3.1

Case study No. 7: *Chololo* planting pits

KENNETH SUNGULA

Kikombo Division, Dodoma Urban District

INTRODUCTION

Background

Kenneth Sungula and his family are dependent on his 4 hectares of gently sloping land in Chololo[2] village. The family own no livestock, other than a few chickens. They grow millet and cowpeas as their main annual crops. Neither Sungula nor his wife are literate. His novel technology dates back to 1978, when Sungula stumbled upon the idea by accident. He noted that some plants growing in a small depression in the ground were strongly outperforming others nearby. He then began to experiment by deliberately creating small planting pits. Sungula claims that 'his stomach taught him' how to make the pits. His meaning is clear: hunger drove him to find a more productive system of production. These *chololo pits*, named after the local village, hold runoff, and the spaces between the pits act as micro-catchments. The extra moisture is vital in initial establishment of crops in this semi-arid area, where the first rains can be erratic.

Kenneth and PFI

Kenneth Sungula was one of the first innovators identified by PFI. His farm has been regularly visited by outside farmers. It is estimated that over 300 have been taken to see the pits for themselves. The Ministry of Agriculture has also brought visitors to this site, and the Regional Commissioner of Dodoma has paid a call. Sungula hasn't stood still himself in terms of innovation. In the last two years he has been working on improvements, driven by what he has seen on fellow innovators' fields. These include both *fanya juu* and *fanya chini* terraces, as well as water harvesting channels leading water from a gully into his fields.

Kenneth Sungula

Importance of the initiative

The *chololo pits* are particularly important for two reasons. First, this is an example of parallel evolution of a similar practice. These pits closely resemble the *zai* from Burkina Faso and *tassa* from Niger described by Reij et al (1996). *Zai* and *tassa* have proved remarkably effective in terms of increasing productivity in those West African countries. The second point of importance is that *chololo pits* are simple and cheap to make. Here is a technology that can be introduced at little extra effort by anybody who cultivates in such an area – though it is incompatible with mechanized cultivation.

[2] In the PFI book (Critchley et al, 1999a), these are refered to as *Chororo* pits. Pronunciation is ambiguous, but *Chololo* is apparently the accepted written form.

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is categorized under WOCAT as a structural measure (because it is not carried out annually). The primary purpose is to improve crop production. In terms of soil and water conservation, the moisture status in the soil is raised through water harvesting. Simultaneously, sheet erosion is controlled.

An extension agent measures the spacing of Sungula's chololo pits

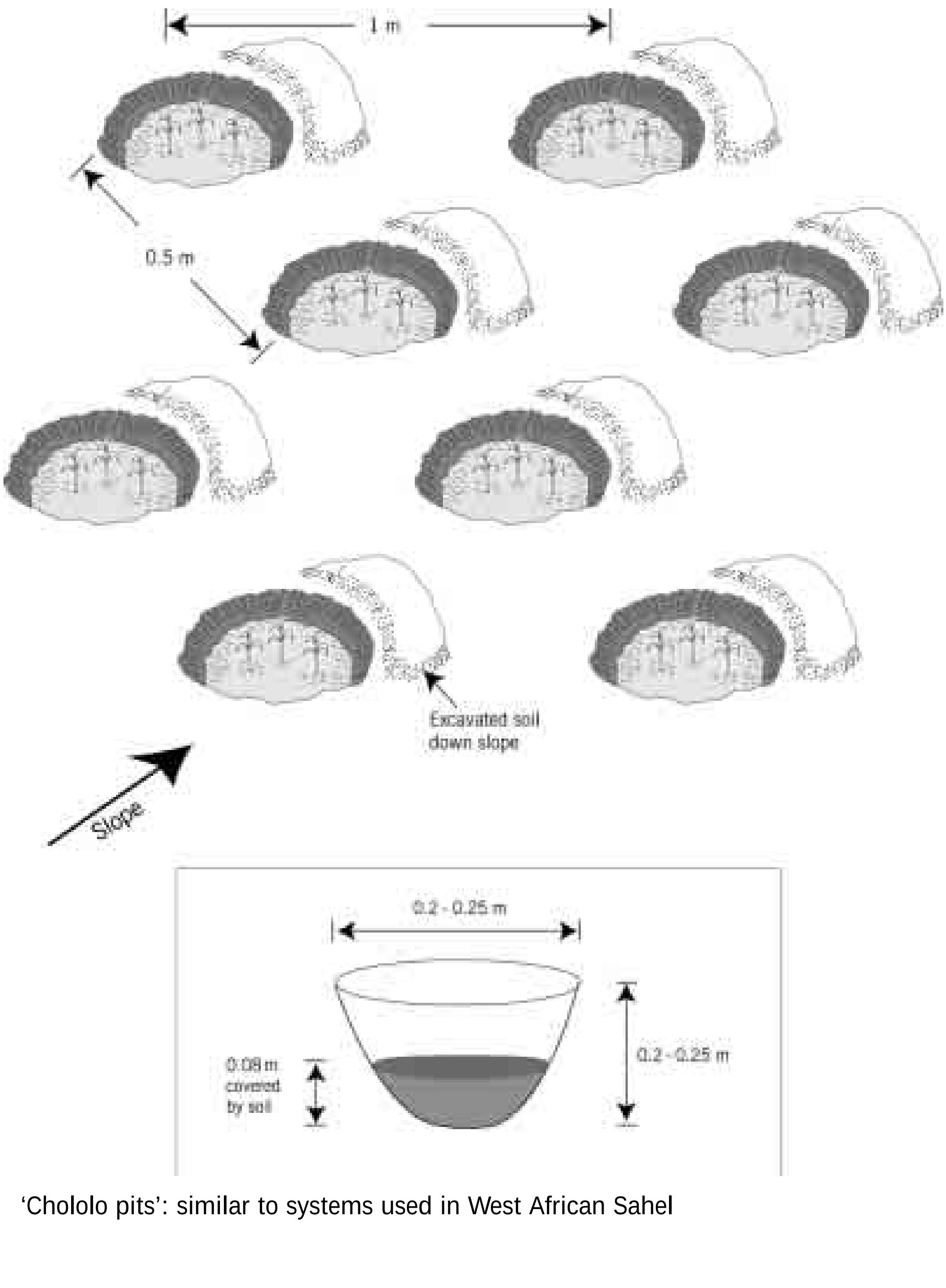
Technical details

Pits of about 0.20 - 0.25 m deep and 0.20 - 0.25 m diameter are excavated in lines across the slope. The spacing is approximately 0.5 m from pit centre to pit centre within lines and 1.0 m between lines. During excavation soil is normally heaped below each pit. The spaces between pits are not cultivated. Pits are made during the land preparation period, before the rains. Planting millet seed in the pits follows. Part of the excavated soil is returned to cover the seed, but a depression remains to permit water harvesting. Sungula has a stick – that he shows to visitors - with which he measures depth.

Construction of contour bunds to control runoff from outside the plot is carried out in places. There is no strict design, as Kenneth is still testing various types. The contour bunds protect the pits (which partially fill with sediment during the season) from excess runoff, and minimise soil erosion.

Operation and maintenance

Pits are generally desilted on an annual basis, but new ones are only constructed, in spaces between the original pits, after a few years. Maintenance is also required for the bunds between the pits.



'Chololo pits': similar to systems used in West African Sahel

ASSESSMENT

Costs and benefits

It is estimated that crop yields (and thus farm income) have increased by up to 150% as a result of the pitting. The labour input of constructing new pits is low at around 30-40 days per hectare. Annual maintenance of the pits is estimated at 15-20 days per hectare. Not surprisingly the benefits are considered to be 'very positive' compared with the costs by the farmer. From an ecological point of view, soil cover is improved, soil moisture increased and soil loss decreased.

Adoption

The spread of this pitting technology has been quite rapid. The latest figures put the number of adopters at just over 300, though apparently it is mainly men who have taken to the system according to PFI-Tanzania estimates. Most of this has occurred since systematic visits were organized by the project.

Research needs/ possible improvements

Kenneth only keeps records of visitors to his plot, so the system remains unresearched. A comparative study of *chololo pits* with the *zai* and *tassa* from the West African Sahel could shed light on possible improvements. What is immediately evident is that there is potential to add value to the pit system by applying compost/ manure to increase soil fertility.

Concluding comments

The *chololo pits* are an example of a readily adoptable technology that clearly (and visibly) improves crop performance without much extra investment. This it achieves through water harvesting. Judging by the speed that similar technologies have taken off in West Africa, it is not surprising that this is, so far, the most replicable initiative of all under PFI.

WOCAT data collection:	Patrick Lameck, INADES-Formation
Extra information:	Tanzania PFI team
WOCAT Ref:	TAN 5

4.3.2

Case study No. 8: Earthing-up Groundnuts

Ms GRACE LUNYONGA

Mpwapwa Division, Mpwapwa District

INTRODUCTION

Background

Grace Lunyonga tells us that she learnt how to 'earth-up' groundnuts at school, in the 1950s. She heaps soil around the base of her groundnut plants at second weeding. This increases the surface area of the stem / root zone in contact with the soil, and stimulates increased pod production. Through her successful groundnut enterprise – and other initiatives, including a small village store – Grace has become relatively resource-rich. She has a total of 8 hectares of land, and usually grows 2 hectares of groundnuts each year. She is now a grandmother, just over 50 years in age. Grace's son, Jackson, is closely following her groundnut husbandry practice, and has become an even more productive grower than his mother.

Grace and PFI

Grace has made a great impression on her fellow innovators, the Regional Commissioner himself, and the local agricultural researchers at Mpwapwa Research station. These researchers have recently requested access to a portion of Grace's farm to compare standard groundnut husbandry with her system. In a countrywide competition sponsored by UNDP in 1999 to find the 'best innovator' in the fight against desertification in Tanzania, Grace won the overall first prize.

Importance of the initiative

The importance of this practice is that, like many others, it is directly linked to production increases, while simultaneously improving soil and water conservation. Although elsewhere in Africa (indeed in western Tanzania as well) groundnuts are regularly earthed-up for the same reason, this can be at least considered an innovation *in local terms*. And there is a special significance to successful groundnut production where Grace lives. Ironically, this is just a few kilometres from the site of one of the largest and most costly agricultural development failures in Africa – the ill-fated Tanganyika Groundnut Scheme of the 1940s (Acland, 1971).

Grace's son and daughter-in-law

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is categorized as an agronomic technology (as the action is carried out annually). The immediate purpose is to increase crop yield, but there is an associated soil and water conservation impact: the heaped groundnuts impede overland flow, improve infiltration and thus address soil erosion by water.

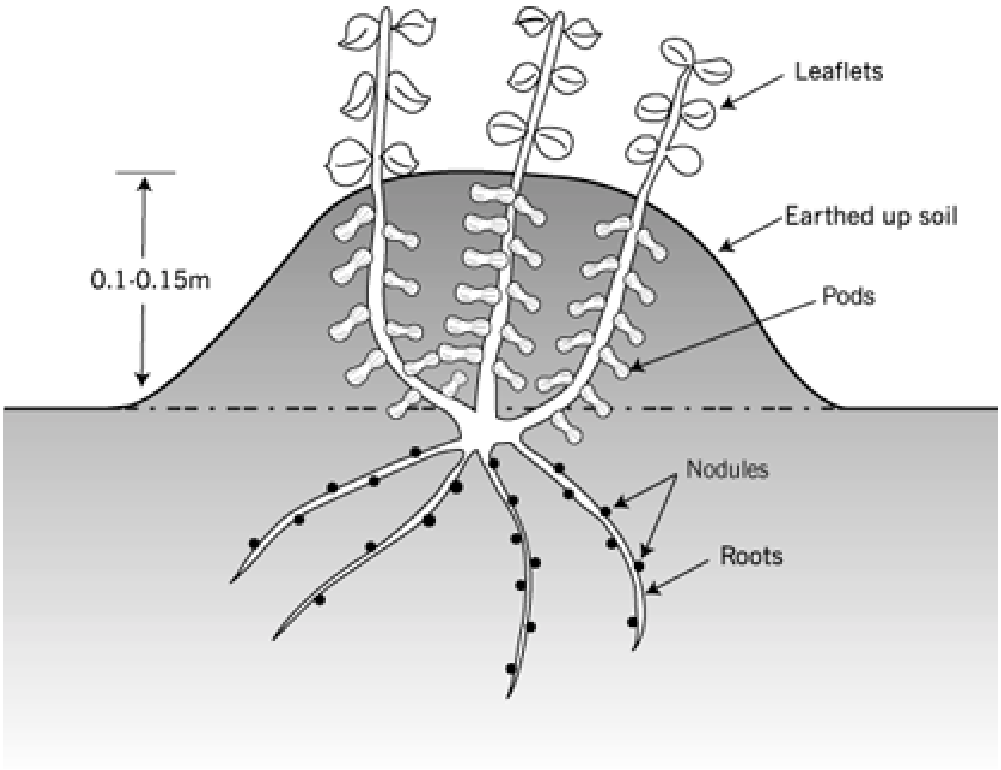
Groundnuts before second weeding

Technical details

Initial deep tillage of the whole field, by hand hoe, is carried out in the dry season, with incorporation of crop residues and weeds. Then, at the onset of the rains, groundnut seeds of an erect variety are planted at a spacing of 0.15 m x 0.15 m. During the *second* weeding of the crop, normally in January, a mound of earth some 0.10 – 0.15 m high is pulled up around the stem of the plant, burying the plant to about half its height. This leads to an increase of surface area of groundnut in contact with the soil, and stimulates 'pegging' (podding) from the previously exposed portion of the stem. Harvesting takes place in February/ March.

Operation and maintenance

The activities are carried out each season.



Earthed-up groundnut

(note: this is original sketch from questionnaire and not botanically precise)

ASSESSMENT

Costs and benefits

Grace estimates that earthing-up more than doubles her groundnut production, and has significantly increased her farm income. She considers that the benefits compared to annual labour costs are very positive. Nevertheless there is an increasing problem with marketing of the crop, which needs to be stored when the market is flooded and then sold strategically as prices rise. The ecological benefits are those associated with good land husbandry, namely incorporation of organic matter, maintaining fertility (the groundnut is a legume which fixes nitrogen) and in-field conservation of soil and water through the earthing-up practice.

Adoption

The number of those who have taken up Grace's system is, according to her personal records, 19. Many people grow groundnuts in the area, but are apparently not willing to invest the extra labour required in earthing-up.

Research needs / possible improvements

It has already been mentioned that scientists at the nearby Mpwapwa Research Station are about to undertake a comparative trial of the 'with *versus* without' situation on Grace's farm. Grace is already keeping records herself, covering rainfall, yields and labour. With respect to possible improvements, it is evident that Grace could pay more attention to the bottom end of her field which is steadily eroding into a gully which runs between the road and her *shamba*. In this regard, a field-end bund, associated with a durable unpalatable perennial grass such as vetiver, would also help keep water in the field.

Concluding comments

Although some would say Grace's earthing-up of groundnuts is merely good agronomic practice, it is innovative in this area. Perhaps it is too labour intensive to be widely adopted, and there is also the question of how much groundnut produce the market can absorb. As a final note, it is satisfying to see that a local woman farmer can, by hand, produce groundnuts cost-effectively where the mighty Groundnut Scheme failed.

WOCAT data collection:	Patrick Lameck, INADES-Formation
Extra information:	Tanzania PFI team
WOCAT Ref:	TAN 6

4.3.3

Case study No. 9: In-situ compost cultivation or 'pattern farming' (*kilimo cha mfumo*)

ALBERT MHEMBANO

Mvumi Division, Dodoma Rural District

INTRODUCTION

Background

Albert Mhembano is in his late 40s and is married. He was formerly an agricultural field agent, but is now retired, and lives off his 3 hectares of land. He is of average wealth, relatively speaking. The system for improved crop production, developed by Albert, originates from two sources. The first is the well known traditional *matengo pit* (*ngoro*) system of south-west Tanzania (Basehart, 1973), and the second is a system used around Dodoma for growing grape vines. In 1995 Albert 'married' the two systems, added his own ideas, and began to dig trenches across the slope. Into these trenches he put cereal stover and whatever other vegetative matter was locally available to increase the fertility and water holding capacity of the soil. Earth was then thrown back over the compost, but the trench not filled up to the top - so that it held rainfall and runoff. Crops were planted along the trenches. Albert noticed a clear difference in crop performance in the first year – and therefore expanded the system in subsequent years. He calls the system *kilimo cha mfumo* in Kiswahili: that is 'pattern farming'.

Albert and PFI

PFI has made considerable use of Albert's initiative for enlightening other farmers. It is estimated that 400 land users from Dodoma have been guided to him, to listen to his explanation. As a result of one particular suggestion made to him by a visitor, Albert has directed surface runoff into his farm, and has constructed a field-end bund that now ensures that valuable water cannot leave. Albert has benefited from tours to other districts, and was selected as a representative of Dodoma Region to visit the Morogoro agricultural show in 2000.

Albert Mhembano

Importance of the initiative

The importance of this particular innovation lies in the fact that the originator has mixed and matched tradition and modern practices to tailor-make a system that suits his own situation. Thus it is the *origin* of the technology as much as the system itself that is of interest. It demonstrates how much work some land users are prepared to invest in order to intensify production.

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

The technology comprises a structural measure, dedicated to improvement of the land for annual cropping. In respect to soil and water conservation it primarily addresses soil fertility and soil moisture problems. It achieves impact through increasing organic matter and water stored in the soil.

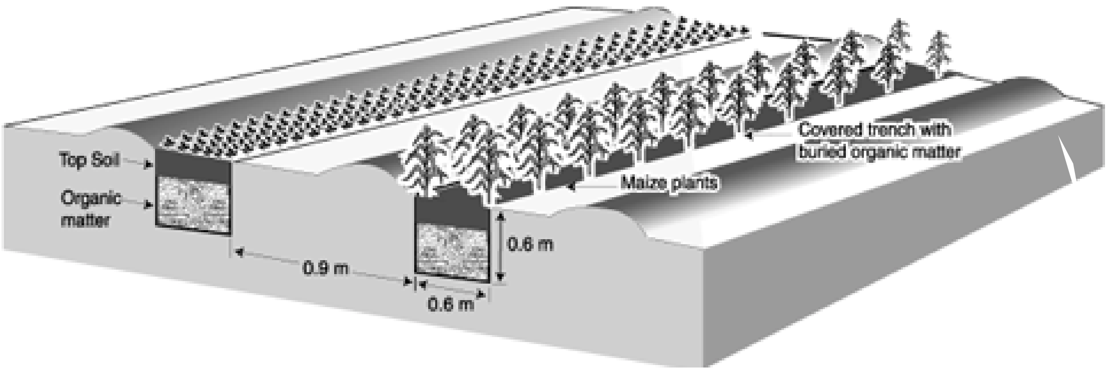
Albert has hosted 400 visitors through PFI

Technical details

The system is based on trench cultivation. This involves excavation of trenches 0.6 m deep and 0.6 m wide, more or less across the slope, at a spacing of 0.9 m apart, edge to edge. The trenches are dug in the dry period, then filled with crop residues, grass and other organic trash, and finally back-filled with soil. The surface is deliberately left some centimetres below ground level so that it can capture runoff. Associated with the trenching, a furrow to harvest rainwater is formed to lead water into the field from outside, and an end bund in the field is built up to prevent its loss. Between trenches a leguminous crop such as groundnuts is grown, while maize, sweet potatoes and tomatoes are grown on the trenches. In the first year, Albert plants at the sides of the trench to avoid damage to crop roots by the heat generated by decomposition. Thereafter crops are planted in the middle. In years of good rainfall it is possible to grow an opportunistic second crop, making use of stored soil moisture. After four years the trench is re-dug, filled with organic matter, and the cycle begins. Further additions/ improvements to the system (which is constantly evolving) are (i) the addition of cattle urine and waste water from the household to hasten decomposition of grass materials; and (ii) mulching between the trenches with crop stover at the end of the season.

Operation and maintenance

The system is basically maintenance free, until the trenches need re-digging. This involves, in the fourth year after original construction, excavation of the trenches and refilling with fresh organic trash. All work is achieved with common household tools such as hand hoes, *pangas* and spades.



Cross-section of 'Pattern farming system'

ASSESSMENT

Costs and benefits

The land was completely bare before the technology and is now productive. Compared with neighbouring farms Albert's yields are estimated to be at least 50% higher, and he considers the benefits to be 'very positive' in relation to the costs. This is reflected in his increased farm income. Those cost, however, are estimated at around 400 person days per hectare for initial establishment. Ecological benefits include increase in soil moisture, improved soil fertility and protection of the land from surface erosion.

Adoption

This is not one of the most quickly adopted initiatives – almost certainly due to the considerable labour involved. However of the 20 who have copied Albert (or modified the idea, as one close neighbour has done) several are women.

Research needs/ possible improvements

Albert has started keeping full input/output records, though it would be useful to have data from a control plot (the 'without' situation) for comparison. One obvious research question is: *how does this system compare technically and cost-benefit wise with making compost separately and adding to small planting pits (such as the Chololo pits described in 4.3.1)?* For the moment, in terms of improvements, Albert (who has already made several modifications to his system in the last few years) can be relied upon to continue experimenting and innovating.

Concluding comments

This system of Albert's, based on trench cultivation, is certainly an innovation, crafted by the farmer himself, although highly labour intensive. Its value to others is probably more in its principles (building up organic matter; water harvesting) than the specific details of the practice. It will be noted that Susanna Sylvesta [4.3.5] discarded a similar system in favour of household compost making.

WOCAT data collection:	Patrick Lameck, INADES-Formation
Extra information:	Tanzania PFI team
WOCAT Ref:	TAN 7

4.3.4

Case study No. 10: Natural forest establishment

MKUPE MKATALO

Zuzu Division, Dodoma Urban District

INTRODUCTION

Background

Mkupe Mkatalo is a relatively wealthy livestock keeper/ farmer who lives in a large compound with his three wives. He was identified by PFI because of his intriguing forest management system. This is based on the protection and nurture of an indigenous tree, *Terminalia sericea*, locally named *mpululu*. When he settled on this plot of land in the early 1980s, it was virtually devoid of tree cover. But he noticed that there were shoots of *mpululu* being grazed by his livestock. In 1987 he started experimenting with the management of this tree by first excluding his livestock. Mkupe then began actively managing the *mpululu* tree. He has been able to establish a robust forest stand, which will soon reach 4 hectares in extent. Mkupe has had no advice from extension services, and developed these technologies through experimentation and his own ingenuity. *Terminalia sericea* has multiple uses. It can be used as poles in construction timber, wood for tools, fodder and fuelwood (Mbuya et al, 1994).

Mkupe and PFI

PFI has not made extensive use of Mkatalo for farmer visits: only around 20 have been to see his farm on an organized basis. This is partially because the plot is remote, but also because the technology is not as versatile as some other innovations. As a result of visits he has made through the project, Mkatalo has adopted (at least) one technology – namely beehives. Mkatalo was featured in the PFI video.

Importance of the initiative

The importance of this innovation lies in the fact that it is a very rare example of *afforestation* in a semi-arid area, through local initiative. As the video script says, there is plenty of doom and gloom talk about wanton *deforestation*: here is some good news about the opposite.

Mkupe Mkatalo

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is categorized in the WOCAT system as a management measure. The main purpose is to nurture a perennial plant to yield income. The ecological impact includes reclamation of denuded land through improvement of ground cover. An additional impact has been the improvement in the microclimate around the farm, which is now relatively cool and shady.

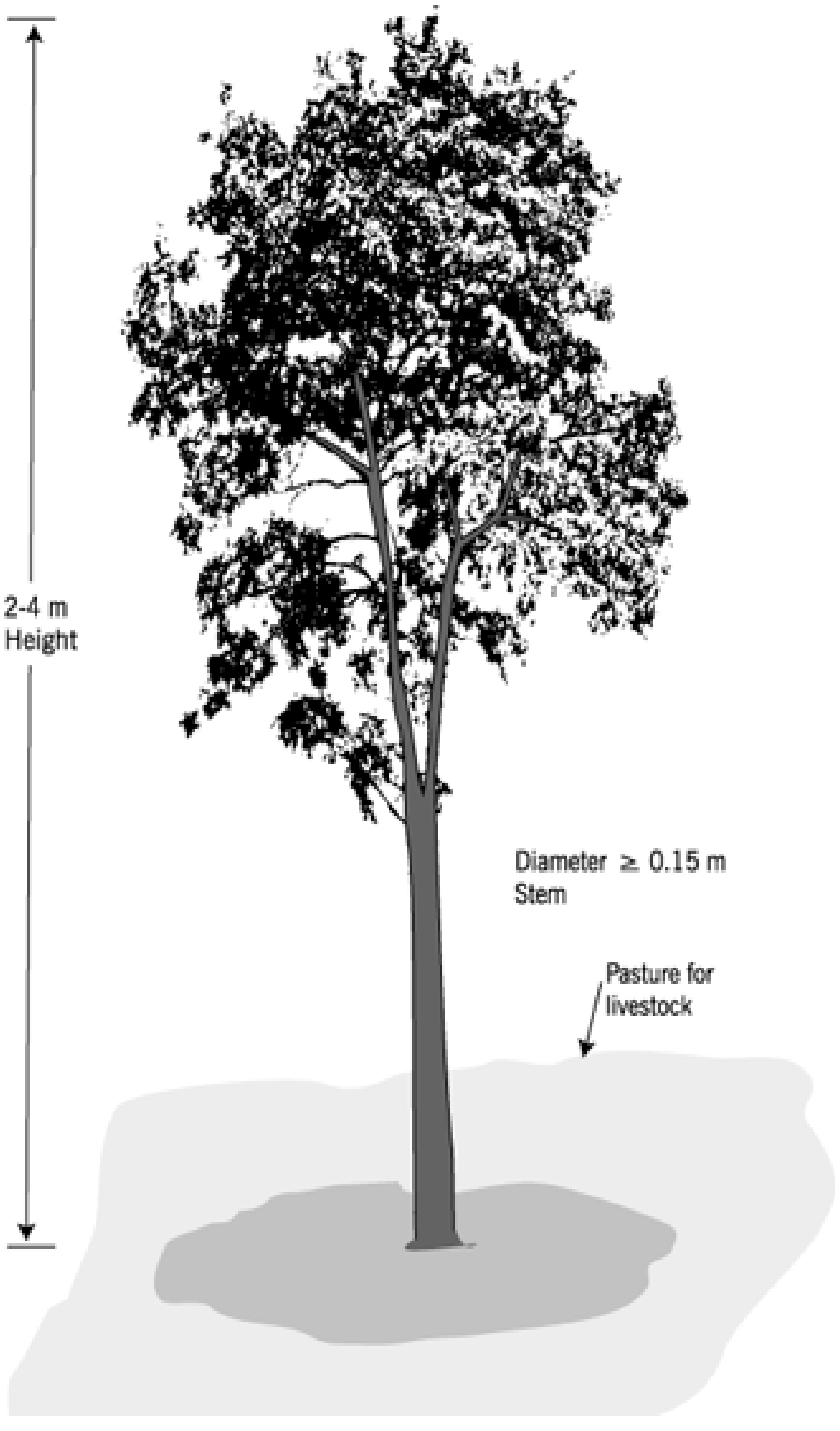
Pruning the trees

Technical details

The procedure starts with demarcating and fencing the area using brush wood fencing. This is followed by identifying healthy upright shoots of *Terminalia sericea*, and pruning lower branches to reduce knot formation/encourage the the shoots to grow straight. A spacing between trees of 3-4 metres in either direction is the aim. On maturity, after 3-4 years, the main trunk of the tree is cut (when it reaches a length of around 3 metres height with a diameter of 0.15 m or thereabouts) and a replacement shoot has been selected for coppicing. This method allows for a sustainable annual yield from the plot.

Operation and maintenance

Apart from the continuous maintenance requirements described in the technical details above, there are extra costs involved in perimeter fence repairs, and night guarding against theft of poles which are a valued commodity locally.



Terminalia sericea after pruning

ASSESSMENT

Costs and benefits

No records have been kept of labour input, but based on Mkupe's estimate, one person is needed to look after 2-3 hectares. A factor that adds to the costs is the need to guard the trees from theft. However, as is the case with most of the other innovators, Mkupe Mkatalo considers the benefits to be very positive in the long term compared with the costs. Of course, returns from sales are not generated until two or three years have passed. The main production / socio-economic benefits include produce of saleable wood, as well as fodder production from the leaves of the tree. There is also now a good supply of fuelwood for domestic purposes. The main ecological benefit is soil cover improvement in an area which is said to have been completely bare beforehand.

Adoption

The latest estimates on adoption of Mkupe's system indicate that it is mainly men who have copied him. The total is around 10.

Research needs/ possible improvements

Mkupe keeps few records, so little is known about the costs and benefits of this system. We rely on the estimates of the farmer himself. Here is an opportunity to carry out a fairly straightforward study of costs and benefits to the farmer.

Concluding comments

It is not surprising that there is limited adoption of this technology, because it requires particular circumstances. Nevertheless it is an extremely important innovation, and quite different from most of the other practices identified under PFI. It surely raises questions about why tree planting projects rely so heavily on producing seedlings of exotic species in nurseries, when selective protection of naturally generating species can be so effective.

WOCAT data collection:	Patrick Lameck, INADES-Formation; Hamidu Dumea, MOA
Extra information:	Tanzania PFI team
WOCAT Ref:	TAN 8

4.3.5

Case study No. 11: *Mapambano* compost making

Ms SUSANNA SYLVESTA

Haubi Village, Kondoa District

INTRODUCTION

Background

Mama Susanna lives in Kondoa District, where average rainfall is below 500 mm per annum. She is an elderly widow, and heads the household. She farms an area of about 6 ha. Susanna, like most of her neighbours, used to be relatively poor. But Susanna has increased her income – and bought land - as a result of her innovation. For long she has been intolerant of burning residues. She used to apply organic wastes directly into ridges in the fields. But Susanna found this led to slow decomposition. Then on her own initiative, she tested and developed a particular system of composting crop wastes with fodder residues, manure and urine from her zero grazed dairy cow and stall-fed pig. She puts this mixture into large pits and adds ash, and wastewater from the household to keep the compost moist. By applying this good quality compost, she keeps her land much more fertile than the local standard, and also manages to sell a surplus to neighbours. Susanna calls this method *mapambano* in Kiswahili – signifying that her compost is the 'fruit of a righteous struggle'.

Mama Susanna and PFI

Susanna was one of the later 'recruits' to PFI, having been discovered in a second wave of identification that took place in 1999. Already many farmers have been taken to see her and listen to her explanations, though it is true that other organizations had already noted her, and had taken groups to visit. It is characteristic of Susanna (and many other innovators) that she doesn't complain about visitors. Indeed she says she likes telling her story and she feels that her capacity to improve and disseminate the technology has increased greatly. She also enjoyed being interviewed when the WOCAT data was being collected.

Importance of the initiative

Of course composting is a well-known and well-documented technology. Mama Susanna's method can even be criticised for not being the most efficient (see under 'possible improvements'). But she is certainly an impressive innovator in local terms, and has influenced a great number of neighbours through her industry, and her sensitivity towards the role of organic matter in land husbandry. The other aspect of crucial importance is the role of stall-fed livestock in initiating, then maintaining, a 'virtuous cycle' of conservation and organic matter recycling.

Susanna Sylvesta

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is categorized as an agronomic measure whose purpose is to raise crop yields through addressing soil fertility and soil moisture problems. A secondary purpose is to bring in cash from sales. Impact is achieved through increase in soil organic matter, improvement in soil structure and thus soil fertility increase.

Susanna makes 15 tonnes of compost each year

Technical details

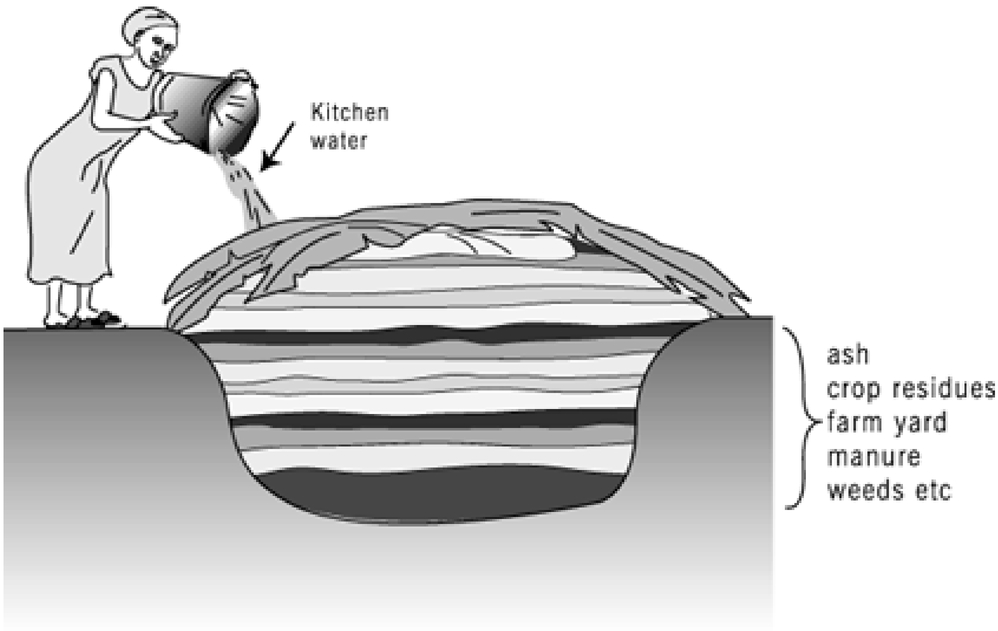
This composting system is based on locally available materials and the following procedure is used: pits of 1 (+) m deep and up to 3 m diameter are dug. Ash is spread at the bottom, then a layer of grass is added, followed by alternating layers of crop residues, grass, tree leaves, sisal leaves, manure, bedding, animal urine, and ash. Waste domestic water from utensil cleaning and household washing is added continuously to keep the mixture moist. The pit is filled, built up above ground level, and topped off with a final layer of ash and a cap of grass. Waste water and urine continue to be added to keep it moist until it is fully decomposed. This takes about 3 months.

The compost is used for growing maize, sorghum, finger millet and millet. It is applied to planting holes (spaced at 0.6 m x 0.9 m) in her fields at a rate of quarter litre per planting hole, once every three years. This approximates to an application rate of 1.5 tonnes/ ha/ year. In addition, surplus is sold: this amounted to approximately 6 tonnes in 1999. As Susanna has 6 ha of land, the implication is that she produces about 15 tonnes of compost per year. Given one dairy cow, one pig and off-farm fodder this would be technically possible according to the literature (e.g. Defoer et al, 2000)

It is significant to note that Susanna cuts and carries the fodder for her cow from the nearby woodland, which is protected from grazing by Government mandate. Kondoa has long been renowned as an eroded area, and in 1973 action began to expel livestock (Ostberg, 1986). Thus her system effectively constitutes a biomass transfer system. This is the reason that she can keep her land fertile *and* sell a surplus of compost to her neighbours.

Operation and maintenance

Apart from digging the pits, this system is simply a continuous cycle of building up layers of organic matter in the pits and leaving them to decompose.



Keeping *Mapambano* compost moist

ASSESSMENT

Costs and benefits

While this is clearly labour intensive, and Susanna has two people in addition to herself working on the farm full time, she views her compost making enterprise to be 'very positive compared with costs'. She also points to production and socio-economic benefits, specifically improved crop production (crop yields more than doubled) and sales of compost, and thus farm income increase. Ecological benefits include improved soil fertility and moisture holding capacity.

Adoption

Susanna has recorded over 30 neighbouring farmers – both men and women – who have followed her novel technology of making compost. While several farmers had begun to follow her system before PFI started working with her, the number reportedly grew rapidly after farmer-to-farmer innovator visits organized by PFI. The current number of adopters is estimated to be ±100, and nearly half of these are said to be women.

Research needs/ possible improvements

PFI has encouraged Susanna to record the inputs and outputs in her composting system and gave her some guidance in doing this. However no data has yet been collected for analysis. A detailed input-output study would require outside assistance and could constitute a micro-research study. The zonal research institute at Mpwapwa (she is the farmer representative on the institute's advisory board) has taken a sample of her compost for analysis. This is a start, but there are still several pieces of the jigsaw puzzle missing (e.g. questions regarding quality of compost and moisture content at various stages), and substantiation of the indicative figures given above is required. Tanner et al (2001) have carried out such a comprehensive study in Java, which shows the crucial role of stall-fed livestock in maintaining the land's fertility.

Susanna might be able to improve her composting by using the three-pit system that is commonly promoted in under conventional extension in East Africa. In that system, compost is turned from one pit to another to speed up decomposition. But she thinks this would demand too much extra labour for the large quantities of compost she produces.

Concluding comments

This story of composing demonstrates how organic farming can develop as a personal initiative, and be 'thought through' by someone, without outside help. Because it has evolved in this way, the initiator, Susanna, makes an excellent source of inspiration for others.

WOCAT data collection:	Patrick Lameck, INADES-Formation; Hamidu Dumea, MOA
Extra information:	Tanzania PFI team
WOCAT Ref:	TAN 9

4.3.6

Case study No. 12: Vegetative gully healing

Ms GRACE BURA

Mvumi Division, Dodoma Rural District

INTRODUCTION

Background

Grace is in her early 50s, and though her farm of 3 hectares is not larger than normal, her homestead buildings indicate that she is rather above average in terms of wealth. This is something she has achieved through her own efforts. Grace has become the main farmer in the family. Her husband is a retired teacher and professes no interest in developing the land further. In 1982 Grace acquired, and decided to reclaim, some badly gullied land. She packed the gullies with check dam 'sandwiches' of trash and soil in alternate layers. On top of these check dams she planted cuttings of a shrub. Gradually the gullies healed. Locally her technology is referred to as *kinga maji la nyasi* (literally 'blocking water with grass' in Kiswahili). Grace is continuing to rehabilitate land, and to branch into other directions. For example a few years back she bought a dairy cow for herself. Closer to home – where her cattle are stalled –fields are intercropped with pigeon peas, and manured with waste from the cattle and house compound. There are also trash lines to be seen in these fields.

Grace and PFI

Grace was one of the first innovators to be identified by PFI. Because her initiative is visually impressive, and because her farm is situated close to Albert Mhembano's she receives many visitors through PFI. She welcomes them. Grace has been featured – like Albert – in both the PFI video and accompanying book.

Importance of the initiative

The significance of Grace's achievement is that she has managed to reclaim land from gullies, using vegetation to form a barrier. There is no 'engineering' as such: no stone is involved, and earth is only used to supplement trash, rather than as a bund or barrier in itself. Furthermore this is a woman's achievement – and shows how women's innovations are not just household-oriented.

Grace Bura

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

Under WOCAT this is characterized as a structural measure (because the vegetative barrier is effectively permanent). The purpose of the technology is reclamation of land from gullies for plant production. Impact is achieved through impeding concentrated runoff and capturing sediment.

Grace and a healed gully

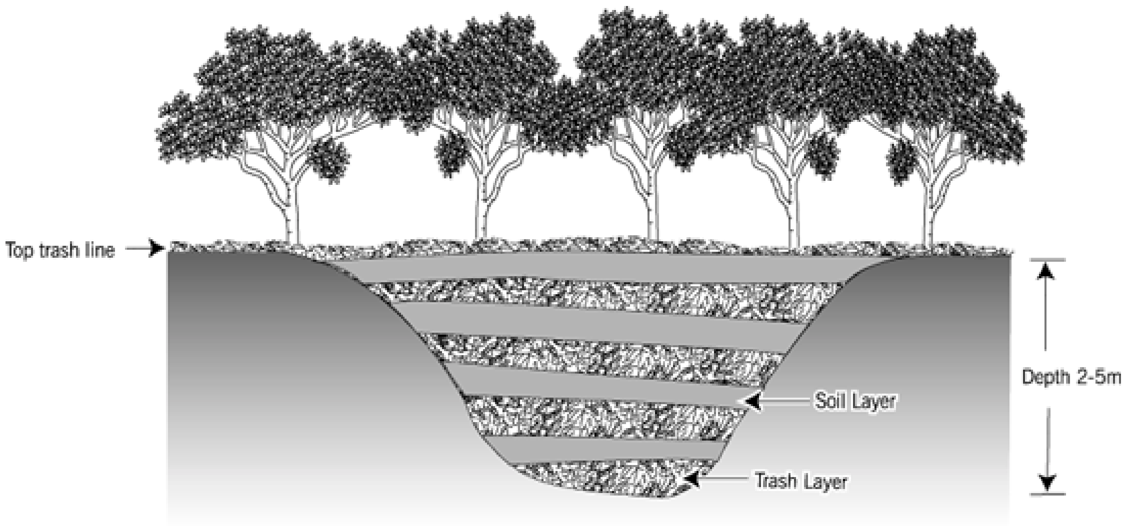
Technical details

This technology constitutes a gully healing process. The starting point is to form a layer of trash and soil across the bed of the gully (a typical gully here is 3-10 m wide, and 2 m or more deep), reinforced with pegs, and to build this up gradually in layers as sediment is captured behind it. On top of the barrier a dense line of *mikayeba* (tree cassava: *Manihot glaziovii*) is planted. Trash continues to be added to the now-living barrier until the gully is fully silted up. The barrier, 1 – 2 metres wide, then appears as a contour line across her land, and continues to function against erosion. *Mikayeba* is not just a living structural support: its leaves are also a source of fresh vegetables. Where the gullies are more severe, she is testing cuttings of *Commiphora africana*.

The treatment does not end with sedimentation of the gully bed. The land is left fallow for one to two seasons. Then, late in the first or second season, the farmer digs in the young volunteer vegetation as a green manure, and plants a ‘catch crop’ of maize. If it produces cobs, well and good. If not, she feeds the plants to her stall-fed cows.

Operation and maintenance

The main maintenance aspect is the continuous addition of soil/trash layer upon previous layers, and tending the living barrier to maintain its density. Maintenance, as well as original establishment, requires only common farm/household tools including hoes, spades, sacks and *pangas*.



Cross-section through a healed gully

ASSESSMENT

Costs and benefits

Although there is no hard data on days worked, the labour requirement (which is the only major input) is considerable. Nevertheless the farmer views the benefits as well worthwhile in the long term. It is indeed a relatively long time (4 or 5 years) before the gully is completely healed. Benefits include increased crop production and farm income as a function of increased cultivable area. The ecological benefits are those associated with gully/ erosion control and reclamation of land/ improvement of soil quality.

Adoption

Only 10 farmers (five men, five women) are known to have followed Grace's technical approach. This technology is only relevant to those with gullies in their fields, and it requires not only a good deal of labour, but also constant observation and responsiveness.

Research needs/ possible improvements

An area of investigation, and possible improvement, would be to test different species of living barrier for effectiveness, and for intrinsic productivity. If the barrier was productive in itself (fruit trees for example) then the 'adoptability' of the system might be increased.

Concluding comments

It is not simply low-cost gully control that Grace's visitors notice and appreciate. It is the sense of creativity and integraton of resources, of using what is available to solve problems. And most of all they go away with a sense that Grace is genuinely caring for, and looking after, her land. One interesting note is that Grace is making constructive use of *Commiphora*, the very tree that Musee Kivunzi [4. 2.4] removes as a pest in his grazing land in Kenya: both have good reasons for doing as they do.

WOCAT data collection:	Patrick Lameck, INADES-Formation
Extra information:	Tanzania PFI team
WOCAT Ref:	TAN 10

4.4 Uganda

The initiatives described here (with one exception, that of Jocelyn Turyamureeba) come from the eastern Ugandan Districts of Soroti, Kumi and Katakwi, part of Uganda's 'cattle corridor' where PFI operates. In contrast to the other two countries, there are no gully harnessing techniques to report. Indeed in this relatively flat area there are few gullies at all to present a challenge. Three of the initiatives featured here are variations of water harvesting practices. Again, this should be no surprise, as it is a dry zone with plenty of opportunities to harvest water from roads and tracks. Two other innovations concern organic matter management, one of these is mulching of perennials, and the other (from Kabale in the south-west of Uganda) is the use of improved trash lines in annual crops. There is also a profile of an innovator who cultivates a multipurpose tree as a crop.

In this region the average rainfall is between 500 and 1000 mm, and the climate sub-humid to semi-arid. The altitude ranges from 500 to 1500 m a.s.l, and the topography is relatively flat. The soils tend to be coarse textured, shallow, of medium fertility, with some loose stones in places. The topsoil organic matter content is medium to low, drainage generally good, and soil erodibility medium to low. Typical household size of the land users is 6 to 10 persons. Most land is owned individually, not titled, but with customary land use rights.

Uganda map showing location of farmer innovators

4.4.1

Case study No. 13: Water-borne manuring system

CHRISTOPHER OJOK

Soroti County, Soroti District

INTRODUCTION

Background

Christopher Ojok cannot be called an 'average' individual in the context of Soroti. He is not just a farmer, but also a progressive local businessman with a well-stocked shop in Soroti township. He has become the focus of attention from various projects. PFI emphasizes the innovations of ordinary people, but an exception has been made in the case of Ojok. That is because he has a genuine low-cost innovation which could be copied by many. His initiative spans from the time a few years ago when he noted an existing orange tree producing large juicy fruits. This was, he concluded, because it happened to have been planted in a hollow which filled regularly with rainfall runoff. Thus the idea of systematic rainwater harvesting came to Ojok. This he then developed into 'water-borne manuring', in other words letting rainfall runoff carry manure, from his cattle stall along channels to his fruit trees. Ojok makes sure that no runoff water is wasted in his farm. He is proud of the many visitors he receives, including the Head of State who visited his farm in 1999.

Ojok and PFI

Christopher Ojok has helped PFI a great deal by hosting more visitors (from within the project area and outside) than any other Ugandan PFI-related innovator. His farm is accessible, and the innovation can be clearly understood. He has profited from study tours outside, and initiated very many new experiments himself as a result – e.g. banana mulching; honey bottling; compost bag vegetable production. He is featured in the PFI video and book. Ojok also now goes out voluntarily to teach others.

Importance of the initiative

This initiative is featured here because it's an example of integrating two limiting resources (rainwater and manure) for a directly productive purpose with simultaneous conservation benefits. Furthermore it is simple and cheap. It makes use of one resource everyone has, that is runoff from the house compound, and a second resource that many people have, that is manure near the homestead. There is another example of such a water-borne manuring system, in Bubale County, Kabale District, under the sister ISWC programme, where the innovative farmer in question is Ms Caroline Kabera.

Christopher Ojok

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

The technology is based on a structural measure (a network of channels). It is aimed primarily at production. It achieves this, and associated SWC impact, through enhancing soil moisture by the means of water harvesting, and improving soil fertility status.

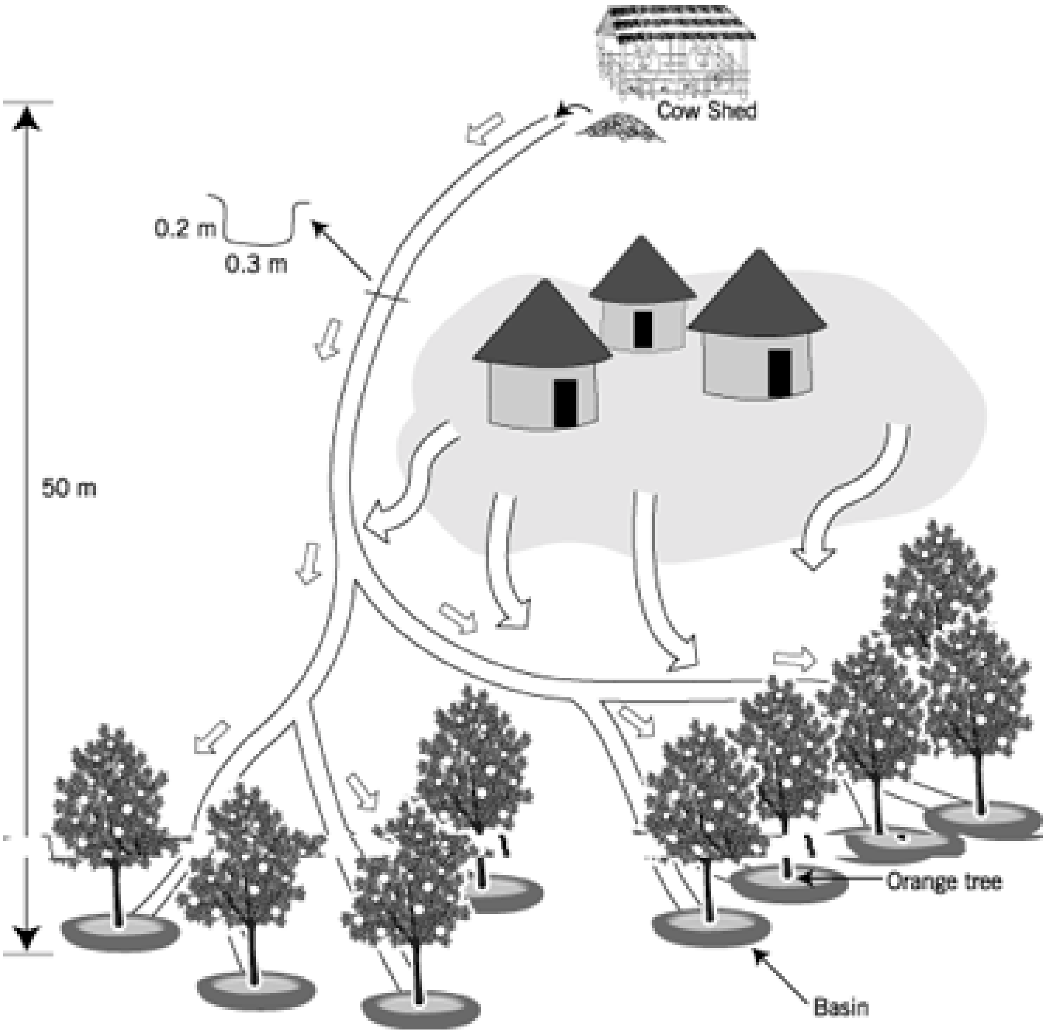
Other farmer innovators visit Christopher

Technical details

The system involves conveyance of manure by runoff water, from the cattle pen above the homestead, to individual trees in the citrus orchard, below the homestead. The distance the manure has to move to reach the farthest citrus trees is ± 50 metres. During the rainy season, manure is placed in channels immediately below the cow shed. It is then transported by runoff water from the roofs of the buildings, from the track leading to the homestead, and from the compound itself, all of which act as catchment areas. This process therefore combines water harvesting and soil fertility improvement. The channels, which are approximately 0.30 m wide and 0.20 m deep, are gently graded (± 1°-2° slope), to ensure a smooth flow to individual citrus trees, around each of which a basin is formed from earth, to pond the enriched runoff.

Operation and maintenance

The channels need to be regularly cleared of growing vegetation, and require desilting from time to time.



Artist's overview of water-borne manuring system

ASSESSMENT

Costs and benefits

It is estimated that the production increase through the extra water and manure on the citrus has raised farm income by over 50%. The farmer estimates that the benefits compared to initial costs are very positive in the long term. Ecological benefits include control of runoff water (from the house compound) and soil loss reduction.

Adoption

Around 100 people have now followed Ojok's principle. This has increased from 50 (30 men, 20 women) recorded 2 years ago when Ojok was initially characterized by PFI.

Research needs/ possible improvements

There is need for research to validate the impact/effectiveness of the system. How much more moisture is available to the trees than if they were planted on the flat? How much labour is saved by transporting manure this way? Possible improvements include: lining the trench with plastic, and construction of diversion bunds to collect more water from outside the compound.

Concluding comments

It is worth pointing out again that we guard against the 'favoured farmer syndrome', where too much attention is given to a resource-rich individual. This may be beginning to happen to Ojok. However we must not lose sight of the importance of this win-win innovation. Runoff is not only controlled, but actually used to save labour in transporting manure to a cash crop.

WOCAT data collection:	Alex Lwakuba; Obanya Obore, MAAIF
Extra Information:	Uganda PFI team; Critchley et al, 1999a
WOCAT Ref:	UGA 3

4.4.2

Case study No. 14: Improved trash lines: 'mobile compost strips'

Ms JOCELYN TURYAMUREEBA

Kamwezi sub-County, Kabale District

INTRODUCTION

Background

Jocelyn Turyamureeba is from Kabale District in south-western Uganda. She is associated not with PFI, but the sister programme 'Indigenous Soil and Water Conservation' (ISWC). Jocelyn is included here because of the particular importance of her practice, improved trash lines, which is not an innovation, but a tradition improved through *participatory technology development*. Jocelyn is the wife of the local extension agent, Shem. They have six children, the eldest of whom has just started at University. As her husband is employed, and they have a relatively large plot (6 hectares) the family are relatively better off than their neighbours. Jocelyn was originally selected as the practitioner of a traditional conservation measure, trash lines (*emikikizo* in the local Lukiga language) and together with researchers helped develop an improved technology.

Jocelyn and the project

Jocelyn began co-operating as a farmer-researcher with the project that preceded ISWC, namely 'Conserve Water to Save Soil and the Environment' (Briggs et al 1998; Critchley et al, 1999b). That was back in 1995. Since then she has continued her association, and played a key role in disseminating the improved technology. She has also benefited from several study tours outside the area – including one to PFI-Uganda.

Importance of the initiative

This is an important technology for three main reasons. First, it is a tradition, which has been improved through participatory technology development (PTD) processes. Secondly, Jocelyn is supported by her husband – an extension worker – so here is an example of 'practising what you preach'. Third it is an effective technology, simple to implement, and particularly appropriate for, and popular with, women.

Jocelyn Turyamureeba

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

The technology is categorized as a structural measure under WOCAT (because the trash lines are kept for more than one season before being ploughed in: otherwise it would be categorized as 'agronomic'). The purpose is improved production of annual crops. It achieves impact through the local increase in organic matter content of the soil and through control of runoff.

Jocelyn's trash lines were improved through PTD

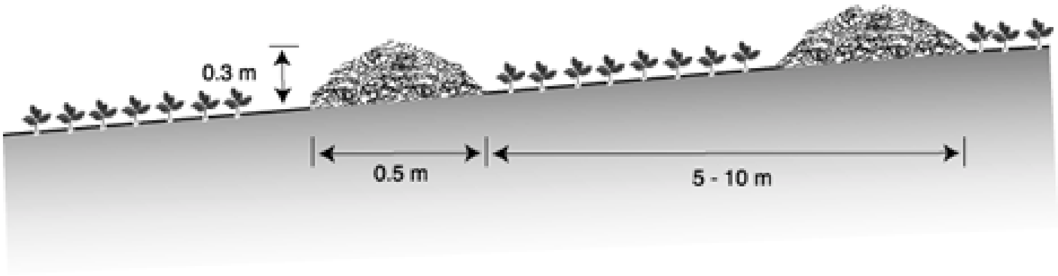
Technical details

The specifications of the improved trash lines (TLs) were developed as a result of collaborative experimentation by Jocelyn, three other 'trash line farmers' and researchers (see Briggs et al, 1998; Critchley et al, 1999b). The main difference is that the new specifications mean smaller, closer and longer duration TLs than the common tradition. These differences maximize the impact of TLs on soil fertility.

Vegetative material (stover; weeds etc) is collected during primary cultivation, and heaped along the approximate contour in the farm. This is supplemented during weeding. The recommended spacing between TLs is 5 - 10 metres, depending on the slope. The material available determines the cross section of the TL (± 0.5 m wide and ± 0.3 m high initially). Improved trash lines are left in place for 3-4 seasons (there are two seasons a year in Kabale) before being dug into the soil, and new trash lines established between the sites of the former lines.

Operation and maintenance

Maintenance comprises removal of weeds that sprout within the line (before they set seed) and addition of more trash during secondary cultivation.



Cross-section through trash lines on sloping field

ASSESSMENT

Costs and Benefits

The costs associated with establishing trash lines are basically labour only: that amounts to about 30 days/ha/year. Maintenance costs are absorbed as a part of regular weeding. Gross margins from fields with trash lines have been calculated to be 50% higher than those without (Briggs et al, 1998). This is largely due to the effect of improved fertility when the trash decomposes and is incorporated into the soil. Ecological benefits are mainly associated with reduction in land degradation.

Adoption

When investigated by Miiro et al (1999), 7 farmers (6 women, one man) were found to have copied the improved technology directly from Jocelyn. On average 4 more had then copied from each of the original 7. This implies a total of 30 (+) and the majority were certainly women (gender was not always specified, so accurate figures are unavailable). Although the expression 'copied' is used here, at least one of the second generation followers had made some (unspecified) adaptations. Looking at the overall picture in the sub-County, about 30% of the land users have adopted some form of TLs (though not necessarily improved, and not necessarily from Jocelyn) with women farmers as the majority.

Research needs/ possible improvements

Participatory technical research has been carried out on TLs and recommendations made for improvements. What is now necessary is to follow up the question of adoption again in detail, this time concentrating on to what extent the *improved specifications* have been followed or otherwise (see 'adoption' section)

Concluding comments

Jocelyn's case is different from the other initiatives described in this book. She is associated not with PFI, but with a sister project, and her technology has been shaped by a PTD process, so in a sense she is 'further down the line' than the others. Here is a technology, based on a tradition, that helps achieve the twin goals of better production and improved conservation. And it is female-friendly, as has been noted with respect to adoption. What is not absolutely clear is to what extent the specific PTD-improved technology has spread, and to what extent it has been a case of trash lines (in any form) being popularized.

WOCAT data collection:	H. Dan. Miiro, MAAIF
Extra Information:	Uganda-ISWC team; Briggs et al, 1998; Critchley et al, 1999b
WOCAT Ref:	UGA 4

4.4.3

Case study No. 15: Integrated runoff water management

FAUSTINO OPIO

Amuria County, Katakwi District

INTRODUCTION

Faustino Opio has introduced a technology to Katakwi that is fairly common in other parts of Uganda – in Iganga and Jinja Districts for example. So it is only an innovation in local terms. It is not usual to cultivate in swampy valley bottoms in Katakwi. Land is less limiting than elsewhere. Faustino used to work as a chef in an international hotel in Kampala. Through the connections he made he visited a farm in Iganga and saw the system that he has now modified for his own situation. The technology has in-built flexibity that allows for drainage in times of too much water, and harvesting of runoff water when rains are limited. The aim is to grow fruit trees - citrus and mangoes - in the valley bottom. Cash for school fees is his ultimate goal.

Faustino and PFI

Even before the advent of PFI, Faustino had been offering his services to assist others to set up similar systems. Only two visits of farmers to Faustino have been arranged by PFI, so little stimulated adoption can yet be expected.

Importance of the initiative

Faustino was identified by PFI, and has been selected here because he has been imaginative enough to bring in a workable system from outside, and then modify it to his own conditions. This example underlines the potential of visits outside the area to stimulate new ideas. But also shows the need also to 'fit' a new system into local conditions.

An extension agent visiting Faustino's farm

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This technology is based on structural measures. The purpose is production of cash crops, based on reclamation of land and control of concentrated runoff. The impact is achieved through a flexible method of drainage/water harvesting, which helps ensure suitable moisture conditions for growth.

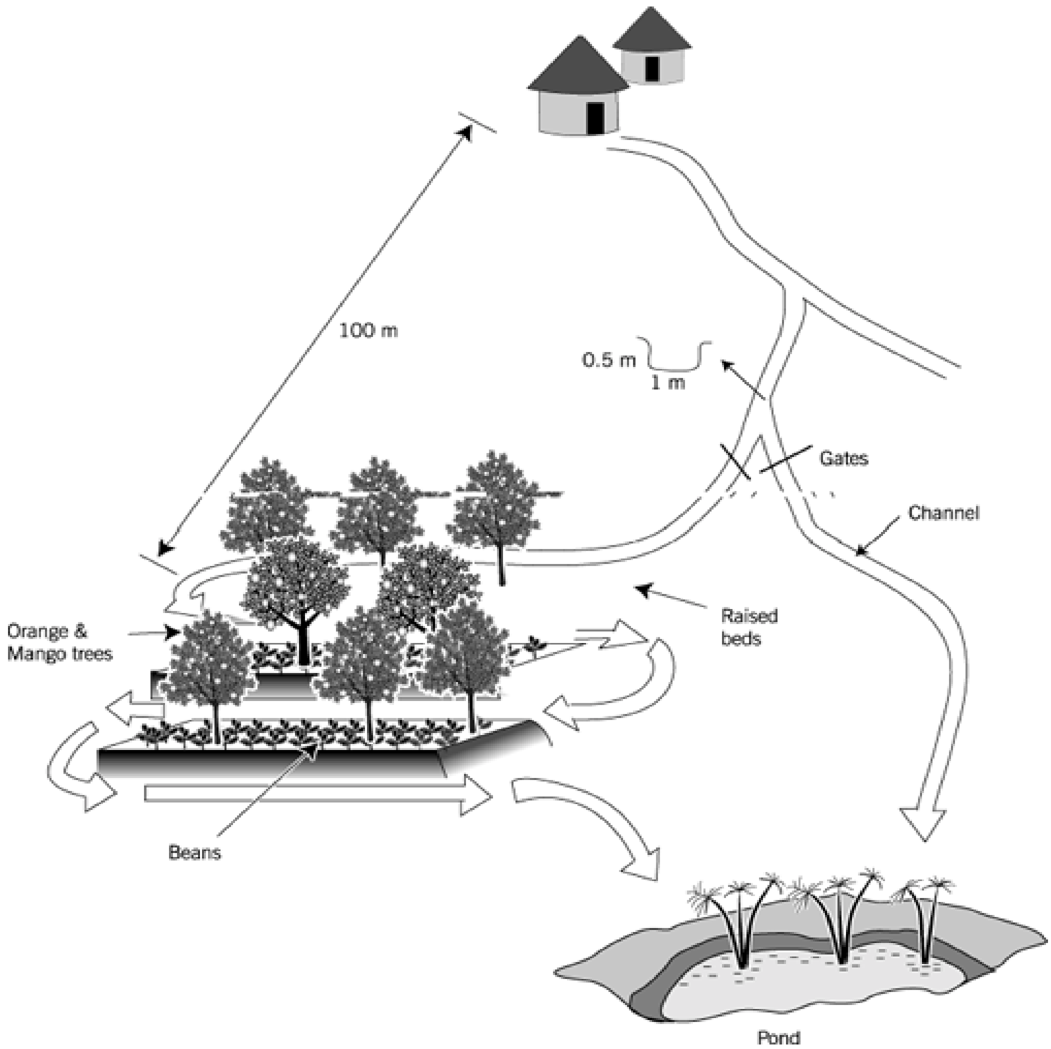
Integrated water management: channels and raised beds

Technical details

This is a system of integrated runoff water and drainage management that allows cultivation in a swampy valley bottom. Setting up the infrastructure involves dividing the land in the valley into raised beds of ±10 m x 20 m which are separated by furrows, acting as drainage channels. Below the furrows is a pond. These furrows, however, can also fulfil the opposite role – distributing runoff water from upslope in the valley bottom if required. A diversion channel has been constructed to guide runoff from a track towards the valley. The channel is 0.5 m deep, 1 m wide, over 100 m in length and with a gradient of 0.5% - 1.0%. It is estimated that the ratio of catchment to cultivated area is 10:1. The channel is left open to divert runoff in times of shortage (though, naturally, as with any rainwater harvesting system, there has to be rain locally before it can be harvested). This water then can be held by the furrows whose outlet can be blocked. Citrus fruits (oranges) and mangoes are planted on the beds, and intercropped with annuals.

Operation and maintenance

The main maintenance aspect is clearing inlets, channels and removing vegetation, using common household hand tools such as spades and hoes.



Artist's impression of Faustino's system

ASSESSMENT

Costs and benefits

The main production and socio-economic benefits are associated with crop yields. The related farm income increase is gauged to be 20-50%, which is adjudged to be a 'very positive' result by Faustino, though this is only realised in the long term. With respect to ecological benefits, there is a modification/ buffering of soil moisture, and control of soil erosion (through runoff and sediment harvesting).

Adoption

Only one close neighbour has shown interest in copying him. 'A few' others from further away, also have. One constraint to adoption is the large amount of labour involved in setting up the system.

Research needs/ possible improvements

There is no data available on actual costs incurred in this enterprise. That, compared with a schedule of production benefits over time (this system is based on perennial crops which do not pay back quickly) would help us understand the economics of such an undertaking.

Concluding comments

What Faustino has achieved is a personal transfer, and modification, of technology from another area to his own. Two non-technical lessons are underlined by this case study. First, near neighbours are often less likely to be impressed by an initiative than those more distant. Second, the requirement for a cash income is commonly a driving force behind innovation. *Warning: It is important to remember that swamp land, and reclamation of such areas is a sensitive issue, and subject to legislation. No such initiatives should be undertaken without making sure first of these issues and any local laws or conventions.*

WOCAT data collection:	Alex Lwakuba; John Erabu, MAAIF
Extra Information:	Uganda PFI team
WOCAT Ref:	UGA 5

4.4.4

Case study No. 16: Mulching of perennial crops

ALI ALIAS AJARU

Amuria County, Katakwi District

INTRODUCTION

Background

Ali Alias Ajaru is an enthusiast, who is not just constantly testing and trying new ideas, but also feels a vocation to teach others. Ali Alias is in his 40s and has three wives. He is better off than the average householder in this dry and remote part of Katakwi District. He has some 20 hectares of land.

It would be a simplification to portray Ali Alias as being a man with just one innovation: in truth he is experimenting and trying out a very wide range of different practices. In fact the initiative featured here, mulching of bananas, is not even the one for which he was originally selected. That was a contour line of pineapples against erosion. Some of the ideas he has picked up on his own travels and PFI sponsored study tours - including the idea for the mulching. Others he has just worked out for himself. In addition to mulching he has various systems of water harvesting (including rooftop to underground tank), retention ditches, vegetative barriers, agroforestry, composting and he uses fermented human urine to kill weevils. One of Ali's mottos is: *'Don't allow a drop of water to escape'*.

Ali Alias and PFI

Ali Alias was one of the originally identified and screened farmers under PFI-Uganda, and has played a crucial role in the programme. He has been on study tours organized by PFI, and has probably brought back more ideas than anyone else: for example as a result of the tour to Mukono, Mbarara, Bushenyi and Kabale (in September 1998) he started testing 7 different technologies. He has also been the focus of organized visits by farmers, and has furthermore trained a large number of farmers (he claims over 240) through his own initiative, voluntarily.

Importance of the initiative

Mulching is a well-known practice in Uganda, particularly in bananas, but is not common in Katakwi. What is especially striking about Ali's approach is that he has set up mulched and non-mulched plots side by side to observe the difference between treatment and control – and to use the comparison to demonstrate his point to others.

Ali Alias Ajaru

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

The technology is categorized as an agronomic measure. Its primary purpose is to improve production through reducing evaporation from the soil surface and thus enhancing the soil moisture status. Positive impact on crop performance and SWC is achieved also through increasing soil fertility, modifying soil temperatures, reducing splash and inter-rill erosion, increasing infiltration of rainfall and suppressing weeds.

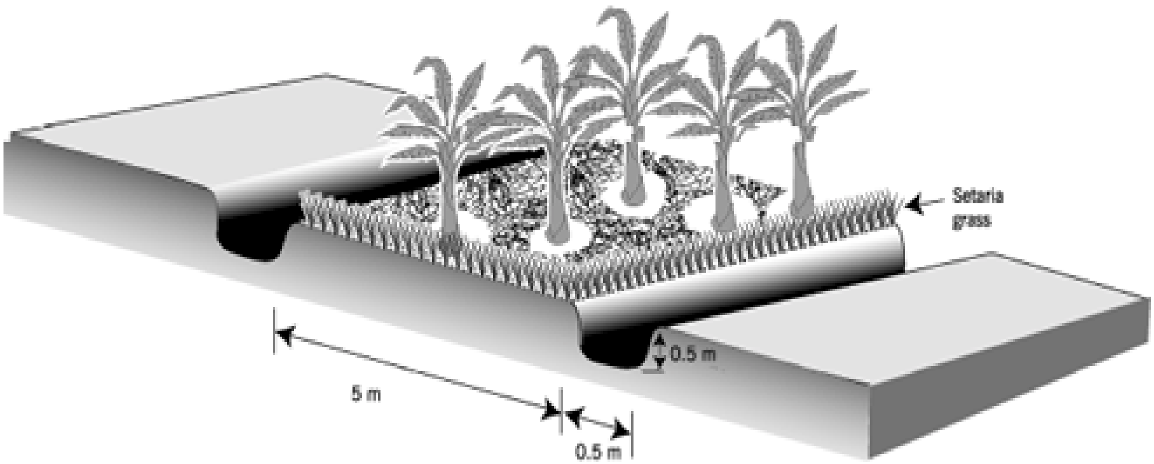
Ali examines his mulch

Technical details

Bananas are planted on raised beds of 5 m x 20 m, separated by furrows 0.5 m deep. Setaria grass is planted as a fringe around the beds, preventing loss of soil into the furrows. Mulch is applied to an initial thickness of about 0.15 m over a layer of manure or compost, over the whole banana bed (citrus and pineapples are also mulched in a similar way). Various materials are used for mulching, including groundnut trash, cereal stover, and grass.

Operation and maintenance

Decomposition and consumption by termites mean that mulch does not last for long. The thickness of the mulch therefore needs to be kept up by regular addition of material.



Mulched, raised bed

ASSESSMENT

Costs and benefits

Production of various crops, and farm income are said to have increased as a result of the mulching. The recurrent labour cost associated with mulching is estimated by the farmer to be 150 days/ hectare/ year. Compared with this cost, the long term return is considered to be positive. Ecologically there are multiple soil amelioration benefits, though on a very local scale.

Adoption

At this relatively early stage only around 10 others have taken up mulching in the neighbourhood.

Research needs/possible improvements

In the case of Ali Alias, who is a teacher by nature, it would be valuable if he could back up the visual comparison of mulched against non-mulched with some hard factual evidence. This he has begun, through simple record keeping of inputs and outputs, on his adjacent 'with and without' plots.

Concluding comments

The particular technology described in this case study (mulching) is less important than the principles and inventiveness that have given rise to it. A visit to the farm of Ali Alias is bound to have an impact – there are so many different trials and proven practices to be seen. But at the root of all of these are the guiding beliefs that water should not be lost out of the farm, and that organic matter should be recycled. Those are the important messages that Ali has to offer.

WOCAT data collection:	Alex Lwakuba; Emasu Ogwella, MAAIF
Extra Information:	Uganda PFI team
WOCAT Ref:	UGA 6

4.4.5

Case study No. 17: Tree farming

WILLIAM OKOTEL

Bukedea County, Kumi District

INTRODUCTION

Background

William Okotel is a secondary school teacher in Mbale town. He grew up in a rural area. Currently he lives in Bukedea County, in Kumi District where the climate is more favourable to farming than most of the PFI-Uganda zone. Annual average rainfall is between 750 and 1000 mm. Okotel is only a part-time farmer, and because of his employment he is relatively better off than his neighbours. His technology involves tending *Markhamia lutea* trees as a forestry crop, through mulching, pruning and addition of organic manure. This is a tree which has been strongly promoted previously in national campaigns, but here it is grown as the farmer's choice, in his particular way.

Okotel and PFI

Okotel is the exception to the rule amongst those innovators covered in this book, for the reason that he is reluctant to become involved in PFI exchange visits or meetings. It is important lesson that, even when a significant and interesting initiative is identified, the rights to privacy of the innovator must be respected.

Importance of the initiative

Many of the same comments can be cited here as were made under Mkupe Mkatalo in Tanzania. In other words, this is an example of a spontaneous individual response to the need for tree products. This is a case of a land user deciding to set up a micro forestry block close to the home- without project help. With so many failed forestry and agroforestry projects aimed at smallholders in Africa it is important to learn of what positive steps people are taking for themselves, and why.

Farmers (here visiting Florence Akol) could learn from William Okotel

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

This is a vegetative measure. The purpose is to provide a supply of various tree products. There are SWC impacts on a micro-scale which include improved ground cover, an increase in organic matter and reduction in wind speed.

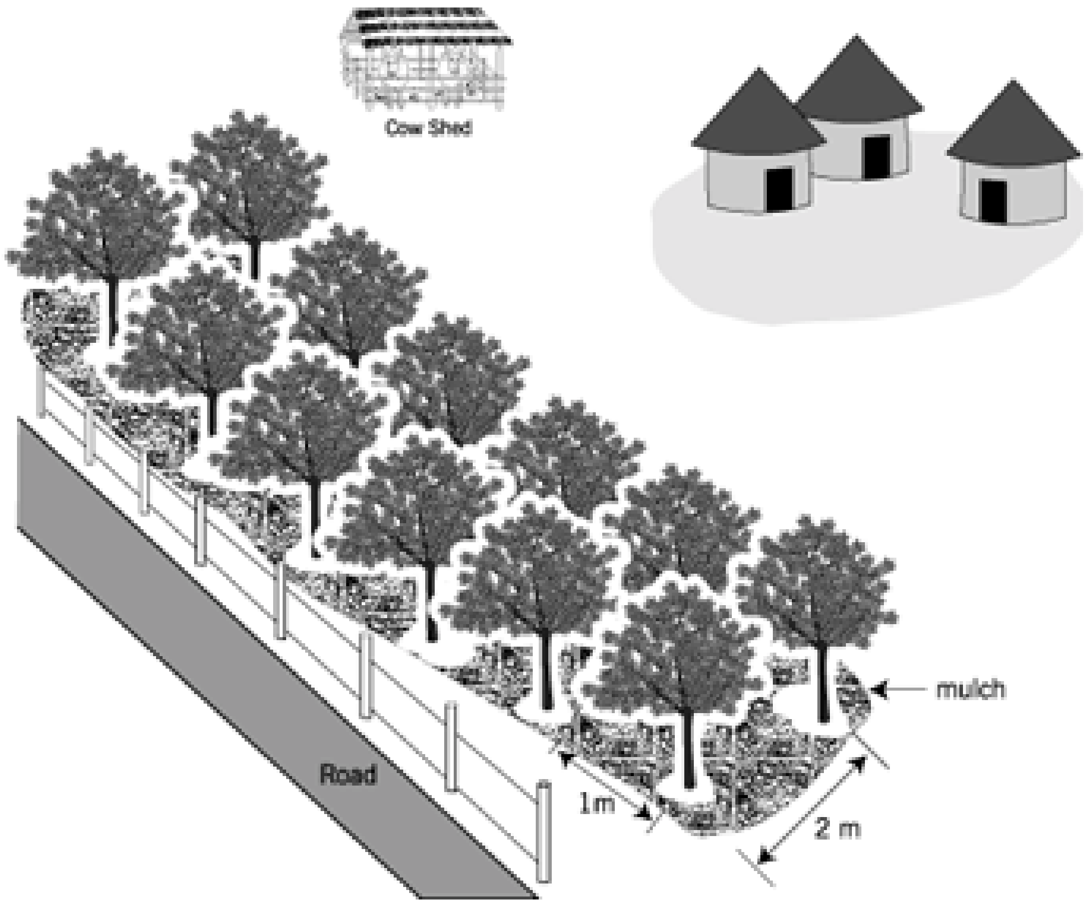
Markhamia lutea at William Okotel's homestead

Technical details

Establishment involves collection and transplanting of naturally generated seedlings ('wildings'). These are supplemented, where necessary, by collection of seeds which are raised in a nursery and then transplanted. The trees are spaced at 2 m between the rows and 1 m between trees in rows. The procedure for establishment is first site clearing, followed by land preparation, planting seedlings, manuring and mulching at a thickness of 0.15 m. While the trees in this case are planted in a block, they can (and are by others) planted along the farm boundary. *Markhamia lutea* is an indigenous, multipurpose tree which improves soil fertility through its leaf litter as well as supplying wood for timber and fuel (ICRAF, 1989; 1992).

Operation and maintenance

Maintenance includes: pruning branches, manure and mulching.



Homestead plantation of Markhamia lutea

ASSESSMENT

Costs and benefits

Production and socio-economic benefits include a significant increase in wood (timber and fuelwood) production for home use and sales of poles. These poles, for light building construction, are the main economic product. They are ready to harvest after 3 years. The trees are coppiced: this keeps the harvest sustainable from year to year. The whole system is achieved at low investment cost, and negligible maintenance. The only significant input is a modest amount of family labour. The benefits are considered to be 'very positive' by the farmer compared with the investment costs. Because the plot of trees is very small (around 0.25 ha) ecological benefits are theoretical rather than actual. These include soil cover improvement, soil loss reduction and reduction in wind velocity. There is general improvement in the micro-climate of the area and the compound looks attractive and eye-catching.

Adoption

Although a number of farmers grow *Markhamia lutea*, this is the only example we know of a householder growing it in a block, and tending it as a crop, rather than having a few trees growing around the field boundaries. The fact that the farmer is reluctant to engage in exchange visits doesn't help spread the message, but as noted above, the plot is by the roadside and clearly visible. Therefore his stand of trees acts effectively as a demonstration plot to all who pass by.

Research needs/ possible improvements

Possibly the most valuable information required from such an enterprise is to understand the farmer's rationale for tree planting and to test whether it appeals to others. This could be combined with a participatory exercise focusing on trees and tree products: *who grows what trees, for what purposes and how?*

Concluding comments

This is the only example here of a farmer who is reluctant to take part in exchange activities. Though that is surprising, given the overwhelmingly positive response to networking that PFI has found, it must be respected. It does not invalidate the technology or the innovativeness of the individual. One of the main lessons may be that innovation and extrovert tendencies do not necessarily go together. For this reason, some of the most creative individuals may remain hidden away.

WOCAT data collection:	Alex Lwakuba, MAAIF
Extra Information:	Uganda PFI team
WOCAT Ref:	UGA 7

4.4.6

Case study No. 18: Road runoff harvesting for bananas

Ms FLORENCE AKOL

Bukedea County, Kumi District

INTRODUCTION

Background

Florence is a farmer and a married housewife. She is 40 years old and has a family of 12 to support despite the fact the family is poorer than average. They own less than one hectare of land, but borrow an extra area to cultivate. Her main technical initiative is water harvesting, together with soil fertility improvement, in a *matooke* (cooking banana) plantation. She started in 1990. She practices harvesting of water from the road into her plantation, and has a system of trenches through which water circulates and is then held by basins around which are banana stools. She also mulches and plants grass barriers within the plantation. There is some doubt whether the water harvesting can really be claimed as her own innovation, as there are variations of this practice in several nearby farms. Nevertheless her holistic management system is probably unique to the area.

Florence and PFI

Florence was one of the first batch of innovators uncovered by PFI and has collaborated strongly with the project. She was featured in both the PFI book and the accompanying video. Florence has been visited by a study tour group from the ISWC project in Kabale, and she received advice from those farmers in banana management. As a result of study tours outside the district she has taken on a number of new ideas, including composting, setting up a home bakery, and raising turkeys.

Importance

This is another example of a technology that is only an innovation in local terms – and even then it is not clear where it started. However water harvesting into banana plantations is undoubtedly valuable, and farmers in Kumi and neighbouring districts still have many opportunities to exploit this technology.

Florence Akol

TECHNICAL DESCRIPTION

Categorization, purpose and impact: *WOCAT system*

The measure is categorized as structural/vegetative. Its purpose is to increase soil moisture for better production of bananas. It achieves impact through water harvesting.

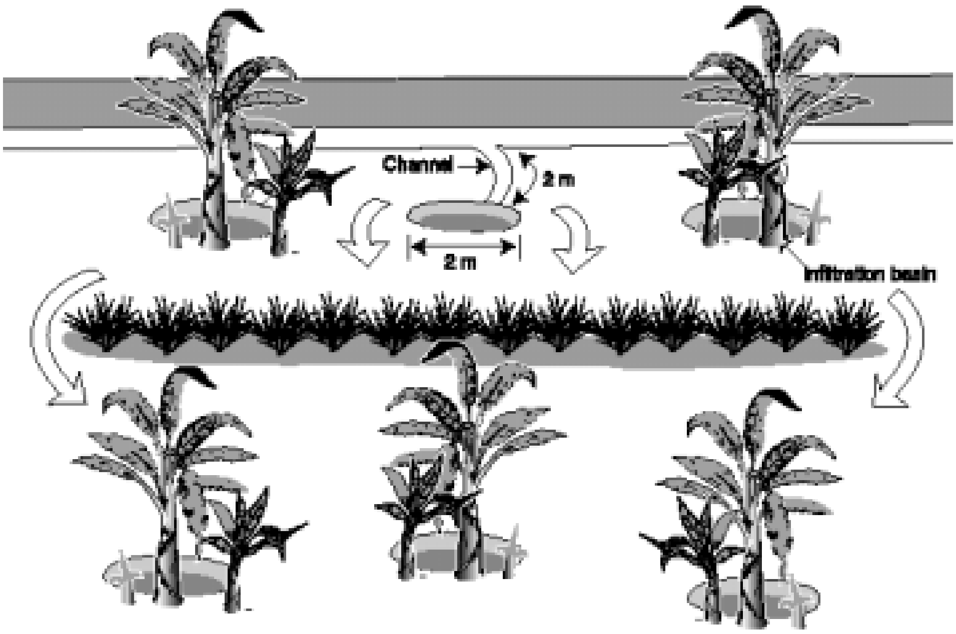
Florence with visitors from the ISWC project in Kabale

Technical details

Runoff water is diverted from the road running by the farm, using diversion ditches, 0.3 m deep and 0.3 m wide. Water is led first into semi-circular infiltration ditches that are 0.3 m deep, and 2 m in diameter. From these ditches, water flows through the banana plantation and is held by infiltration basins around which are groups of banana stools. Setaria grass is planted to stabilize the edges of the basins and is also used to stabilize a bund which runs through the plantation. Mulching is practised throughout the plantation, primarily to reduce the loss of valuable moisture.

Operation and maintenance

Maintenance involves desilting the channels and mulching bananas. Florence cuts the grass used to stabilize her structures to feed her goats.



Sketch of Florence's system

ASSESSMENT

Costs and benefits

The production and socio-economic benefits estimated by Florence include higher banana yields, and associated farm income increase of over 50%. Ecological benefits include soil loss reduction through control of concentrated road runoff.

Adoption

Water harvesting in bananas is becoming an increasingly common practice in Kumi District. It is not possible to say currently how many families have taken up this technology – or indeed how many of these can be directly attributed to Florence's example.

Research needs/possible improvements

There are certain technical areas that would be interesting to research, for example to look at the relationship between catchment: cultivated area ratio (thus amount of runoff harvested) and production. However, it would be also useful to know more about the spread of this technology, which is evidently becoming quickly more popular. *What has influenced people to take it up? What design have they copied? To what extent have they modified the design they started with?*

Concluding comments

Water harvesting for bananas works in Florence's situation. The design is simple and adaptable. The ingredients of success are simply hard work and an understanding of the potential of rainwater runoff. Florence has very limited resources and a heavy domestic burden. When we talk of looking for 'adoptable technologies' then a technology that yields benefits to a resource-poor women on a small plot of land surely fits the bill.

WOCAT data collection:	Alex Lwakuba; Charles Imoko, MAAIF
Extra Information:	Uganda PFI team; Critchley et al, 1999a
WOCAT Ref:	UGA 8

Chapter 5

Discussion and Analysis

5.1 Introduction

This chapter briefly looks analytically at two aspects. First, the technological initiatives and the innovators behind them. Second, we ask the question: *how has the PFI-WOCAT link worked in practice?*

5.2 The Innovators and the Initiatives

5.2.1 The People behind the Initiatives

The innovators who have been featured in this exercise were selected on the basis of having developed especially promising technologies (see Chapter 1 for criteria). Although the selection has been made to include a wide range of technologies; women and men, young and old; these people are broadly representative of what PFI considers 'good innovators' (see Table 1). In fact the age range and gender split conform quite well to the overall population of innovators uncovered by PFI[1]. Of the 18 innovators in this publication, there are 7 women and 11 men. PFI initially had problems identifying women innovators, then a deliberate campaign helped partially correct this (Ong'ayo, in press). To what extent this represents the *true* population of innovators in land husbandry is impossible to know. That depends on definitions of what we are looking for, and what constitutes 'ownership' of an innovation. However, it is clear that both men and women (and partnerships of the two) innovate, but women's innovations may not be as visible to identification teams as men's.

Looking now at the ages of those featured here, it is clear that innovators are often relatively old. This is logical: it takes time and experience (innovation on the land commonly occurs during retirement) to see, think through and test new ideas. Eight are over 50 years old, a further eight between 40 and 50, and only two below 40 years old. A crude estimation of wealth was attempted through the PFI characterization forms (which preceded the WOCAT exercise), and through discussions with field agents. This was based on farm size, livestock holding, employment in the family and so forth. Bearing in mind that all of the innovators are *absolutely* poor, and that direct comparisons between countries should not be made, a large majority (14 of the 18) come from *relatively* wealthy households. This does not simply mean that either (a) only the relatively wealthy innovate, or (b) innovation leads to wealth creation, but both statements are

[1] see Critchley et al, 1999a for a characterization of the first batch of innovators identified by PFI, and chapter 2 here for latest figures on the gender split between innovators

certainly partially true. In particular (b) is clearly articulated in a number of the case studies. Finally, a first analysis of the primary source of the ideas demonstrates that 'thinking through' and observation of biophysical processes by the innovators was the most important factor behind eight of the initiatives. The next most important main stimulus (for five) was visits to friends/travel. The other three can be grouped into a 'modifying traditions' category.

Table 1. *Summary of the Innovators and Initiatives*

Innovator	Initiative	Brief Description Initiative
KENYA		
Mr Musyoka Muindu	Road runoff harvesting	Runoff is harvested from a tarmac road and distributed through a field using various types of banks & channels
Mr Kamuti Nthiga	Riverbed reclamation	A strip in a sand riverbed has been reclaimed by fencing-in and planting to sugar cane which is mulched
Ms Kalekye Mutua	Gully rehabilitation	Cross-gully barriers are formed by earth dug from pits, planted to bananas, through which runoff passes
Mr Musee Kivunzi	Grazing land improvement	*Commiphora* trees, which suppress grass, are selectively removed by ring-barking
Ms Kakundi Kiteng'u	Sugar cane pitting	Deep pits are dug on the bank of a sand river, and planted to sugar cane, whose roots can reach moisture
Mr Mwaniki Mutembei	Gully harnessing	A gully has been rehabilitated, with stone barriers and made productive by planting fruit trees
TANZANIA		
Mr Kenneth Sungula	*Chololo* planting pits	Shallow planting pits (like the *zai* of Burkina Faso) help millet grow, through harvesting water
Ms Grace Lunyonga	Earthing-up groundnuts	Groundnuts are earthed-up at 2nd weeding to stimulate 'pegging' and increase infiltration of rainfall
Mr Albert Mhembano	'Pattern' farming	Organic trash is incorporated in deep trenches which also trap runoff: 'Life' is added to the barren soil
Mr Mkupe Mkatalo	Natural forest establishment	Naturally regenerating seedlings of a multipurpose tree (*Terminalia sp*) are protected to form a mini-forest
Ms Susanna Sylvesta	*Mapambano* compost making	Compost is produced in large quantities based on manure from stall-fed livestock
Ms Grace Bura	Vegetative gully healing	Land is reclaimed from gullies by the combination of trash/ soil cross-gully checks and vegetative barriers
UGANDA		
Mr Christopher Ojok	Water-borne manuring	Manure from a cattle shed is washed down to citrus trees by rainfall runoff in earth channels
Ms Jocelyn Turyamureeba	Improved trash lines	Traditional trash lines in sloping crop fields have been improved by Participatory Technology Development
Mr Faustino Opio	Integrated water management	A valley bottom is made cultivable by raised beds which can drain water or distribute runoff as required
Mr Ali Alias Ajaru	Mulching of perennials	Thick mulch is applied to perennial crops for multiple reasons, with multiple benefits
Mr William Okotel	Tree farming	A multipurpose tree (*Markhamia lutea*) has been planted in a block, for sale and home use
Ms Florence Akol	Road runoff harvesting	Banana production is increased by harvesting runoff from a track side, and water conserved by mulching

source: WOCAT Technologies questionnaire and PFI Characterization Forms
nb: refer to chapter 5.2 for explanation and discussion

	Age Innovator	Relative Wealth	Source Idea	WOCAT Category	PFI Grouping	Cost	Benefit	Adoption
	70s	high	self/ MOA	structural	rainwater harvesting	high	'v. positive long term'	40
	60s	high	self/	agronomic observations	sand river technology	medium	'v. positive long term'	5+
	30s	high	self/ friend	structural	gully harnessing	high	'v. positive long term'	0
	60s	high	self/ from tradition	management	pasture improvement	low/ medium	'v. positive long term'	'a few'
	50s	high	self/ observation	structural	sand river technology	high	'v. positive long term'	75
	30s	low	self/ friend	structural	gully harnessing	high	'v. positive long term'	'a few'
	40s	average	self/ observation	structural	rainwater harvesting	low	'v. positive long term'	300
	50s	high	self/ school	agronomic	agronomy	medium	'v. positive long term'	20
	40s	average	self/ various sources	structural	organic matter management	high	'v. positive long term'	20
	50s	high	self/ observation	management	afforestation	medium	'v. positive long term'	10
	60s	high	self/ observation	agronomic	organic matter management	high	'v. positive long term'	100
	50s	high	self/ observation	structural	gully harnessing	high	'v. positive long term'	10
	40s	high	self/ observation	structural	rainwater harvesting	low	'v. positive long term'	100
	40s	high	self/ PTD	structural	organic matter management	low	'v. positive long term'	30+
	40s	high	self/ outside visit	structural	rainwater harvesting	high	'v. positive long term'	'a few'
	40s	high	self/ outside visit	agronomic	organic matter management	high	'positive long term'	10+
	40s	high	self/ observation	vegetative	afforestation	medium	'v. positive long term'	10+
	40s	average	self/ from tradition	structural	rainwater harvesting	medium	'positive long term'	'many'

5.2.2. The Technologies

Categorization

Using the main WOCAT category for the technologies (ignoring here combinations of categories for simplicity), 11 are 'structural', 4 'agronomic', 2 'management' and 1 'vegetative'. While this WOCAT system is useful, there are some anomalies. For example the trash lines belonging to Jocelyn Turyamureeba (see 4.4.2) are classed as 'structural' because they last, just, for more than one year: 'agronomic' may seem more logical as they hardly differ in principle from the mulch of Ali Alias (see 4.4.4) in Uganda. One may also wonder about Kenneth Sungula's planting pits (see 4.3.1), being officially classed as 'structural'.

If we follow a function-oriented, grouping based on that used by PFI (see Critchley et al 1999a), which is supplementary to the WOCAT system rather than an alternative, then 5 technologies are broadly 'rainwater harvesting', 4 'organic matter management', 3 'gully control/harnessing', 2 'afforestation', 2 'sand river technology/water table management', 1 'agronomic' and 1 'pasture improvement' (Table 1). This range of technologies does represent, as it was intended to, the spread of land husbandry innovations that PFI has identified in these dryland areas. As has been previously mentioned, some of the technologies are variations of each other (for instance the three examples of gully harnessing: see 4.2.3, 4.2.6, 4.3.6), others could potentially work in a complementary way (for example road runoff harvesting and *chololo* pitting; 4.2.1 and 4.3.1). In one comparison (compost making versus trench cultivation; 4.3.3 and 4.3.5) it could be argued the former is already a partial evolution of the latter. But perhaps it is not right to emphasize comparison. The lesson is: don't always push what technicians believe is best. A 'second best' technology that has been developed *in situ* is preferable to a 'better' outside introduction that is not popular. Rather, the innovator should be helped develop improvements that suit him or her.

Purpose and Impact

For each of the technologies, purpose and impact have been presented. What is abundantly clear is that every one of the initiatives has been developed with the aim of improved plant production (for food, cash income or both), either as an immediate, primary purpose (the large majority) or sometimes as a combined aim, together with the need to control gullies or control runoff. Here is a central message: conservation is *never* divorced from production in the eyes of the innovators. Impact is achieved through a variety of, and this has been noted according to a specific WOCAT question: *main means technology achieves impact.* These include water harvesting, sediment harvesting, increased infiltration, soil fertility improvement and so forth. Usually impact is multiple ways. Most of these impacts have a direct, positive, effect on plant production.

Costs and benefits

This subsection is weak in terms of quantification. The reason is simply that none of the initiatives has yet been adequately validated in numerical terms, either by the land user or by research agents. Where figures are given, they are generally farmer's estimates that we have accepted as credible after relating to comparable, documented technologies. If an arbitrary and qualitative rating of 'high input' *versus* 'medium/ low input'[2] is used to categorise technologies, then the initiatives fall roughly half-half into these categories. Naturally the structural measures tend to be relatively high input. What is striking, but not surprising, is that the very large majority of the input comprises hand labour. These are all, therefore, low-external inputs (LEI) systems.

Data on economic benefits are correspondingly weak. We have relied on the answers to the WOCAT question: *how do the benefits compare with the investment costs (a) in the short term and (b) in the long term?*[3] Although this can only yield non-quantitative data, it does give an idea of what the innovators perceive about the worth of their technologies. Interestingly, all answer either 'very positive' (n = 16) or 'positive' (n = 2) in the long term. Even when the short term question is considered, 16 of the 18 answered 'slightly positive' or better. Perhaps the owners of the technologies have a vested interest in 'talking up' the benefits. But even so, these benefits must be real in order to underpin the investment. Otherwise they would simply be uneconomic. There is little evidence of that in this selection. A final point regards the reliance of the innovators, in most cases, on a locally marketed cash crop (including fruits, sugar cane, groundnuts and timber products) to realize the economic benefits. These are markets that can be easily saturated. The benefit associated with adoption of innovations will not, therefore, be so great if the best market opportunities have already been exploited by the original innovators.

Adoption

With respect to adoption, the data gathered regarding numbers (Table 1) has variable reliability. Again it comprises estimates (confirmed by, or originating from, extension agents), but is often based on records of names kept by the innovators themselves. Adoption is, in all cases, without outside incentives. Technically speaking it may be simple copying. It may be further adaptation. There are some data from PFI to show that further adaptation after/ during 'adoption' may occur in two out of three cases (PFI-Uganda: yet unreported impact assessment exercise in Dec 1999). Moswmof the innovations described here have been adopted by 10 or more fellow farmers. PFI has only stimulated this process, and cannot take full credit, as this spread is partially a natural process, and may also have been helped by other organizations. Some have

[2] Based on per unit area, initial establishment cost. A figure of 100 person days per hectare has been used as an arbitrary dividing line.

[3] There are no time scales attached to the question in WOCAT QT (which was put to the innovator). It can be answered 'very negative/ negative/ slightly negative/ neutral/ slightly positive/ positive/ very positive'

hardly spread at all. This may be to do with site specificity of the innovation, or high labour input required. However high cost/ labour input is perhaps not as great an issue as might be thought - as long as the benefits are equally large. Taking the four most popular innovations, those of Christopher Ojok, Kenneth Sungula, Ms Susanna Sylvesta and Ms Kakundi Kiteng'u, the first two are low input, the last two high input. The other aspect of adoption is the intangible element, namely the stimulation of 'innovativeness'. This is the 'promoting farmer innovation' of the programme title. *Have visitors to innovators been stimulated to think through their own problems?* It certainly appears that this stimulation has taken place. But the measurement oo this phenomenon is not clear-cut, and is outside the scope of the current exercise.

5.3 The PFI-WOCAT Exercise

5.3.1 Introduction

This exercise was a test of the complementarity of two initiatives: *how well could WOCAT serve PFI, and to a more limited extent, vice-versa?* Initially, WOCAT was used as a stand-alone exercise to make an inventory of technologies and approaches in specific countries or international regions, using earmarked funds. This situation is changing. Decentralization of programmes – in South Africa for example – has occurred since 1998. However in our situation, WOCAT has been tested for specific purposes, *within* an on-going project, with (mainly) the project's own resources. PFI had already gone through an internal process of characterization of its innovators and their initiatives, but the question was: *how much value could WOCAT add to the description and evaluation of those technologies?*

5.3.2 Methodology

A few brief notes on methodology are required. The exercise, including training and data collection was carried out, more or less alongside routine project activities, over a period from December 1999 until May 2000. Taking one country, Kenya, as an example the data collection (of 6 technologies) took 3 weeks. The two principal authors of this booklet (both experienced 'WOCATeers') were responsible for training the national PFI coordinators, and for completing, themselves, the one approach questionnaire. In fact each of the three coordinators had had previous exposure to WOCAT, so the training was more of a topping-up/refresher exercise. That took one to two days in each case. The coordinators in turn trained their field staff. From May 2000 until the end of that year there was an intermittent process of checking data, referring back to the field enumerators, followed by digital entry into the WOCAT database. During the first half of 2001 the data from the WOCAT questionnaires, together with existing PFI characterization data (and supplementary information from field notes/discussions with PFI staff) was analysed and the draft of the current document produced.

5.3.3 Observations

The clearest finding from the exercise was expected: there was a lack of hard data in all cases to satisfy the demands of the WOCAT technologies questionnaire (QT). This was unsurprising since it is often the case, even when WOCAT's QT is applied to well-known, technically recommended practices. WOCAT has often uncovered quite a disappointing level of quantitative knowledge amongst SWC specialists. So, for farmer innovations which have only just been exposed, it will obviously be an even greater shortcoming. From this arose another problem: that of injudicious 'guesstimation'. Several times, during cross-checking of questionnaires, figures turned up that were clearly grossly inaccurate[4] or simply inconsistent. These had to be filtered out, and referred back to the enumerators. When this was done, a reasonable level of credibility was arrived at.

It also became apparent that not all the innovations fitted neatly into the technology framework, simply because PFI has a rather wider technological span (land husbandry in its widest sense) than WOCAT. It was difficult, for example, to 'massage' a composting system into the questionnaire. Furthermore various questions were not easy to answer for individual initiatives – those regarding areal coverage for example. And some innovations are not fixed technologies, they are constantly evolving and are thus 'moving targets'. There was also tedious repetition of background information: not surprisingly since in each country the initiatives are clustered, physically, closely together. This in fact could have been avoided by identifying which questions need only be asked once for a local cluster of technologies. A number of weaknesses in clarity of questions in QT showed up, though these were as much to do with inadequate training of enumerators and lack of time than the questions themselves[5] . One more specific point regarded the diagrams (both an 'artist's impression' and a 'technical drawing' are asked for). Not only was there confusion between the two, but - as freely admitted, and in common with most people - some of the enumerators simply can't draw very well!

5.3.4 Comments on the process

Here are some of the comments given during the exercise, by those involved. Most are taken directly from the evaluation section within the questionnaires, answered by the enumerators.

- *it made me think*
- *the questionnaire was too long and repetitive*
- *how useful will it be to whom?*
- *I like the standardization*
- *it requires information that we don't have….*

[4] for example one labour input given for a simple in-field technique was found to be unbelievably high on cross-checking (equivalent to levels used in construction of bench terraces). The farmer had been asked to estimate his daily input 'per hectare'. This was a concept he clearly didn't understand. When taken to the field afterwards, he marked out an area that he could achieve in a single day. His wife was asked the same independently. The two answers were consistent. The result was a labour input around 10% of the original 'guesstimate'

[5] a few ambiguities turned up: these will be fed into the ongoing WOCAT process of upgrading the questionnaires

- *time consuming!*
- *some questions are confusing in relation to individual innovators*
- *nerve cracking!*
- *I have learnt from it*

Three themes emerge. First, several of the enumerators found the questionnaires long and tiresome. But there is no mention of the farmers being fatigued. Many of them clearly enjoyed being closely questioned about their practices – or at least appreciated the interest shown in them. Second, the questionnaire caused the enumerators to think though a number of aspects that they had not considered before. Third, the paucity of available data became very clear to all.

5.3.5 Concluding lessons

Three general lessons about WOCAT field exercises – none of them entirely new - are supported by our experience. The first is that there simply must be enough time dedicated to training in the enumeration of the questionnaires. Virtually the only way to do this satisfactorily is for an experienced 'WOCATeer' to work one-on-one with a specialist, on at least one real-life case study. Certainly not enough time was dedicated to that training during the current exercise, nor was adequate time allocated to completion of questionnaires in the field. A second general lesson is that data must be carefully cross-checked after submission of questionnaires, by (again) an experienced WOCATeer. Our experience is that there are always a number of dubious answers given, and sometimes there are obvious contradictions. Furthermore some questions are simply overlooked.

Perhaps the third general lesson learnt is the most important one. WOCAT *can* be useful within a project, to describe technologies, approaches and areal extent of conservation. But the WOCAT data will need to be supplemented by other information as well to maximize its utility to the project. Selected data from such an initiative will also be a valuable addition to the global WOCAT database. As we have noted above, one of the main problems with the current exercise was the lack of readily available data. This led to some frustration and the problem of inaccurate estimates and guesses. But in this final lesson lies an opportunity. WOCAT could perhaps best be incorporated into such a project *from the start*, to help guide technical validation of specific, best-bet technologies, and thus to help evaluate them. That way, WOCAT would be mapping out a path for technical monitoring. Relevant data would be built up gradually - rather than being demanded abruptly, with inadequate preparation.

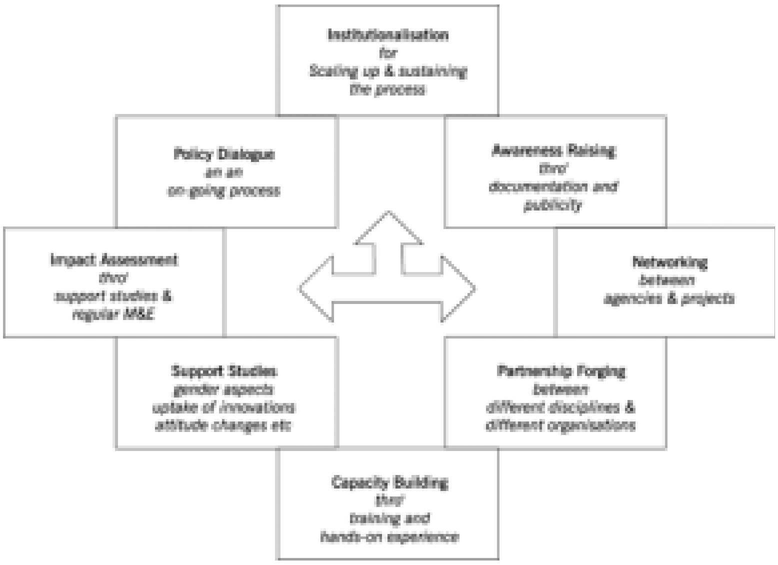
All in all, this has been an instructive exercise. This booklet is testimony to the fact that it has been directly functional also. It demonstrates what can be achieved when there is constructive collaboration between different field initiatives and programmes which work in a common field.

Annex One

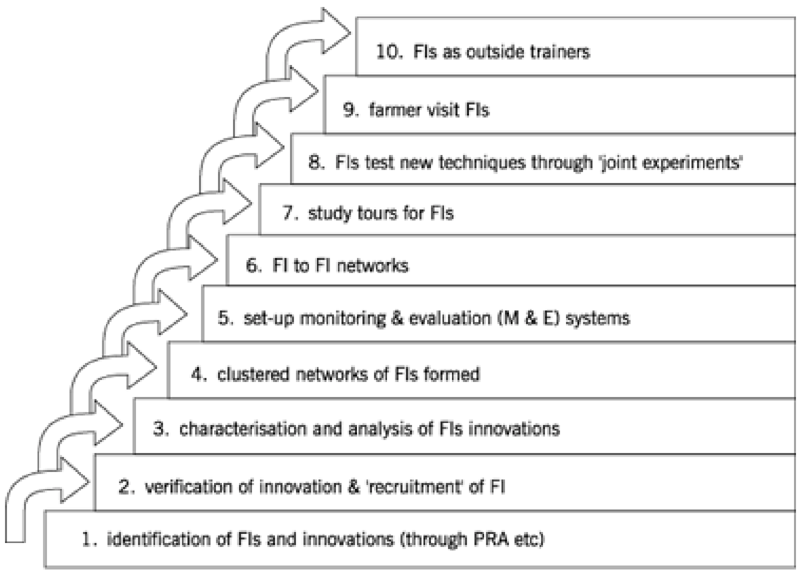
Farmer Innovation Methodology:
(1) Programme Development Processes *and* (2) Field Activities

Adapted from Critchley et al, 1999a

1. Programme Development Processes



2. Field activities: ten steps in harnessing farmer innovation



FIs = Farmer Innovators PRA = Participatory Rural Appraisal M & E = Monitoring and Evaluation

Programme Development Processes: *some explanatory notes*

The programme development process 'shell' highlights some of the most important processes that need to accompany field-based implementation activities. There is no strict sequence, other than to say that the training component of capacity building needs to have a high profile at the commencement of the programme, and institutionalization takes up relatively more time and energy in the later stages. That is why they are located where they are in this shell. The other processes 'kick in' at various stages and tend to continue throughout, sometimes at centre stage, sometimes in the background.

Capacity building **is a foundation stone, but is also integral throughout the course of such an unconventional programme. Training is required primarily in re-orientation of roles (see section on roles and responsibilities)** and in methodology – the programme development processes and the field activities. Training is also necessary for specifics such as participatory learning and action (PLA: including PRA, PTD etc), farmer innovator identification, gender sensitivity, and monitoring and evaluation. It may also be needed for elements which are determined on an ad hoc basis as they arise. But capacity building is more than just training. It incorporates 'learning by doing' which is integral to such a process approach. **Partnership forging** between the various disciplines (especially research and extension) and between organizations needs to be addressed systematically. This is 'coalition building' to use the term favoured by Broerse (1998). As in all workable coalitions, they depend on mutual benefits to justify their existence. Uneasy and unstable alliances are a real danger. **Support studies** result from specific needs that arise at different stages of the programme: examples are gender studies and inventories of related project initiatives (in preparation for networking) or evaluatory analyses of various aspects of the programme, such as effectiveness of training or adoption of innovations. **Networking** between agencies and projects can be an important means of exchanging experience and sharpening ideas, as well as a rapid means of upscaling through the 'lateral' adoption of the methodology by network partners. **Overall impact assessment** needs to be carried out at critical points within the cycle – typically towards the end of specific programme phases. This should be based on a combination of existing data (from the M&E programme: see following methodological section on Field Activities), participatory workshops and special impact studies. **Awareness raising** basically implies publicity. This can be carried out directly through media campaigns as well as more informatively and indirectly through publication at various levels of academic sophistication (or, to put it another way, at different levels of accessibility, taking into consideration the relevant target audiences). **Policy dialogue** and lobbying are essential prerequisites if the programme is to lift itself above mere local and temporary impact, and if it is to achieve **institutionalization** within permanent agencies. Institutionalization is placed at the top of the Programme Development Process shell to denote the fact that it is the ultimate objective.

Field Activities: *some explanatory notes*

The 'ten steps' of field activity have been developed to help guide those involved in programme implementation who have had little or no experience with participatory technology development-type projects. The steps are not strictly sequential: one triggers the next. Some activities continue once started (e.g. step 5: M&E), and some are reactivated in phases (e.g. step 1: Indentification).

Step 1 is the **identification of farmer innovators** (FIs). Here we are looking for innovations or for special traditional practices. We must be careful to trace an innovation back to its roots, in other words we should always try to find the original innovator. Identification can be achieved through a process of PRA, or more simply by starting with what extension staff and local contacts know already, and then following up this process. A sister project (the ISWC2 programme) in Ethiopia has even used a competition to attract new innovators. **Step 2** is the process of **verification** – i.e. confirming that the innovation is genuine and important. This puts a judgemental burden on whomsoever is vested with the responsibility (ideally a team involving research, extension and peer farmer innovators). Sometimes field agents find an 'innovation' which isn't really one at all. This step also includes **recruitment**: it's essential to make sure that the innovator (the FI) really wishes to join a network, and take part in all the activities that it entails. He or she may not want to be 'recruited'. **Step 3** follows the recruitment in step 2. This is **characterization** of the FIs and innovations. It means recording certain, basic information about the person and the technology at the start. It could be called a 'snapshot' of information. Where innovations are particularly promising (and some cannot be technically improved) it is urgent to 'write them up' at this stage. Characterization is followed by an **analysis** of this data, which should help to answer questions such as: what type of person is an innovator and why do they test and try new systems? and what sorts of innovations are there and where have the ideas come from? **Step 4** consists of the **creation of farmer networks**, from farmers who live close together (in clusters). From experience it's best to have around 8 in a group for pragmatic reasons: the whole group can then easily meet in a small room, and can also fit into a vehicle for study tours. Groups should be encouraged to fall into place naturally. Each network should be as balanced as reasonably possible in terms of men and women, and in terms of the young and the older. **Step 5** involves setting up a **monitoring and evaluation** (M&E) system, with discussions between partners (farmers, researchers, extension workers) about who measures (and who analyses) what and for what purpose. We are looking particularly for an emphasis on 'farmer measurable indicators' based on parameters that the farmers want to measure. Labour and other inputs, yields, rainfall and runoff events can, for example be monitored by the farmer (if he or she wishes to do so). Changes in soil fertility or moisture are examples of parameters that need to be measured by the researcher with special equipment. Evaluations are invariably carried out jointly by farmers, extensionists and researchers. **Step 6** is when **FI to FI cross visits** begin – logically first between FIs within the same network, and then visits between FIs of different networks. This is the process of getting to know what others are doing, sharing ideas, and 'releasing creativity'. **Step 7** takes the visits one stage further. **Study**

tours for each network are now carried out. This means taking the whole network (or sometime representatives from several networks) outside the area to visit other farmers, or research stations etc. There will also be other farmers from outside visiting the area – reciprocal visits. **Step 8:** it is hoped that the study tours (and of course the network visits as well) will stimulate the adoption and further **development of new techniques**. Ideally FIs will then expand their range of experiments, and these will again be monitored through the M&E processes described in step 5. This should lead to further technologies (which though still possibly undergoing adaptation by farmers) that can be described and made widely available in the written form so they can be spread further than just by farmer-to-farmer means. **Step 9** sees the beginning of the dissemination process. When we have a technique that can be recommended to other farmers – or at least worth looking at - these farmers can be brought to the farm of that innovator to gain inspiration from what they see. The extensionist should help facilitate this **training or 'field day'**. **Step 10** then involves using the farmers to go out to spread messages with the extensionists. **Farmer innovators act as outside trainers.** Farmers often learn best from their own colleagues. In an example from Tunisia, farmer innovators are given exposure on the radio in a regular 'slot' (C. Reij: pers comm). In both dissemination steps (9 and 10) the extensionist has a key role to play as facilitator and organiser.

n.b. four different types of 'cross visits' can be differentiated: these are FIs to FIs (step 6) study tours (step 7), Farmers to FI (step 9) and FI to Farmers (step 10)

n.b. there is no strict sequence between steps 1-10, and there will be repetitions of various stages

References:

Acland, J.D., 1971. *East African Crops.* FAO / Longman Group, London

Basehart, H.W., 1973. Cultivation intensity, settlement patterns and homestead farms amongst the Matengo of Tanzania. *Ethnology* 12, 57-75

Briggs, S.R., Critchley, W.R.S., Ellis-Jones, J., Miiro, D.H., Tumuhairwe, J. and Twomlow, S., 1998. *Livelihoods in Kamwezi, Kabale District, Uganda*. A final technical report from Environmental Research Project no R4913. 'Conserve water to save soil and the environment' (1995-1998). Unpublished report no IDG / 98 / 11. Silsoe Research Institute, Silsoe, UK

Broerse, J.E.W., 1998. *Towards a new development strategy. How to include small-scale farmers in the biotechnological innovation process.* PhD Thesis, Vrije Universiteit, Amsterdam. Eburon, Delft, The Netherlands

Critchley, W., Reij, C. and Seznec, A., 1992. *Water Harvesting for Plant Production, Volume 2. Case Studies and Conclusions for Sub-Saharan Africa*. World Bank Technical Paper no. 157, Washington DC, USA

Critchley, W.R.S., Cooke, R., Jallow, T., Lafleur, S., Laman, M., Njoroge, J., Nyagah, V. and Saint-Firmin, E., 1999a. *Promoting Farmer Innovation.* Nairobi: RELMA Workshop Report no 2, Nairobi, Kenya

Critchley, W.R.S., Miiro, H.D. and Ellis-Jones, J., Briggs, S. and Tumuhairwe, J., 1999b. *Traditions and Innovation in Land Husbandry. Building on Local Knowledge in Kabale, Uganda.* RELMA Technical Report no 20, Nairobi, Kenya

Defoer, T., Budelman, A., Toulmin, C. and Carter, S.E., 2000. *Building common knowledge. Participatory learning and action research* (Part 1). In: Defoer, T., Budelman, A. (eds), 2000. *Managing soil fertility in the tropics. A resource guide for participatory learning and action research.* Royal Tropical Institute. Amsterdam, The Netherlands

ICRAF, 1989. *Markhamia*: a very practical ornament. *Agroforestry Today* (1) 3

ICRAF, 1992. *A Selection of Useful Trees and Shrubs for Kenya.* International Centre for Research in Agoforestry, Nairobi, Kenya

Jaetzold R. and Schmidt, H., 1983. *Farm Management Handbook of Kenya.* Ministry of Agriculture, Republic of Kenya

von Maydell, H-J., 1986. *Trees and Shrubs of the Sahel.* Schriftenreihe der GTZ no 196. Eschborn, Germany

Mbuya, L.P., Msanga, H.P., Ruffo, C.K., Birnie, A. and Tengnas, B., 1994. *Useful Trees and Shrubs for Tanzania.* Technical Handbook no 6, RSCU / RELMA, Nairobi, Kenya

Miiro, H.D., Critchley, W, van der Wal, A. and Lwakuba, A., (in press) Innovation and impact: a preliminary assessment from Kabale, Uganda. *In* Reij, C. and Waters-Bayer, A. *A Source of Inspiration: Farmer Innovation in Africa* to be published by: Earthscan, London, UK

Mwarasomba, L.I. and Mutunga, K., 1995. *Soil and Water Conservation Technology Development in ASAL – A Survey of Positive Experiences.* Unpublished Report. Ministry of Agriculture, Republic of Kenya

Ong'ayo, M. in press. *Gender and Innovation.* to be published through RELMA, Nairobi, Kenya

Ostberg, W., 1986. *The Kondoa Transformation: Coming to Grips with Soil Erosion in Tanzania.* Research report no 76, Scandinavian Institute of African Studies, Uppsala, Sweden

Reij, C., Scoones, I. and Toulmin, C. (eds), 1996. *Sustaining the Soil.* Earthscan Publications, IIED, London, UK

Tanner, J.C., Holden, S.J., Owen, E., Winugroho, M. and Gill, M., 2001. Livestock sustaining intensive smallholder crop prouction through traditional feeding practices for generating high quality manure-compost in upland Java. *Agriculture, Ecosystems and Environment* 84, 21-30

Thomas, D.B. (ed), 1997. *Soil and Water Conservation Manual for Kenya.* Soil and Water Conservation Branch. Ministry of Agriculture, Nairobi, Republic of Kenya

Thomas, D.B. and Mati, B., 1999. An External Review of *Promoting Farmer Innovation.* UNSO-UNDP, Nairobi

Thomas, D.B., Mutunga.K. and Mburu, J.K., (in prep). *Kenya Overview of Soil and Water Conservation.* To be published by RELMA, Nairobi, Kenya

WOCAT, 1995. *Workshop Report. First Regional Workshop: East Africa.* WOCAT, GDE, University of Berne, Switzerland

WOCAT, 2000. *Knowledge for Sustainable Soil and Water Management.* (Brochure) WOCAT, GDE, University of Berne, Switzerland

The Swedish International Development Cooperation Agency (Sida) has supported rural development programmes in Eastern Africa since the 1960s. It recognizes that conservation of soil, water and vegetation must form the basis for sustainable utilization of land and increased production of food, fuel and wood. In January 1998, Sida inaugurated the Regional Land Management Unit (RELMA) based in Nairobi. RELMA is the successor of the Regional Soil Conservation Unit (RSCU), which had been facilitating soil conservation and agroforestry programmes in the region since 1982. RELMA's mandate is to contribute towards improved livelihoods and enhanced food security among small-scale land users in the region, and the geographical area covered remains the same as previously, namely, Eritrea, Ethiopia, Kenya, Tanzania, Uganda and Zambia. RELMA's objective is to increase technical know-how and institutional competence in the land-management field both in Sida-supported programmes and in those carried out under the auspices of other organizations. RELMA organizes training courses, workshops and study tours, gives technical advice, facilitates exchange of expertice, and initiates pilot activities for the development of new knowledge, techniques and approaches to practical land management. To publicize the experiences gained from its activities in the region, RELMA publishes and distributes various reports, training materials and a series of technical handbooks.

The Office to Combat Desertification and Drought (UNSO) of the United Nations Development Programme (UNDP) leads the organization's efforts in promoting long-term development in the drylands. UNDP has acquired considerable expertise in fighting poverty in the drylands through several of its country programmes and most particularly through the work of UNSO. Currently UNSO works in all regions of the world in support of drylands development. UNSO has supported countries in the implementation of the United Nations Convention to Combat Desertification. Among the new services to be provided by UNSO to countries through its new integrated programme are:

- Mainstreaming of dryland issues into national development frameworks.
- Reduction of vulnerability.
- Local governance for natural resource management.

In line with the new upstream focus of UNDP, UNSO will be providing assistance to countries in the form of policy advice, technical support and institutional capacity development for integrating drylands issues into national development planning frameworks and UNDP country programmes. Based at Nairobi, Kenya, UNSO works within the Environmentally Sustainable Development Group under the umbrella of the Bureau for Development Policy (BDP). UNSO has adapted a decentralized structure and has three regional offices located in Nairobi (to provide support for Eastern and Southern Africa – Ms. Verity Nyagah, Regional Coordinator; e-mail verity.nyagah@undp.org), Ouagadougou (for Western and Central Africa – Mr. Mounkaila Goumandakoye, Regional Coordinator; e-mail mounkaila.goumandakoye@undp.org) and a new unit in Beirut (for the Arab Sates/ West Asia -Mr. Elie Kodsi, Regional Programme Manager; e-mail elie.kodsi@undp.org.lb). Operational support to countries is provided through these offices.

About this book:

This book is a follow-up to the 1999 publication 'Promoting Farmer Innovation' (RELMA Workshop Report No 2) which looked at the methodology behind working with farmer innovators. 'Farmers' Initiatives in Land Husbandry' lays out case studies of 18 of the most interesting technical systems uncovered during three years of working with such innovators in East Africa. There is an abundance of illustrations and photographs. It also describes the people behind the initiatives: this is not just a technical manual. The methodology used to generate the data for the cases studies was that of WOCAT – the World Overview of Conservation Approaches & Technologies. This document is the product of collaboration between PFI, WOCAT and RELMA, which has proved to be a fruitful partnership. The book is aimed principally at field technicians and project managers in East Africa, but it is hoped that it will prove relevant to a much wider audience.

ISBN 9966-896-63-5

RELMA

Regional Land Management Unit, RELMA/Sida, ICRAF Building, Gigiri, P. O. Box 63403, Nairobi, Kenya
TEL: (+254 2) 52 40 00 Ext. 4418, 52 25 75, FAX: (+254 2) 52 44 01, E-mail: relma@cgiar.org
Internet: www.relma.org

SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY Sida