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Seeing Beyond Fertiliser Trees

A Case Study of a Community Based Participatory Approach to Agroforestry Research and Development in Western Kenya

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Seeing Beyond Fertiliser Trees

A Case Study of a Community Based Participatory Approach to Agroforestry Research and Development in Western Kenya

Evelyne Kiptot

Proefschrift
Ter verkrijging van de graad van doctor
Op gezag van de rector magnificus
Van Wageningen Universiteit,
Prof.dr. M.J. Kropff,
In het openbaar te verdedigen
Op dinsdag 18 September 2007
Des namiddags om 16.00 uur in de Aula

Evelyne Kiptot (2007)

Seeing Beyond Fertiliser Trees
A Case Study of a Community Based Participatory Approach to Agroforestry Research and Development in Western Kenya. PhD. Thesis,
Wageningen University, Wageningen, The Netherlands.

ISBN: 978-90-8504-722-3

For Tom and Quincy

Abstract

Kiptot E. 2007. Seeing Beyond Fertiliser Trees. A Case Study of a Community Based Participatory Approach to Agroforestry Research and Development in Western Kenya

The thesis explores and describes various processes that take place in the implementation of a community based participatory initiative known as the village committee approach by a collaborative agroforestry programme between the Kenya Forestry Research Institute (KEFRI), Kenya Agricultural Research Institute (KARI) and the World Agroforestry Centre (ICRAF) which has since 1988 been undertaking soil fertility research to address the problem of nutrient deficiency in smallholder farms within the western Kenya highlands. Over the years, various agroforestry technologies have been developed to address the problem of soil fertility. Issues that this thesis explores in detail are the processes of participatory learning, adoption/adaptation/non-adoption, dissemination and diffusion of the technologies. Overall, the thesis is guided by the technographic approach which makes use of diverse observational and analytical methods and frameworks to arrive at hypotheses about likely mechanisms affecting the operation, transformation or adoption of technological processes. One such framework adapted to the needs of this thesis is the context-mechanism-outcomes configuration (CMOC). This framework rests upon realist assumptions. This study drew upon the qualitative methods used by ethnographers. But some issues to do with learning and adoption were assessed from the perspective of a sampling approach. Attention was paid to the integration of quantitative and qualitative approaches. Multiple sources of data were used, including formal and informal surveys involving structured/semi-structured/unstructured interviews with farmers, in-depth interviews with key informants, case studies, participant observation and secondary data.

Findings presented show that the use of the village committee approach was misplaced as the approach assumed that groups are fully appropriate vehicles for technology development and dissemination. The groups did not play a major role in agroforestry dissemination, as was hoped by the programme. This may partly be attributed to the fact that agroforesty as a technology was not high on the agenda of most groups and therefore farmers did not give it much thought. In addition, group formation and success depended on being able to exclude some of the most needy persons through imposing membership requirements, such as fees. The thesis shows that groups work, but only for those who have assets to begin with. This suggests the possibility that wealthier farmers benefit from cooperation only when they can exclude poor resource farmers. Second, agroforestry is apparently treated as a kind of ritual requirement helping groups access assets that really make sense – namely livestock distribution through the pass-on system. The possibility must be faced that agroforestry in western Kenya is valued more as a networking opportunity than as a mechanisms for transforming land management. In short, the context was not thoroughly understood, and unanticipated mechanisms (associated with village power politics) kicked into play, resulting in outcomes that diverged from those intended by the agroforesters.

As regards to participatory learning this thesis shows that achieving genuine participation has remained elusive. Some people were virtually excluded from the learning process. Exclusion was either by choice (self exclusion) or a product of village power politics. Part of the reason lies in the fact that despite the shift from top down to bottom up in development circles, community structures have remained paternalistic, with a few (better educated, better connected) elites (often older farmers retired from urban employment) controlling development initiatives. This is a major obstacle to participation, and unless it is tackled, efforts being made to involve marginalized members of society through up-scaling of development initiatives will have disappointing results. As regards to farmer to farmer dissemination, findings show that informal social networks were more effective for seed dissemination than for knowledge sharing. This calls for simplification of technical information by development professionals, in order to help support farmers' understanding and communication of complex principles. In relation to agroforestry adoption, the results show that the process of adoption is highly variable and dynamic, with farmers taking up or discontinuing the use of soil fertility management technologies due to a whole range of factors of which soil fertility management is just one. Mechanisms of adoption are complex, and switched on and off by contextual factors. For this reason adoption research needs to probe beyond categorization and correlation, and frame its analytical questions in terms of the context-mechanism-outcome configurations advocated as the basis of a realistic evaluation methodology. Adoption and diffusion of these technologies has been disappointly very low. This sends a strong message to researchers; for agroforestry-based soil fertility replenishing technologies to be attractive to farmers, they must provide other tangible economic benefits besides soil fertility improvement. Secondly, the marginal superiority of a complex technology is not good enough, it must either be so superior as to sell itself, or it must be sufficiently clear in terms of how the basic mechanism works in local context that pioneer farmers could indeed disseminate it to other farmers if they wished. But this raises the question of whether the social mechanisms of community participation do indeed work as agroforesters had hoped. Spontaneous spread of agroforestry soil-improving agroforestry innovations remains a goal in western Kenya, but basic effort is still needed to specify a plausible scenario linking context (exteme poverty), mechanisms (technical knowledge) and favourable outcome (adoption of agroforestry innovation). What this thesis shows is that if the context is not conducive for the technology, diffusion and adoption simply can not take place. All in all the thesis concludes in the final chapter, that soil fertility management is a function of socio-economic processes within a community, and it is therefore imperative that researchers develop a realist awareness of the contexts, mechanisms and outcomes governing participatory technology development so that there is rapid correction when evaluation reveals evidence of negative or perverse outcomes. By establishing good feedback to R&D, there will be a better chance of avoiding a situation in which a lot of time and resource is wasted on promoting technologies that are 'not good enough' in the eyes of farmers.

Key words: *village committee approach, agroforestry, improved tree fallows, biomass transfer, realist evaluation, soil fertility, adoption, dissemination.*

Acknowledgements

A journey of a thousand miles begins with a single step, so the saying by Chinese Philosopher Confucious goes. This journey began in September 2003 when I came to Wageningen University to enroll for a PhD Programme under the Participatory Approaches and Upscaling Programme (PAU) coordinated by Technology and Agrarian Development (TAD) Chair Group. It has been indeed a long journey full of ups and downs, but everything that has a begginning also has an end. It has finally come to an end and I wish to acknowledge the support of people and institutions that have contributed to my being able to complete this journey. First and foremost I wish to thank the Rockefeller Foundation, for providing financial support both for my fieldwork in Kenya and my stay in the Netherlands. My gratitude also goes to Dr. Paul Konuche - Director, Kenya Forestry Research Institute for granting me study leave. I also wish to thank the Centre Director, Muguga Regional Research Centre, Mr Elly Mwanza for logistical support; he was always willing to assist. He provided a vehicle whenever I wanted to go to the field, even on short notice. *Asante sana!*

I wish to acknowledge the support I received from my supervision team. My promoter, Prof. Paul Richards, co-promoters Dr. Paul Hebinck and Dr. Steven Franzel all put in many hours to ensure the completion of this thesis. It was indeed an honour to work with Paul Richards. He introduced me to realism and realist evaluation that have formed the basis for my thesis. There are many times I got confused and overwhelmed, but I now look back and appreciate the fact that confusion is part of the process. Paul, your philosophical and critical comments/suggestions and final editing of the thesis have made it what it is today. *Thank you!* And to you Paul Hebinck, your optimistic nature and enthusiasm often made me feel so at ease even when the going got tough. You always had time for me even when you had other deadlines to meet. The frequent meetings we had and your suggestions greatly improved the thesis. *Asante sana!* To Steve, thank you for making it possible for me to use the World Agroforestry Centre (ICRAF) facilities in Nairobi and for your suggestions and valuable comments during the initial stages of my fieldwork and also when I was writing articles for journals. Your encouraging words often gave me the motivation to write more papers. *Dank u wel!*

To Dr. Conny Almekinders, the coordinator of the PAU Programme, no amount of words can really describe my appreciation. Your vigour, energy, and support in all aspects of my stay in the Netherlands are highly appreciated; from identification of relevant courses, field visits, finding a suitable co-promoter, financial matters and even taking time to show us (PhD students in the programme) many interesting sites in the Netherlands. Thank you for incorporating personal development and peer learning in the programme, it indeed made me understand myself better and how to relate with others in addition to creating an environment of sharing ideas with my fellow students which greatly improved the development of my research proposal during the early stages. *Dank u wel!* Inge Ruisch, thank you for adminstrative support (tickets, making sure I had a room in Bornsesteeg whenever I came to the Netherlands, allowances etc.) and for being a friend, your occasional loud laughter, something we hardly hear of in the Netherlands, often made me feel like I was back in Kenya. Thanks Inge for taking me to many social places; it indeed made my stay in the Netherlands enjoyable. *Asante sana* Inge! *Na Mungu akubariki.* My colleagues from the third cohort; Dr. Michael Misiko, Diana Oyena, Tran Sy Hai, Kennedy Ogoro and our PAU III-freinds, Roberta Gerpacio (Bobbie), Qui Sun and Benjamin Mweri really made my stay in the Netherlands memorable. Our Sunday ritual - get together over a cup of *uji* (Swahili for African porridge made from millet flour) often made weekends in the Netherlands worth looking forward to. Mike, Diana and Ken, thank you for the biking lessons. The Kenyan community in Wageningen through the years provided a Kenyan environment whenever we met to catch up on Kenyan politics; They include; Ayub Oduor, Liza, Viviane Oguya, Benjamin Kibor, Dr. Edward Ontita, Dr. Lawrence Mose, Gabriel Muturi, Susan Imbahale, Moses Sila, Dr. Patricia Mwendo, Pauline Andago, Dr.Beatrice Salasya, Catherine Macharia, Dr. Harrison Charo, Dr Faith Nguthi, Lydia Ndirangu and many others who have left. Special thanks also go to other colleagues in PAU and TAD for their friendship and a good working environment during my writing phase; Kalunde Kissawike, Christopher Bukenya, Philip Idinoba, Dr. Prossy Isubikalu, Tendayi Mutimukuru, Douglas-Ruiz Barrasa, Benard Kamanga, Asrat Amele, Florent Okry, Francisco Guevara Paco, Valerie Foster, Alfred Mokuwa, Dr. Edwin Nuijten and Dr. Kees Jansen. Dr. Harro Maat, thank you for introducing me to theories of technology development some of which are included in the thesis. From Rural Development Sociology group, I wish to sincerely thank Dr. Alberto Arce for introducing me to sociology of knowledge in particular various theories and concepts such as the actor-oriented perspective, social capital, and livelihood approach. It has indeed been a challenge finding a balance between rural sociology and my forestry background. But I am glad to have trekked that path because I am now able to look at issues from a broader perpective. In the field, I wish to thank Dr. James Ndufa, Centre Director, Maseno Regional Research Centre for providing logistical support in western Kenya. I also wish to acknowledge the support of George Muok, Ken Ambane and Daniel Wasonga for assisting me in data collection. *Asante sana.* I sincerely appreciate the support of Franklin Mairura in data analysis. And to all the farmers I visited and interviewed in Siaya and Vihiga, I say *Orokamano* for sharing your experiences with me.

Last but not least, I wish to thank my parents for the encouragement they often gave me. *Kongoi misini!* Special gratitude goes to my siblings (brothers and sisters) for taking care of my home and my son when my husband and I were away. May you be blessed tremendously. I wish to thank my husband Tom Mongare for his enormous support, encouragement and love. Thank you for being there for me; you shared in my joys and frustrations. I often made phone calls to you at 3 am whenever the going got tough and could not sleep, but you were always there to encourage me. It has been four long years and I thank you for your understanding and patience. Now that it is over, I do hope we will spend more time together. To Quincy Mongare my beloved son, I never spent much time with you the way I had wanted. But I thank you for your understanding and for passing your primary exams in 2006. It made your dad and I so proud and I do hope that now that it is over I will spend more time with you. And to all those who have contributed in one way or another, I say, *asante sana na mola awabariki*!

Evelyne Kiptot
Wageningen, August 2007

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Research context, setting and theoretical perspectives

CHAPTER 1

Research context, setting and theoretical perspectives

Introduction

This thesis is based on a collaborative agroforestry programme between the Kenya Forestry Research Institute (KEFRI), Kenya Agricultural Research Institute (KARI) and the World Agroforestry Centre (ICRAF) which has since 1988 been undertaking soil fertility research to address the problem of nutrient deficiency in smallholder farms within the western Kenya highlands. Over the years, approaches have evolved from a linear model of technology transfer to the current participatory approach. The core of this thesis explores and describes processes that take place in the implementation of a community-based participatory activity known as the "village committee approach" devised by the agroforestry programme in partnership with the local community to ensure technology adoption and dissemination. The village committee approach emerged after the failure of earlier top-down approaches, and also in reaction to the fact that extension services almost ground to a halt after the implementation of the Structural Adjustment Programmes (SAPs) imposed by the International Monetary Fund (IMF) in the late 1980s and early 1990s. Many extension officers were retrenched and appointment of new staff was frozen. In addition, World Bank funding to extension services stopped in 1997.

The top down approach made use of a positivist framework which did not fully capture local complexities, or take into account farmer adaptations; technologies successful in one context were applied irrespective of context, with widespread failure (Pretty and Chambers, 1993). By positivist in this context I mean the attempt to "push" on-station inventions as fully-finished innovations. In terms of institutional arrangements and relationships, the positivist model created a rigid promotional hierarchy, discouraging feedback of information. The village committee approach currently being used in western Kenya is an alternative to this earlier positivist model, and it explicitly recognises that natural resource management is not characterised by problems for which fixed answers must be sought, but rather that problems are such that they need joint learning, reflection, negotiation and feedback, and subsequent on-going modification of innovation strategies. Recently, there has been a growth of interest in the application of participatory learning approaches - as will be discussed in chapters 3 and 4 - that seek to facilitate the involvement of individuals, groups and organisations in problem solving and decision making. In addition, roles are being transformed, with farmers taking up a major role in technology development.

The village committee approach was first tested in 17 pilot villages of Vihiga and Siaya districts in 1997 and not much has been documented so far about either mechanisms of adoption or outcomes among various local actors[1] in the agroforestry technology adoption and dissemination process. Technology adoption and dissemination involves not only technologies as tools, machines or processes, but also is required to accommodate a range of actors with varied and often competing interests. So any study of technology focused (as here) on understanding mechanisms of technological change has to focus on the interaction of the various elements i.e. tools, actors and interests. In western Kenya, research has concentrated a great deal on the biophysical features of agroforestry-based soil fertility technologies, to the relative neglect of farmer perceptions and the underlying mechanisms involved. The present research contributes to redressing this imbalance. This thesis therefore tries to move beyond the tool-like elements to explore how various actors interact with the technical elements and

[1] These were mainly individual farmers and farmer groups from both pilot and non-pilot villages

among themselves in processes of participatory learning, adoption/adaptation and dissemination. The two main soil fertility-replenishing agroforestry technologies that this thesis explores are improved tree fallows and biomass transfer, which are described in detail in chapters 5, 6 and 7. The theoretical entry point for this study is therefore interface between agroforestry technologies and participation. The central questions formulated in trying to understand these socio-technological processes are "how" and "what" questions. How does participatory learning, technology adoption and dissemination take place? What are the mechanisms and outcomes that are involved when actors interact amongst themselves around and with the technology? Here, participation must be seen as a political and dynamic process, as there are always tensions and underlying issues, such as who is involved, how and why. In addition, although participation is often seen by its proponents as a means to challenge patterns of dominance, it may also become a means through which existing power relations are reproduced and entrenched. This thesis will keep this latter position in mind, as it analyses the social interactions attendant upon farmer participation in a range of agroforestry technology development processes. Because participation means different things to different people, chapter 2 will attempt to unpack the concept and its role in current debates about rural development and poverty alleviation.

Overall, the thesis is guided by what has sometimes been termed the technographic approach (Sigaut, 1994; Richards, 2001), as described later in this chapter. Here, it is sufficient to remark that technography makes use of diverse observational and analytical methods and frameworks to arrive at hypotheses about likely mechanisms affecting the operation, transformation or adoption of technological processes. One such framework adapted to the needs of this thesis is the context-mechanism-outcomes configuration (CMOC) applied by Pawson and Tilley (1997) to the evaluation of social policy interventions. This framework rests upon realist assumptions. Realism is a philosophy that argues that the world contains real entities and processes, even where these are elusive of human observation or control, and that it is the objective of science (including social science) to provide warranted inferences concerning such real objects and processes (Manicas 2006; Sayer, 1992). CMOC is discussed in more detail in the methodology section of this chapter. It is important to note here, however, that the CMOC realist evaluation framework is not a research technique, but a form of inquiry that can be applied to any social programme, in order to grasp underlying mechanisms and outcomes shaped within certain contexts.

The central issues in this thesis concern the study of interactions between agroforestry technologies and social actors and therefore before going any further it is essential to explain what agroforestry is, its history, and its development in Kenya. This will be followed by a brief background description of the agroforestry programme in Maseno which forms the basis for this thesis. Later on I will operationalise the concept 'technology' since it is treated in this study as a key entry point in understanding agroforestry adoption and dissemination in western Kenya. I will discuss what technology is by looking at it from several perspectives, and then present a definition adapted to the purposes of this thesis. Subsequently, I will review various theories/perspectives on technology development with the view to highlighting some aspects of these theories that I consider to be flawed, and therefore not capable of explaining agroforestry development and change in western Kenya. This will be followed by a presentation of the objectives of the study, a description of the technographic approach, realist evaluation framework and the organizational framework of the study. Thereafter, the methods, description of study site, a definition of key concepts used in this thesis and finally the outline of the thesis are to be presented.

What is agroforestry?

Although a lot has been written and said about agroforestry, it is often misunderstood. It is a relatively new name for a set of old practices. At the time ICRAF was established (in 1977) much confusion and ambiguity surrounded its definition. The situation was reviewed by an editorial in the inaugural issue of *Agroforestry Systems Journal* (1982). A selection of the definitions of agroforestry proposed by various individuals was included in the editorial, and later these (and other) definitions were summarised and discussed in an in-house ICRAF meeting, resulting in the following suggestion for a preferred definition.

> Agroforestry is a collective name for land use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc) are deliberately used on the same land management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence. In agroforestry systems, there are both ecological and economical interactions between the different components (Lundgren and Raintree, 1982).

This definition became established all over the world and is still applicable today. It is important to note that the second part of the definition emphasises that for agroforestry to be beneficial, the different components must have a positive effect on the entire land-use system through ecological and economic interactions between the relevant components. The interactions, whether they are ecological or economic, can be positive or negative. The interaction is complementary if the presence of one component increases the output or yield of the other, neutral if one has no effect on the other, and competitive if the presence of one component reduces the yield of the other. The aim of agroforestry is to identify positive interactions and maximise them, while trying to reduce negative interactions.

In 1996, Roger Leakey, then the Director for Research at ICRAF, redefined agroforestry in more holistic and ecological terms. According to Leakey (1996), agroforestry is a dynamic, ecologically based natural resource management system that through the integration of trees in farm land and rangelands, diversifies and sustains production for increased social economic and environmental benefits for all land users at all levels. This definition does not specify the fact that the various components may interact either in space or time. Therefore this present thesis will revert to the definition offered by Lundgren and Raintree (1982), since this captures the fact that for any system to qualify as an agroforestry system there has to be some interaction between various components, whether in sequential or simultaneous arrangement. In sequential arrangement, the different components are not present on the plot together, but follow each other in time. A tree fallow alternating with agricultural crops would be an example. Components can also partially overlap in time, for example, tree planting for improved fallow before the end of the agricultural cycle. In simultaneous arrangements, the different components are present on the same plot at the same time. Examples are trees in a pasture, trees in association with perennial crops, i.e. hedgerow intercropping, contour hedges, boundary planting, home-gardens (Sanchez, 1995). It is important to note that simultaneous agroforestry systems can be transformed into sequential agroforestry systems. This is the case for example when trees in a hedgerow intercropping are allowed to grow into a fallow and cropping is discontinued. In the next cropping cycle the trees are severely pruned to minimize competition with crops, but they are allowed to grow when crops are gone (Sanchez, 1995).

Classification of Agroforestry Systems

Based on the definition of what agroforestry is, Nair (1989) classified agroforestry into various systems and practices/technologies, as shown in Table 1.1.

Table 1.1. Classification of agroforestry

Major system	Sub-system/technology
Agrisilvicultural system	Improved fallows, biomass transfer, the taungya/shamba system, hedgerow intercropping, tree gardens, trees/shrubs on farmlands, shelterbelts, soil conservation hedges
*Silvopastoral systems	Cut and carry fodder banks, live fences of fodder trees and hedges, trees and shrubs on pasture land
*Agrosilvopastoral systems	Woody hedges for browse mulch, green manure and soil conservation
Other systems	Apiculture, aqua-forestry etc

Adapted from Nair (1989).

* It must be noted though that for a system to qualify for the suffix "pastoral", animals must be physically present near trees and benefit from the browse or fodder.

The history of Agroforestry

It has long been the practice all over the world to cultivate trees in combination with agricultural crops. The practice has a history of at least 1300 years according to pollen records (Brookfield and Padoch, 1994). Examples are numerous. For instance, in parts of northern Europe during the Middle Ages, forests were clear felled, the slash was burnt, and then food crops were cultivated for varying periods; planting tree species before or along with, or after sowing of, agricultural crops was a common practice (King, 1987). This type of swidden cultivation later died out, but was still widely practiced in Finland up to the end of the 19th centuary, and in parts of Germany as late as the 1920s (King, 1968).

In Latin America, the examples are numerous. Many societies traditionally simulated forest conditions in their farms in order to obtain beneficial effects of forest structures. In Central America, farmers often planted different species of plants, corresponding to the layered structure of mixed tropical forests, e.g. coconut or papaya with a lower layer of bananas, citrus, a shrub layer of coffee or cacao, annuals such as maize, and finally a spreading ground cover of plants such as pumpkins (King, 1987). In Asia, the Hanunoo farmers of the Philippines practiced a complex and sophisticated type of shifting cultivation whereby when clearing forests for agricultural crops they deliberately left certain selected trees which by the end of the rice growing season, would provide a partial canopy of new foliage to prevent excessive exposure to the sun at the time when moisture is more important than sunlight for the maturing grain (Conklin, 1957). In other parts of Asia, Indonesia, India Pakistan etc. are famous for home gardens. These home gardens date back to the pre-historic period in Indonesia, since they have been found documented in paintings, papyrus illustrations and texts dating to the third millennium BC (Soemarwoto, 1987). According to Hutterer (1984), home gardens may have originated in pre-historic times when hunters and gatherers deliberately or accidentally dispersed seeds of valued fruit trees in the vicinity of their camps. A prominent characteristic of a home garden is the great diversity of species forming a multi-strata vegetation formation, e.g., creepers such sweet potatoes, pumpkins to tall trees such as coconut palm, vines climbing on bamboo poles and trees (Soemarwoto, 1987).

Africa also has numerous examples of this type of multi-layered farming system, especially in the West African forest zone. For instance, in high rainfall zones of southern Nigeria, yams, maize, pumpkins and beans were typically grown together under a cover of scattered trees. In Tanzania, the Chagga people, from around Mt. Kilimanjaro, are famous for their home-gardens composed of a mixture of different species forming multiple strata (Fernandes et al., 1984). Farmers in the dry zone also have equivalent systems. A system of growing millet and sorghum crops under *Faidherbia albida* parkland is common in parts of the Sahel (Vandenbelt, 1992). Gardens formed around *Acacia senegal* are common in parts of Sudan. In Zambia, the *Bemba* tribe practice a type of shifting cultivation known as *chitemene*, in which trees are cut and the wood piled and burnt, and crops planted in the ash covered area. The *chitemene* system is unique in that crops are grown in an ash garden made from burning of a pile of tree branches obtained by lopping and chopping trees from an area many times larger than the ash garden. Traditionally, a new *chitemene* ash garden is made every year (Stromgaard, 1985; Chidumayo, 1987). These examples indicate a wide geographical coverage of traditional agroforestry practices. The practitioners of these traditional agroforestry systems of production perceived food production to be an integral part of the system, with trees performing a supportive role.

By the end of the 19th century, the establishment of forest plantations intensified wherever agroforestry was utilized as a system of land management. It began with the advent of the taungya system in Burma where forest plantations were established by using labour from landless people who were given permission to plant their crops alongside the trees for several years before the closure of the tree canopy (King, 1968). In return, the labourers would cultivate land between rows of seedlings and retain the agricultural produce. From Burma, taungya spread to many parts of the world via colonial networks, as colonial foresters saw it as an inexpensive way of establishing forest plantations. Kenya was included. During the colonial and post colonial era many forest plantations were established by this system, known locally as the *shamba* system (Oduol, 1986). However, the Government of Kenya decided to ban the system in 1987, due to the large amount of forest destruction caused by cultivators living close by (Wanyiri et al. 2001). Debate about the merits and demerits of the system still continues. In fact, it seems likely the system may be re-introduced because it has been shown by Wanyiri et al. (2001) to be so far the most cost-effective method of plantation establishment, with benefits in terms of food security, employment and alleviation of poverty far outweighing disadvantages.

For more than a hundred years (1856-1970) during which period the taungya system was the colonial norm for establishment of forest plantations, little thought was given to food production, the farm or the farmer. The system was designed to reduce the costs of establishing forest plantations and the foresters never envisaged it as capable of making a significant contribution to agricultural development through becoming a land management system, as distinct from a forestry system in the narrow sense (King, 1987). The important contribution of the forest sub-sector to agricultural production was acknowledged, however, by the World Bank, the International Development Research Centre (IDRC) and Food and Agricultural Organization (FAO) during the 1970s, and these agencies began to re-examine their policies pertaining to forestry to see how they might benefit the rural poor. One result was that the World Bank formulated in 1973 a new forestry policy paper which not only contains many elements of agroforestry but is designed to assist the peasant farmer to increase food production, obtain wood and conserve the environment. The forestry policy paper is still being used as the basis for much of World Bank lending in the forestry sub-sector. At more or less the same time (in 1974) FAO appointed an Assistant Director General with responsibility for forestry, after which it made an assessment of the forestry projects it was helping to implement in developing countries. From this assessment it became clear that forestry could play a much more important role in supporting agriculture and raising the welfare of the rural poor, a perspective previously completely ignored.

FAO therefore redirected the thrust of its assistance to the rural poor. Its new policies, while not abandoning traditional forestry development, emphasised the importance of forestry for rural development, the benefits of which could accrue both to the farmer and the nation if greater attention was paid to the beneficial effects of trees and forests on food and agricultural production (King, 1979). FAO also stressed the need to devise a system that would provide food and fuel and yet conserve the environment. As a result of the change in policy in the forestry sub-sector, FAO prepared a seminal paper 'Forestry for Rural Development (FAO, 1976), and with funding from the Swedish International Development Agency (SIDA) organized a series of workshops on the subject and implemented rural forestry projects throughout the developing world. In these projects, as with the World Bank's social forestry projects, the interaction of trees and crops played a vital role in rural development. During the Eighth World Forestry Congress held in Jakarta, Indonesia in 1978, FAO used this opportunity to focus the attention of the world's leading foresters on the importance of agroforestry. The central theme for the congress was "Forests for People", and a special session was devoted to 'Forestry for Rural Communities.'

At about the same period FAO was transforming its policies in favour of forestry for rural development, IDRC was also seriously re-assessing its policies in the forestry sector. In 1975, it commissioned John Bene, a Canadian, to undertake a study to:

- Identify significant gaps in the world forestry research and training
- Assess the interdependence between forestry and agriculture in low-income tropical countries and propose research leading to the optimization of land use
- Formulate forestry research programmes which promise to yield results of considerable economic and social impact on developing countries
- Recommend institutional arrangements to carry out such research effectively and expeditiously
- Prepare a plan of action to obtain international donor support

John Bene appointed an advisory committee and regional consultants to make recommendations on the forest needs of the tropics. Professor Larry Roche, at that time Professor of Forestry at the University College of North Wales, Bangor, UK, but previously a forester in West Africa, was one of the consultants, he organized a workshop at the University of Reading, UK, on tropical forestry research and related disciplines. The proceedings of the workshop (Roche, 1976), along with the reports by the other consultants, formed the basis for the report by Bene et al. (1977) entitled 'Trees, Food and People,' which was submitted to IDRC. Bene and his colleagues stated in the report:

> 'It is clear that the tremendous possibilities of production systems involving some combinations of trees with agricultural crops are widely recognised, and that research aimed at developing the potential of such systems is planned or exists in a number of scattered areas. Equally evident is the inadequacy of the present effort to improve the lot of the tropical forest dweller by such means. A new front can and should be opened in the war against hunger, inadequate shelter, and environmental degradation. This war can be fought with weapons that have been in the arsenal of rural people since time immemorial, and no radical change in their life style is required. This can be accomplished by the creation of an internationally financed council for research in agroforestry, to administer a comprehensive programme leading to better land use in the tropics.'

The Bene report was well received by the international and bilateral donor agencies, and at a meeting of potential donors in 1976 a steering committee was commissioned to consider the establishment of the proposed council. As reported by King (1987), the Steering Committee met in Amsterdam in April and June 1977 and decided to proceed with the established of the council along the lines proposed by the Bene report. So the International Council for Research in Agroforestry (ICRAF) was born (1977). Its main objective was to support, plan and coordinate on a world wide basis, research in agroforestry. An old practice was institutionalised as part of applied science and development practice for the first time. The steering committee approved a draft charter for ICRAF and elected a board of trustees, with John Bene as its first Chairman. It appointed IDRC as the executing agency for ICRAF until such time as the Council became a fully fledged body. It was decided that the permanent headquarters should be in a developing country, and Nairobi, Kenya was selected. Before the establishment of the Nairobi headquarters, ICRAF was temporarily housed at the Royal Tropical Institute in Amsterdam, The Netherlands. ICRAF was the first science institution dedicated to agroforestry. No institutes of this kind existed at national level. Furthermore, although agroforestry involves the integration of trees and agricultural crops and/or animals, it was foresters and not agriculturalists who were behind the establishment of ICRAF. Thus one of the functions that ICRAF undertook was to create awareness about the contribution of agroforestry to development, and the need to develop national mechanisms to institutionalise agroforestry within national research and extension frameworks. It is largely through ICRAF's efforts that today agroforestry is taught as part of forestry and agriculture degrees in many universities. Today, specific degrees in agroforestry are already offered at Bachelors and Masters level. National agricultural and forestry institutions in developing countries also incorporated agroforestry in their programmes.

Agroforestry Development in Kenya

Agroforestry, as already mentioned, is an age-old practice. It existed in Kenya, among farmers, and in extension advice, long before the establishment of ICRAF in 1977. For instance, even before Kenyan independence in 1963, programmes encouraging the planting of fruit trees, trees for shade, windbreaks and soil conservation had been introduced through the agricultural sector. The Kenya Forestry Department also practiced agroforestry according to the *shamba* (taungya) system for plantation establishment (Oduol, 1986). What is new is the development of agroforestry as an applied science, and as a focus for systematic development effort (Nair, 1989). This section therefore looks at how the science of agroforestry has evolved over the years in Kenya.

When agroforestry was institutionalised in 1977, ICRAF embarked on a number of activities, including collection and synthesis of information, conceptual and methodological developments, technology generating research, economic investigation, establishment of research networks, agroforestry extension and training and education. In 1984, an external review panel recommended that ICRAF begin to apply its accumulated knowledge through the development of collaborative research with national agricultural research institutions (Steppler, 1987). An essential first step in the development of these collaborative networks was the establishment of National Steering Committees in each country. In Kenya, a national agroforestry steering committee (NASC) was formed in 1987 under the auspices of the National Council for Science and Technology (NCST) to spearhead research and development in agroforestry. This steering committee was composed of representatives from KARI, KEFRI, the Ministry of Agriculture, the Ministry of Environment and Natural Resources (MENR) and the National Council for Science and Technology (NCST). The committee was responsible for undertaking institutional coordination, monitoring and evaluating progress of agroforestry research and development strategies in Kenya. An initial task of NASC was to spell out clearly the role and responsibilities of these institutions so as to ensure that research, extension and training in agroforestry are carried out without duplication efforts. At about the same period in 1986, KEFRI became a fully fledged research institution with a forestry research mandate for Kenya. KEFRI had various thematic programmes, one of which was agroforestry.

In order to work effectively with national agricultural research systems (NARS), ICRAF embarked on establishing the Agroforestry Research Networks for Africa (AFRENAs). One of the AFRENA networks was the East and Central Africa (AFRENA-ECA) which encompassed four countries, namely Kenya, Uganda, Rwanda and Burundi. In Kenya two NARS institutions, KEFRI and KARI were involved. Two regional research centres were identified to lead research on various themes. Maseno Regional Research Centre, hosted by KEFRI, was mandated to carry out agroforestry research to address land use problems within the bimodal highlands of western Kenya. Embu Regional Research centre, hosted by KARI was mandated to carry out agroforestry research to address land-use problems within the central highlands of Kenya. A summary of agroforestry research activities undertaken by these two centres are shown in Table 1.2. All this work was collaborative between KEFRI, KARI, ICRAF and relevant line ministries. The Agroforestry programme in KEFRI also had its own research priorities and undertook research on characterization and analysis of land-use systems, screening, management and improvement of multi-purpose trees, agroforestry technology development, soil fertility/erosion research and fodder production (Nyamai, 1996).

As regards to agroforestry education, ICRAF - through its African Network for Agroforestry Education (ANAFE) programme - has worked closely with Kenyan universities and colleges to develop an agroforestry curriculum. This is because as agroforestry gains increasing attention in rural development and research programmes, the demand for persons with competence in agroforestry is increasing. Educational institutions are responding to these needs by incorporating agroforestry in their programmes. ANAFE was launched in 1993 by ICRAF, as a joint effort among colleges and universities to strengthen teaching of agroforestry. Its objectives are to support curriculum development, encourage production of teaching materials, facilitate exchange of expertise and provide postgraduate fellowships in agroforestry (Rudebjer and Temu, 1996). As a result of this initiative, Kenyan universities now offer courses in agroforestry at Bachelors, Masters and PhD level. As of 1996, eight Kenyan technical colleges and universities were members of ANAFE (Rudebjer and Temu, 1996).

Table 1.2. Research agenda for AFRENA-Kenya in the 1990s.

Site	Research Theme	Research emphasis	Other priority research themes
Maseno	Soil fertility	Improved fallows; hedgerow intercropping; biomass transfer; nutrient cycling and budgets; on-farm research	Upper-storey trees for timber and fuel-wood production; fodder
Embu	Fodder	Fodder production; tree grass fodder systems; fodder utilization; socio-ecological and economic implications; on-farm fodder production	Soil fertility research

Source: Cooper and Attah Krah (1996).

In regard to agroforestry extension, the Kenya government recognises that agroforestry is a sustainable land use system that tackles the problems of wood shortages, rural poverty, low agricultural productivity and environmental degradation (Ministry of Agriculture, 1992). Agroforestry has, therefore, been incorporated in the programmes of the various ministries charged with extension, namely the Forestry Extension Services Branch (MENR), the Soil and Water Conservation Branch (Ministry of Agriculture) and the Biomass Division of the Ministry of Energy (Omoro et al., 1996). Non governmental organizations (NGOs) such as Kenya Energy and Environmental Non-Governmental Organisation (KENGO), CARE International-Kenya, the Kenya Wood fuel and Agroforestry Programme (KWAP) and the VI Tree planting project are all involved in promoting agroforestry in the country.

Maseno Agroforestry Programme Background

Agroforestry based soil fertility research in western Kenya was undertaken jointly by scientists from KEFRI, KARI and ICRAF, now known as the World Agroforestry Centre, based at the Maseno Research Station in western Kenya. Maseno Centre is run by KEFRI. Researchers from KARI and ICRAF were seconded to the centre to work on collaborative projects to address problems faced by smallholder farmers within the region (Table 1.2). Maseno centre was established in 1988 by the three institutions. Its establishment was based on a diagnostic study carried out earlier that identified soil fertility as a major limiting factor to crop production in the region (Minae and Akyempong, 1988). At the time Maseno was established it was mandated to carry out agroforestry based research under the umbrella of ICRAF's Agroforestry Network for Eastern and Central Africa (AFRENA-ECA) to address soil fertility problems, lack of fodder and fuel-wood. The thrust of the programme, however, was soil fertility research. The initial goals of the agroforestry programme, according to Nordin et al. (2003), were: (i) to do agroforestry research better adapted to farmers' conditions, (ii) to assist farmers to test agroforestry practices on their own and to exchange information about their experiences, (iii) to study extension approaches, (iv) to study the impact of agroforestry on farmers livelihoods and (v) to estimate the adoption potential on a regional scale.

The first problem identified in regard to soil fertility was the fact that the soils of most parts of western Kenya were characterised by low levels of Phosphorous (P) combined with low Nitrogen (N) content and localised Potassium (K) deficiencies. This is as a result from continuous cropping with little or no inputs. The use of mineral fertilisers is rare as farmers are too poor to afford it, or due to poor incentives for agriculture (for example, the lack of rural credit and markets). The second problem that the programme in Maseno intended to tackle was the lack of low cost soil fertility management technologies to address soil nutrient deficiencies within the region. The first goal therefore encompassed technology development research. This was undertaken on-station and on-farm. On-station research involved controlled experiments set up by researchers at the on-station sites to address various issues. Issues tackled at the initial phase were: nutrient dynamics between tree-crop interfaces, nutrient budgets and development of low cost agroforestry technologies to address farmers constraints. Technologies with potential were taken on-farm for further testing under farmers' conditions. There were three different types of on farm trials; each with different levels of farmer involvement.

Type 1 on farm trials were designed and managed by researchers. They were meant to study biophysical processes (nitrogen fixation, nutrient dynamics in tree-crop interfaces, hedgerow intercropping etc.) on farmers' fields. In these experiments, data was collected under highly controlled experimental conditions, just like in on-station trials. Some of these trials were used as demonstration sites. Farmers' involvement was basically to provide land and labour, which was paid for by researchers. Type 2 on-farm trials were designed by researchers but managed by farmers. The aim was to collect both biophysical and socio-economic data. Data was jointly collected on crop and tree performance, in addition to labour requirements. Farmers provided the labour for weeding and the crop harvests belonged to them. Type 3 trials were aimed at allowing farmers a free hand to test technologies without researcher involvement. This allowed researchers to come in later to assess farmers' innovations, designs, species choice and limitations. Farmers sometimes received free tree seeds and advice from researchers.

As research on the biophysical aspects of the technology progressed, the programme realised that there was a general lack of understanding of the socio-economic issues related to adoption and management. Studies on feasibility, profitability and acceptability were initiated (Swinkels et al., 1997). It was during one such study that it was realised that adoption rates of the various soil fertility technologies was very low. This was partly blamed on the linear model of technology transfer that relied on extension officers to disseminate information to farmers. The extensionists relied on contact farmers who in most cases were more well off than the general population, and therefore did not interact much with the community. This led to a fourth challenge of finding an appropriate approach that would involve the entire community in technology development and dissemination, thus increasing adoption rates, hence the emergence of the village committee approach in 1997 (Noordin et al., 2001). Later on, the programme realised that for farmers to gain maximum benefits, they needed to add external sources of P to organic sources, which are only able to supply N and K. But since most households are too poor to afford inorganic inputs, a credit scheme was needed to supply farmers with the much needed inputs, hence the initiation of a project known as SCOBICS (Sustainable Community-Based Input Credit Scheme) in the year 2001 to address the above concerns, i.e. provide farmers with credit in the form of inputs which they could repay after harvesting their crops.

This thesis analyses all these processes and assessed how farmers' motivations and perceptions about agroforestry have been shaped by the various approaches/projects, while at the same time looking at outcomes in terms of considering how farmers have rejected or reworked/re-designed these technologies to suit their circumstances. Re-designing or adaptation is one of the manifestations of farmer ability to exercise agency. The concept of agency, as defined in the actor-oriented perspective (Long, 2001), is the capacity of actors to process social experiences and devise ways of coping with life even under the most extreme conditions. The position this thesis takes (as stipulated in the actor perspective) is that farmers are active participants in agroforestry technology development, processing information and strategising in their dealings with other actors, other institutions and material challenges associated with land management.

What is technology?

> 'In order to talk meaningfully about techniques, it is first necessary to know what they are. Now there actually exists a science that deals with techniques…it is the science called technology' (Marcel Mauss, 1948, "Les techniques at la technologie, *Journal de psychologie* 41: 71-78," trans. J. R. Redding [Schlanger, 2006]).

The concept "technology" is derived from the word technique with origins in the Greek *technologia*. However, defining it is quite problematic, as different people with different interests view it differently. I will therefore give various definitions and later present the one which has been adapted for this study. Technology according to the definition in the Oxford Students English dictionary (p 652) is the scientific knowledge that is needed by a particular industry. This is rather a narrow perspective, and therefore I will present other definitions found in the literature. The Britannica Concise Encyclopaedia gives an elaborate definition which is:

> 'the application of knowledge to the practical aims of human life or to changing and manipulating the human environment. Technology includes the use of materials, tools, techniques, and sources of power to make life easier or more pleasant and work more productive. Whereas science is concerned with how and why things happen, technology focuses on making things happen. Technology began to influence human endeavour as soon as people began using tools. It accelerated with the industrial revolution and the substitution of machines for animal and human labour. Accelerated technological development has also had costs, in terms of air and water pollution and other undesirable environmental effects' (http://www.answers.com/topic/technology).

Technology, as implied in the definition above, is very important to humans. Technologies feed, clothe, provide shelter, transport, and entertain, among other things, but also have negative aspects which may lead to death. Whether good or bad, they are according to Mackenzie and Wajcmann (1999), interwoven in our everyday life, from simple tools to large technical systems. Defining technology is in itself very problematic and confusing (as argued above) and therefore I will attempt to look at it in terms of its ultimate goal, purpose or aim. Technology often serves a practical end, which is usually meeting 'human need.' Even this last phrase is rather confusing because, although until recently it was believed that the development of technology was restricted only to human beings, recent studies show that other primates (such as chimpanzees), have developed simple tools and learned to pass this knowledge to other generations (McGrew, 1992). Due to the learning component this can legitimately be termed non-human technological development. But for the purposes of this thesis, we will limit ourselves to humans. The aim of meeting 'human need' can be seen from two perspectives: i) the material technology of objects and process and ii) the non-material technology of efficient action. The latter view is less common and a more abstract formulation of the aim of technology. The material technology of objects and processes aims at relieving humans from physical work and to provide increased efficiency. The second view of the aim of technology shifts the focus of the activity toward the non-material character of the technology - efficiency. Artefacts, devices and processes are results of technological activity, but what needs to be stressed here is the internal dynamism in humans, which drives the quest for new and better objects. Better is used here in the sense of increased durability, reliability, speed, sensitivity and higher productivity (or better yields in the case of agricultural technologies). The non-material character of technology is according to Frey (1991) best expressed as the pursuit of effectiveness.

For the purposes of this thesis, I will not look at the broader concept of technology, which would have to be articulated in relation to science, economics, politics, and business etc. because various issues such as knowledge, values, ethics, practice and the nature of each activity have to be addressed. I will limit the scope of my discussion of technology by following Mitcham's (1978) simple definition of technology as the human making and using of material artefacts in all forms and aspects, the goal of which according to Frey (1991) is optimization. In a similar manner Richards (2007a) refers to technology as human instrumentality, which both involves the relationship between the user and the object in addition to the fact that it involves the application of mental and physical effort in order to achieve some value. The emphasis in this thesis is the relationship between the user and technology in its instrumental aspects, as stressed by Richards (*ibid.*). Such uses are best studied using a technographic approach, described in the methodological section of this chapter.

A review of theories of technology development

In this section I briefly present and discuss some theoretical approaches/perspectives on technology development. The aim is not to assess the merits and critical issues of these perspectives, nor to enrich such debates, but to provide a brief overview of current insights and approaches, as well as commenting on some contested issues and flawed aspects relevant to the explanation of technology as discussed in this thesis.

Diffusion of Innovations theory

Diffusion of innovations theory was formalised by Everett Rogers in a classic book, *Diffusion of Innovations* (Rogers, 1962). Diffusion theory is used to describe patterns of adoption, to explain mechanisms by which they occur and to assist in predicting whether a new innovation will be successful. Rogers categorizes the adopters of any new innovation or idea as early adopters, early majority, late majority and laggards. Each adopter's willingness and ability to innovate depends on her/his awareness, interest, evaluations, and trials. Roger's theory considers access to information about an innovation to be the key factor in determining adoption decisions. This school of thought assumes that the appropriateness of innovation is given, and thus reduces the problem of technology adoption to communication of information on a given technology to potential end-users. The theory places emphasis on extension contact, use of mass media, and the role of opinion leaders as a means of influencing adoption for new technologies. An example of work following this line of thought is Agrarwal (1983).

However, the theory has been criticised as being 'top-down' in orientation and thus flawed by its lack of attention to farm or firm-level variables in its 'packaging' (Roling, 1988). The model has also been associated with various problems of implementation, particularly concerning choice of contact farmers (Moore, 1984), poor research-extension linkages (Chapman, 1988), and weak linkages with farmers at field level (Dejene, 1989). It also assumes that all members of a social system are potential adopters and that it is desirable to accelerate the pace of adoption. It does not take into account the fact that diffusion and adoption may fail because the innovation was a bad idea to begin with, or that the technology did not fit the socio-economic context of all farmers. Tied to this is bias towards individualism. It suggests laggards or late adopters are responsible for the failure to adopt, not taking into account the fact that members of a social system have collective responsibilities. Equality gaps are another criticism of diffusion theory. This criticism suggests that social gaps caused by e.g. differences of income and education hinder diffusion and adoption, and are not accounted for in diffusion research (Rogers, 2003). Despite criticism, the diffusion of innovation theory has formed the basis for most adoption and diffusion research, and parts of the theory are still applicable despite the fact that it is a linear top-down model that ignores farmer innovations and the complexity of social contexts in which small holder farmers operate. Some concepts used in this thesis - such as adoption, innovation and diffusion - are adapted from this theory and are defined later in this chapter.

Technological determinism

Technological determinism places great emphasis on the technology itself. It postulates that technology matters, including not just to the material condition of our lives and our biological and physical environment, but also to the way we live together socially. That technology has such generative and transformative impact seems undisputable. Lives are transformed by the motor car, the telephone, mass media etc. But technological determinism goes further to purport that:

i) the development of technology itself follows a trajectory significantly independent of social, cultural or political influence

ii) technology in turn has effects on societies that are inherent, rather than socially conditioned.

As a simple cause-effect theory, technological determinism can be accused of being simplistic. If technology is a neutral exogenous factor developing autonomously, how is that possible? As part of the criticism of this theory, MacKenzie and Wajcman (1999) argue that if technology's physical and biological effects are complex, then it would be rather naive to expect its social effects to be any simpler. The view that technology just changes on its own accord, promotes a passive attitude towards technological change. It assumes that social actors - such as farmers, considered key actors in this thesis – have only one response (accept/reject), and play no role in actually shaping technologies. This aspect precisely makes technology determinism deficient as a theory of technology development and change because it does not take into account the fact that social actors play a vital role in shaping technological development, as will be discussed later in this thesis.

Neo-classical economic viewpoint on technology development

The neo-classical economic viewpoint on technology development – e.g. Hayami and Ruttan (1985) - considers technology to be an output rather than input. Technological change is induced by factors such as labour, land, capital and the operation of markets for innovations. This paradigm of technological change has been criticized for its economic determinism, i.e. it equates economic growth with development, rather than taking into account social processes such as power differentials and the divergent interests of different actors (Beckford, 1984) or the part played by culture (Hebinck and van der Ploeg, 1997) in influencing technological development.

Social Construction of Technology (SCOT)

SCOT is a response to technological determinism. Its proponents argue that technology does not determine human action; rather, human action shapes technology. And they stress that the way a technology is used cannot be understood without understanding how that technology is embedded in its social context. I will therefore briefly look at SCOT's origins and later discuss various aspects of its development.

This theory traces its origins to Pinch and Bijker's (1984) article, 'The Social Construction of Facts and Artifacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other.' This article was among many others that were presented at a workshop held at the University of Twente, Netherlands in July 1984 and later published in a book entitled *The Social Construction of Technological Systems* edited by Wiebe E. Bijker and Thomas P. Hughes and Trevor Pinch (Bijker et al. 1987). Among the collection of eight articles, Pinch and Bijkers's article remains the most influential, as all subsequent work by both proponents and critics of SCOT have taken it as a benchmark. Pinch and Bijker's article is based around a case study of the development of the bicycle, one of five artifacts examined in a paper that Bijker presented in a conference in 1982 (Bijker et al. 1982). Since then, the case study has been published in different forms, one of which is as part of a book entitled *Of Bicycles, Bakelites, and Bulbs* (Bijker, 1995).

I begin by summarising the basic concepts of SCOT as well as some recent criticisms of this approach. As originally presented by Pinch and Bijker (1984), this perspective according to Klein and Kleinman (2002) consists of four elements: interpretive flexibility, relevant social group, closure/stabilization and the wider context. Interpretive flexibility suggests that technology design is an open process producing different outcomes depending on the social circumstances of development. What this means is that technology design is flexible enough to allow for other possible designs, so whatever finally results from the process, it may be very different from the original concept. The second component of SCOT is the relevant social group. SCOT analyses artifacts in the context of society. So the particular way in which society is conceptualised and linked to artifacts is through relevant social groups. According to Pinch and Bijker (1984), all members of a certain social group share the same set of social meanings, attached to a specific artifact. They are the agents whose actions manifest the meanings they impart to artifacts. So basically according to SCOT, technology development is a process in which multiple groups, each having a specific interpretation of an artifact, negotiate over its design, with different social groups seeing and constructing different objects. The key point is that such groups share meanings in relation to the artifact, which can be used to explain particular development paths. Once a certain social group comes to a consensus that their common artifact works, design ceases (Bijker, 1995). It is important to note that the meanings associated with technology may be favourable or unfavourable. The third component is closure and stabilization. Over time as technologies are developed, controversies may arise when different interpretations lead to conflicting images of the artifact, and design activity will continue, to address such conflicts until such a time as they are resolved and the artifact no longer poses a problem to the relevant social group. This is when the process achieves closure, no further design modifications occur and the technology stabilizes in its final form.

Fourth is the wider socio-cultural and political context in which technological development takes place. This is perhaps a major downside to this theory, as the interaction between various social groups is not addressed, such as their relations to each other, how these relations might influence technology development, and how issues of power distribution among and between groups might influence technology development. This is where I found this theory inadequate, and therefore inapplicable to the explanation of agroforestry technology development in western Kenya, which is the focus of this thesis. As will be shown, agroforestry involves a great deal of power play between groups and vested interests, including the vested interests of farmers and researchers. Some critics of SCOT have focused their fire on this inadequacy at the level of the micro-politics of power. SCOT implies the view that society is composed of groups. Winner (1993) critiques this as a pluralist view of society. Russell (1986) is concerned with the fact that SCOT is inadequate in terms of social structure, since it concentrates only on groups and not the wider context. Far beyond identification and description of groups, technological analysis (he argues) needs to be located in a structured context. That is, we need to map out not only the relation of groups to the technology but to consider also group relations to other sectors of society and the more specific events leading groups to "their" technology. According to Klein and Kleinman (2002), SCOT assumes that groups are equal and that all relevant social groups are present in the design process. This fails therefore to address issues of power between groups. William and Edge (1996) indicate that some social groups may even be prevented from participating in the design process, and some groups according to Russell (1986) may not be groups at all but a collection of subgroups claiming to represent a certain social group. So SCOT overlooks power differences, rooted in structural features of society. Here, the view taken is that technological development and change is part of the wider struggle for recognition, resources and influence that is a manifest part of all rural development in Africa.

Actor-Network Theory
Actor-network theory, often abbreviated as ANT, is a sociological theory developed at the Centre de Sociologie de l'Ilnnovation (CSI) of the Ecole Nationale Supérieure des Mines de Paris in the early 1980s by Michel Callon and Bruno Latour and a visiting scholar, John Law. Latour, Callon and Law criticise the SCOT approach because of the fact that it explains technology development and change with reference to the prior way social groups are constituted. Theory would take a different route if it was considered that technology forms part of the manner in which societies and groups are constituted. ANT tries to meet this challenge. It postulates that an actor network contains not merely people, but objects and organizations that are interlinked to form a network. These are collectively referred to as actors. ANT postulates that any actor, whether person, object, or organization is equally important to a social network. And this order breaks down when certain actors are removed. For example, the malfunctioning of traffic lights can bring about unexpected jams on the road (i.e. lack of order). So the actor network consists of and links together both technical and non-technical elements, hence ANT talks about the heterogeneous nature of actor networks. Latour and Callon call subjects and objects actants. According to Latour (1988), an actant may be a tool or machine – e.g. an automatic can opener. Several case studies are given to demonstrate the theory at work, e.g. scallops off the coast of Brittany (Callon, 1986), or the development of a British advanced fighter aircraft in the early 1960s (Law and Callon, 1992). In networks of humans, machines, animals and matter in general, humans are not the only beings with agency, and not the only ones to act; objects matter because objects also act. This is the most controversial aspect of ANT since to many critics it appears that machine actions are totally derivative of human agency. ANT also appears to imply that all actors are equal within the network, and therefore it neglects pre-existing structures of power responsible for configuring the network, and instead claims to see structure as emerging from the actions of actors within the network. The position taken by this thesis – following (Long, 2001) - is that agency is a term only properly applicable to humans, and that human and machine actors cannot be easily equated. It is the human capacity to process social experience which in turn makes them respond with technological choices best fitting their perceived circumstances.

The focus of the study

As mentioned in the introductory section, the present study's main objective is an attempt to explore and describe (technographically) how a community-based participatory approach devised by the agroforestry pogramme functions, by examining learning, adoption/adaptation, dissemination and diffusion processes associated with agroforestry technologies for soil fertility management, while seeking also to understand the broader social dynamics of various groups and classes of actors.

Specific Objectives

The specific objectives are to:

1. Study the social dynamics of various actors, and the interfaces between them, at various institutional levels (village committees, farmer groups, etc).
2. Explore the processes of participatory learning, adoption/adaptation and diffusion associated with introduction and spread of agroforestry technologies.
3. Assess pathways of technology dissemination among farmers.

4. Identify constraints hindering agroforestry adoption and recommend appropriate measures to achieve high adoption rates.
5. Identify and recommend ways to improve community-based participatory approaches, to encompass full participation of all stakeholders.

Methodological Approach

In order to understand the ways in which farmers in western Kenya have been involved in agroforestry via the village committee approach and to unravel the underlying mechanisms that bring about various outcomes such as adoption, adaptation and rejection, a methodological approach that maps out various actors and technologies and analyses the interactions was needed. Such an approach is technography, as described in the following section.

What is a technographic approach?

The central element of a technographic approach (Sigaut 1994; Richards, 2001) is for the researcher to be able to see beyond the technology itself to problems technological applications are supposed to solve and to understand the underlying mechanisms involved. The word 'technography' is therefore used to describe the basic field within which technological interventions take place. It aims at understanding the interactions between various components of socio-technical systems. In technographic analysis, various elements that make up a socio-technical system must be identified and explanations made of the interactions among these components. Questions that one needs to ask in a technographic approach are for instance:

- What are the main components of the socio-technical system or process?
- What are the boundaries of the system or process?
- How are the components related?
- How does the system or process perform?
- How is the system or process changing?

In seeking to answer these questions technography requires to establish an analytical framework and methods, combining both qualitative and quantitative methods of data collection. One such framework – adopted below - is the realist evaluation framework using the context-mechanism-outcome configuration [CMOC] (Pawson and Tilley, 1997), to explore, describe and relate contextual variables and the various mechanisms and outcomes involved in Kenyan agroforestry.

Realism

Realism is an old philosophical doctrine (a belief that entities exist, as opposed to the doctrine that all we can know of the world is names – nominalism). While it can be argued that the entire edifice of modern science presupposes realism, the epistemological revival of realism linked to methodology for the social sciences in particular can be traced to the works of Bhasker (1975) and Harré (1972). It is a philosophical belief that purports that there is a world existing independently of our knowledge of it (Sayer, 1992). We come to discover more and more of the entities of which the world is composed through the constructs around which scientific theory is built. According to Blackburn (2005), realism purports that whatever we believe now is only an approximation of reality and that every observation brings us closer to understanding reality. Sayer (1992) further expounds that a realist views the world as differentiated and stratified, consisting not only of events, but also of objects and structures which are capable of causal relationships. In order to understand, read and interpret what these objects and structures mean, a realist has to dig deeper into the hidden layers of social reality, in order to identify causal mechanisms. Although such mechanisms are interpreted from the researcher's own frames of meaning, reality exits regardless of any researcher's interpretation.

Realist evaluation

As mentioned above, realism's key features stress the understanding of underlying mechanisms by using an explanatory strategy. Realism seeks to address the real and to uncover mechanisms which can be used to explain a 'world' out there. So a realist evaluation (Pawson and Tilley, 1997) is an analytical framework seeking to evaluate how social programmes and interventions work through applying a CMOC frame. Social programmes/interventions are real in several ways; they deal with real events. Real problems such as low soil fertility which occur in real conditions, where they produce real effects by activating real causal mechanisms. Yet social programmes are also products of the human imagination and are often about social betterment. They are often initiated to improve the status quo, e.g. in the case of the agroforestry programme, they seek to involve farmers in improving soil fertility on their farms through the use of agroforestry technologies. So programmes are shaped by a vision of change and they succeed or fail according to the initial vision of betterment. In order to find out the performance of a programme/intervention, the underlying programme theories have to be tested through a realist evaluation. The realist evaluation framework does not make generalisations in its evaluations i.e. a programme has failed or succeeded; it instead acknowledges that interventions never work indefinitely in the same way and in all circumstances, or for all people. In this respect, the CMOC framework captures the ways in which programme outcomes may vary depending on the context or mechanism. So the basic questions often asked in a realist evaluation are "what works for whom in what circumstances and in what respects, and how?" And this is better understood by identifying various mechanisms, outcomes and the contexts under which various interventions/programmes operate.

Context

In a realist evaluation framework, the context within which a mechanism functions is crucial. Mechanisms will often be active only under particular circumstances, and these vary in different contexts. Therefore contexts describe the conditions in which programmes/interventions are introduced and are relevant to the operation of the programme mechanisms. Realism utilises contextual thinking to address the issues of for whom, in what circumstances a programme/intervention will work. For instance, for the case of soil fertility enhancing trees, it is important to specify in what circumstances these shrubs/trees may work and for whom, via activation of which presumed mechanisms. In the case of the village committee approach, one may ask the question "in what context does this approach work/not work?" It is important to note that context is not in any way limited to locality, it may relate to systems of interpersonal and social relationships, to the technology, to access to markets etc. For instance, working in a context where there is a market for seed for soil fertility enhancing shrubs/trees, introduction may trigger hitherto hidden mechanisms, which may lead to farmers planting more soil fertility enhancing shrubs, thus enhancing adoption levels. But if the shrubs are introduced in a context where there is no market for tree seed, and thus different mechanisms triggered, then the outcome may totally be different (See chapter 6).

Mechanisms

Mechanisms describe what it is about programmes/interventions that bring about effects. Mechanisms are often hidden and cryptic, and therefore one has to dig deeper to bring them out. Sometimes a mechanism can be observed directly, but in most instances key aspects may not be so obvious to the researcher unless he/she penetrates beneath the surface to dig them out. For instance, this thesis is about soil fertility enhancing shrubs/trees and farmers' participation, but there is more to it than meets the eye, hence the title, 'Seeing beyond fertiliser trees.' Various mechanisms concerning how decisions are made, rural power relations, deep-seated conflicts etc. may be involved, and can only be unearthed through careful examination of well-guarded process variables. This is the reason why a realist evaluation does not ask the question of whether an intervention/programme works, but rather how it works under what circumstances and for whom. This is the pivot around which a realist research revolves. So mechanisms refer to the ways in which various components of an intervention may bring about change; they trace the destiny of a programme theory and pinpoint ways in which the resources on offer may bring about various outcomes.

Outcome patterns

Programmes/interventions are often initiated in existing social systems thought to have certain problems or limitations. These initiatives are undertaken to improve social functioning. But how do we tell whether this has been achieved? This is best analysed by looking at intended and unintended outcomes (in this thesis, these outcomes could be for instance adoption, adaptation, rejection, non-adoption etc. of various agroforestry technologies) that come about as a result of various mechanisms being engaged in different contexts. Because programmes are often introduced in multiple contexts, then we expect that the outcomes mentioned above will vary depending on contexts and mechanisms. A realist evaluation therefore tries to understand what the outcomes of an initiative are and how they are produced. For instance, if we find in this study that many farmers are not planting soil fertility enhancing shrubs/trees, then the context and the mechanisms under which this outcome prevails have to be spelled out in context-mechanism-outcome configurations (Chapter 9). By so doing, we achieve the ultimate goal of a realist evaluation, to inform the thinking of policy makers and development practitioners.

Organizational framework of the study

The central issues explored in this study (to understand underlying mechanisms and the links between mechanisms and outcomes of technological processes) are learning, adoption/adaptation and diffusion. These may be influenced by several factors, as outlined in Figure 1.1.

Learning

Learning is a key process in technology development and dissemination. Learning can be through the initiatives of the programme, e.g. participatory learning, through farmers' own experience or even as a result of interaction with other farmers. Learning is integral to everyday life. It is this kind of learning - as distinct from classroom learning - that this study addresses; i.e. adult learning. In understanding the learning process, who, what, how, why and from whom are key questions addressed (Chapter 4).

Technology adoption/adaptation/diffusion

If and when learning occurs, one of the outcomes is adoption/adaptation, or even non adoption of agroforestry technologies, which in turn may/may not influence diffusion, as outlined in Figure 1.1 (note the dotted arrow). Learning may occur but without being translated into actual practice. According to diffusion of innovation theory (Rogers 2003), adoption of a technology can be described as a mental process, known as the innovation-decision process. This is whereby farmers go through a stage of being aware of or becoming knowledgeable about a new technology, form a positive or negative attitude towards it, and ultimately decide whether to adopt, re-invent/ or reject. This process can be influenced by several factors, as identified by several authors such Feder et al. (1985), Weir and Knight (2000), Lapar and Panday (1999), and Rahm and Huffman (1984), influencing the adoption of agricultural innovations. The factors include: a) household/individual factors such as age, wealth, status, education, gender, etc., resource base and outside contacts, b) community factors such as access to extension, education, market, c) external level institutional factors such as training, the nature of the technology, provision of support services, d) factors associated with the operation of local level institutions (Figure 1.1). It was argued above not that diffusion theory was wrong, but that it covered only part of the story (how farmers learn about ideas). While attention will be paid in this thesis to whether or not the ideas associated with agroforestry are effective, learning is an important issue once it can be shown they are. In effect, this is the point at which the CMOC approach becomes relevant. How does learning occur, for whom, why and under what circumstances.

Research strategy

In using a technographic approach, the study first identifies various actors (farmers, groups, officials of various groups, villages elders etc.) and analyses their social organisational dynamics, and the interfaces between actors at the local institutional level (village committees and farmer groups) [see Figure 1.1]. The formation and functioning of village committees and farmers groups is described in detail (Chapter 3). Who participates and doesn't participate is manifested at this level. This is where underlying mechanisms of power relations, agency, social capital, conflicts and negotiations have to be sought, as multiple actors mobilise social relations and deploy discursive and other means for the attainment of specific ends, including that of perhaps simply remaining in the game, as will be shown in chapter 6. In the process of interaction, not every actor has equal influence; some may be more powerful than others and this may reflect long-term and basic power struggles over resources. Long (2001) argues that such struggles are founded upon the extent to which specific actors perceive themselves as capable of manoeuvring within particular situations and developing effective strategies for doing so. Creating room for manoeuvre implies a degree of consent, negotiation and thus a degree of power, as manifested in the possibility of exerting some control, prerogative, authority and capacity for action.

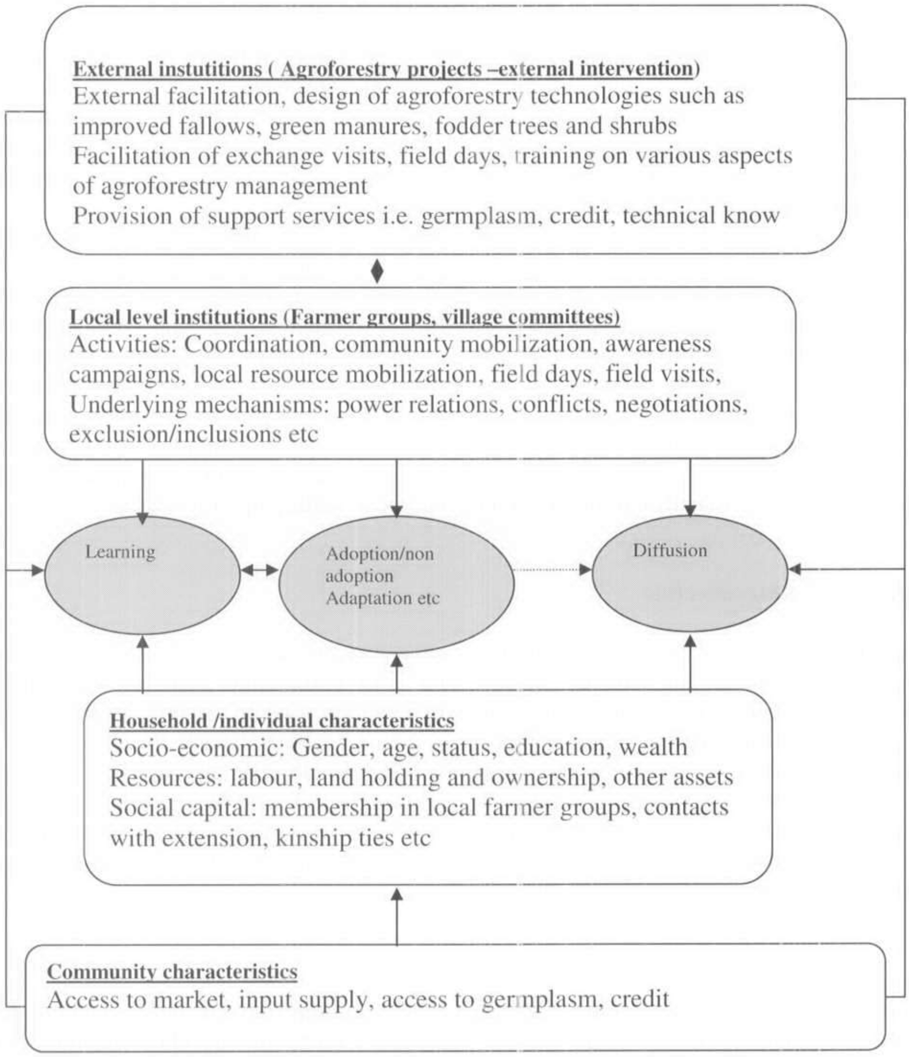

Figure 1.1. Organisational framework of the study

Then, as is readily apparent, power tends to generate resistance, accommodation and strategic compliance as regular components of everyday life. The issue of power also is basic to understanding patterns of exclusion of some classes of social actors from participation, as will be discussed in chapters 3 and 4. What actually takes place at this level has implications for mechanisms of learning and adoption of agroforestry technologies, as will be discussed in chapters 5, 6, and 7.

Secondly, the study assesses the impact of the village committee approach on learning and adoption/adaptation of agroforestry principles and practices (Figure 1.1 and presented in chapters 5, 6, 7). What mechanisms influence outcomes in this context? The outcome of the village committee approach was considered to have two components: a) a technology component (for which case will outcomes be apparent in terms of changed farmer practices, e.g. more farmers practicing agroforestry, and b) a learning component – (what new knowledge sets are formed) which may be there, but is more difficult to measure. Actually, there may be extensive learning (learning mechanisms may have been triggered), but it may not be visible as outcomes because the technologies were simply unsuitable and were rejected. This is the more reason why I had to use various methods of data collection (as discussed in the next section) in order to dig deeper so as to bring out the operation of mechanisms not immediately apparent in material outcomes.

Third, the study looked at the diffusion process and the implications for research and development. This is presented in chapters 5 and 8. The village committee approach is based on the assumption that it has a rippling/multiplier effect and therefore technologies and the learning process are presumably believed to diffuse to other farmers and communities from the initial groups of participating farmers. How and what diffuses is not clearly understood. It is not clear whether the diffusion of the technology/practices go hand in hand with the diffusion of principles underlying the practices, or only the practices/technologies diffuse. This study therefore aims (consistent with its technographic orientation) to document what has actually transpired. Without fully understanding actual events and processes at the intervention level, it is difficult or hazardous to propose scaling up of the same.

Methods of data collection

To understand the various processes outlined in the previous section, more than one method is needed. Close interaction with the farmers and other participants involved was important. This study therefore drew upon the qualitative methods used by ethnographers. But some issues to do with learning and adoption require to be assessed from the perspective of a sampling approach, so it was also necessary to use the quantitative approach to social science. Attention has been paid to the integration of quantitative and qualitative approaches. Multiple sources of data were used, including formal and informal surveys involving structured/semi-structured/unstructured interviews with farmers, in-depth interviews with key informants, case studies, participant observation and secondary data sources.

Case studies

Case studies were used to explore analytical issues needing in-depth understanding. A case study, according to Yin (1984), is used to investigate a contemporary phenomenon within its real-life context. The distinctive feature of this approach is that it tends to involve small samples, more depth in e.g. interviews, and a selective and strategic approach to data collection in order to understand certain phenomena in their social context. As a case study is in essence an in-depth look at one individual or social unit, such as an organisation, community or a group, I found the approach useful when I needed to understand issues that came up in formal surveys, in such cases; in-depth probing and empathetic understanding tend to be essential. Many a times I selected individual farmers, farmer groups, village committees in-order to understand the social processes taking place. As for the individual cases, selection depended purely on the issues that arose during formal surveys, when I thought that follow-up with individual farmers would provide some important additional insights. The method of inquiry during the case studies was usually informal interviewing using open ended unstructured questions guided either by my own line of inquiry or by issues raised by farmers.

Participant observation

This is a special type of observation in which the researcher is not merely a passive observer but may take a variety of roles within a study situation and may actively participate in the events being studied (Yin, 1984). This method was used in the course of the study to understand the behavior of individual actors, attitudes and their level of participation in various activities. Events where I used this approach included funerals and participatory learning forums, where in the process of participating I would observe events not normally observable in everyday encounters.

Formal surveys using structured questionnaires

Formal surveys have often been criticised for not being able to capture respondent's perceptions, because questions are designed by researchers and therefore responses are to a large extent influenced by the researcher's perspective rather that of the respondent (Kiptot, 2007). Nonetheless, they may be used to serve other purposes. Formal surveys using a structured questionnaire were purposively used in this study to gain a general understanding of patterns of adoption of various agroforestry-based soil fertility technologies over the years. Surveys were also used to identify particular issues of interest that were later followed up during in-depth analysis using other methods such as case studies and semi-structured interviews with key informants. Right from the beginning, I had in mind these potential shortcomings and therefore turned to qualitative methods to provide explanations of some of the patterns identified during the formal surveys. Whenever a formal survey was undertaken, a simple random sampling technique (see details in the sampling section) was used to select farmers for interviewing, except in one case where a snowball sampling technique was used to build a selection of second generation farmers. The random sampling was aimed at minimising biases in the sample selection.

Informal surveys involving key informants

Most of the informal surveys with key informants were unstructured; there was no laid down format in relation to the sequence in which questions were asked. Key informants are defined by Kumar (1987) as individuals who are likely to provide detailed information, ideas, and insights on a particular topic. The key informants interviewed were agroforestry programme officials, extension officers from the Ministry of Agriculture, village elders, assistant chiefs, officials of farmer groups and individual farmers. The individual farmers were in most cases identified on the basis of particular issues that had arisen in the formal surveys and therefore needed more in-depth understanding. Although the discussion often began with an introduction to the particular issue needing clarification or more understanding, I allowed informants to take the discussion in directions that interested them. In most cases, they often brought up new insights to form the basis for further inquiry in regard to the particular situation under study. The other advantage of giving key informants a free hand in directing the discussion was that it allowed natural conversation, which as a matter of fact made the informants feel so at ease that they could talk about issues without having to withhold anything. I often brought up such conversations as they worked on their farms, and in cases where some of them had to attend to certain engagements before the end of the discussion, I would stop and follow up discussions on a later date. During subsequent visits, issues discussed previously were often taken as points of departure.

Secondary Data

The study took advantage of the long history of agroforestry research in western Kenya which spans 20 years. I was therefore able to use information from project records kept by ICRAF and KEFRI and many studies that have been done over the years within the region. Nonetheless, some sources of information could not be traced and in such situation I had to use recall data from informants. This was in some cases problematic because not all informants recall the details of activities they had undertaken many years ago.

Unit for analysis

The study focuses on individual farmers and groups. Individual farmers in this study all belonged to a household, which in this case also included the field belonging to the farmer. A household in western Kenya refers to a production/consumption group composed of kin, i.e. it is a family group whose members farm and eat together. Various households make up a village. Kenya is administratively divided into eight provinces, each headed by a Provincial Commissioner (PC). The provinces are further subdivided into districts; currently there are 72, each headed by a District Commissioner (DC). The districts are further subdivided into divisions, headed by a District Officer (DO). These are further subdivided to form locations, headed by chiefs[2] and sub-locations, the smallest government administrative unit, headed by assistant chiefs. It is important to note that the heads of each level of administrative units are civil servants appointed by the government and paid a salary. They are not elected by land-owning family groups or electoral colleges as in some parts of West Africa. The sub-locations are further sub-divided to form villages headed by a village headman/elder. The village elders work on a voluntary basis and are appointed by villagers in consultation with the assistant chiefs. Villages comprise various households; in Vihiga and Siaya households per village (villages sampled in this study) range from 39 to 379 units (own survey).

Sampling

Here a basic outline is offered, but details of the sampling procedure are provided in the respective chapters of the thesis. Before the sampling, there was a preparatory phase of two months that involved a reconnaissance survey, selection and training of research assistants, preparation and pre-testing of the questionnaires. The reconnaissance survey was done in order to get a general view about the pilot[3] and non-pilot villages, and identify keys issues for the formulation of the questionnaires, which involved talking to some key informants about agroforestry in general.

The first formal survey forming part of the results presented in chapters 4, 5, 6 and 7 involved a random selection of first generation farmers in the two districts. This sampling targeted farmers in 8 pilot villages who had interacted with development projects under study, had received seed of improved tree fallows and also had been trained on various aspects of agroforestry. The 8 villages selected for this study were among 17 pilot villages (six in Siaya and eleven in Vihiga district) that were initially selected by the agroforestry programme for

[2] Chiefs are appointed by the government and work under the office of the President, and should not be confused with hereditary chiefs in the pre-colonial era, or those found in some parts of West Africa (e.g. southern Nigeria) who hold a title but without executive functions.

[3] Pilot sites refer to those villages where the agroforestry programme initially engaged with farmers to test agroforestry technologies for soil fertility management while non-pilot sites refer to villages where the agroforestry programme has not had any contact with farmers.

wide scale dissemination of agroforestry technologies using the village committee approach. The initial selection of the 17 villages was based on a categorization study that had been done by Carter (1995) which identified various village clusters based on land use and farming system intensity, demography, and environmental factors such as slope, elevation and edaphic factors. This stratification complemented with ethnicity distribution. So in each cluster, 2 to six villages were included resulting in the initial sample of 17 villages. A detailed description of how the 17 villages were selected is provided by Niang et al. (1998a). As for the 8 villages sampled for this study, selection was stratified by district with four villages selected randomly from each district from an initial list of six villages in Siaya and 11 from Vihiga. In order to select farmers for interviewing, village elders and some farmers involved right from the inception of the agroforestry programme were consulted to help in drawing up a list of farmers from the 8 villages. Because there were no project records and some village elders involved at the outset have since died or are too old to remember, and because most of the agroforestry staff and extension officers involved at the outset have been transferred, it was indeed a big challenge to identify farmers and it also offers a clear lesson about why it is hard to evaluate projects in such a context. An easier alternative might have been to call a village meeting and request farmers who had received seed and also been trained to identify themselves. But after consultation, it was found this would not be appropriate, as most farmers who were given seed never planted it, as will be shown in Chapter 5. Some who did have since abandoned the technologies, and they would therefore not feel comfortable identifying themselves in public. A list for each village was eventually drawn up which included a total of 149 households from Vihiga and 152 from Siaya. To ensure representativeness (some villages had fewer households), the sampling was done on a village basis where 40% of households were picked, resulting in a total of 120. Farmers from these households were later interviewed in order to understand the processes of learning, adoption/adaptation, dissemination and diffusion of agroforestry technologies.

A second formal survey was undertaken to understand more about learning, dissemination and adoption /adaptation of agroforestry practices by 2nd generation farmers (defined here as farmers with no prior contact with development projects but received seed and information on agroforestry from participating farmers refereed to in this thesis as first generation farmers). A snowball method of sampling was used. Snowball sampling in this case entailed asking the 1st generation farmers to give names of farmers to whom they had given seeds of agroforestry species. A list of farmers who had at one time or the other received seed from 1st generation farmers was then constructed, and follow-up was made to study dissemination pathways. Details are presented in Chapter 5.

A third formal survey was undertaken among farmer groups who had some members interact directly with the agroforestry programme. The purpose of this survey was to find out whether the trained farmers disseminated information on agroforestry technologies to other farmers within their groups. This is because the village committee approach works on the assumption that farmers who are trained will disseminate information to other farmers. This survey therefore sought to find out whether this actually takes place. Here the case study approach was also used to understand the social dynamics of farmer groups and village committees. Details of the sampling procedure are discussed in Chapter 3. A final formal survey was undertaken among a random sample of 103 farmers within 4 villages in the two districts neighbouring the pilot villages that have not had any contact at all with the agroforestry programme. The purpose was to find out the diffusion process of the technologies within the non-pilot villages. Details of the sampling protocols and sample sizes are discussed in Chapter 8.

Data analysis and presentation

The quantitative data were analysed using SPSS (Statistical Package for the Social Sciences) and simple descriptive statistics such as frequencies and means are used to interpret results. A logit regression model is used in three cases to determine factors likely to influence i) seed sharing ii) knowledge sharing iii) adoption of improved tree fallows and biomass transfer technologies in the study region. As for the qualitative data from case studies etc, these are presented descriptively in a narrative form, with in some cases inclusion of excerpts from various conversations with farmers.

Description of study site

This thesis is based on a study carried out in two districts of western Kenya, Siaya and Vihiga (Figure 1.2). They fall within the densely populated, high potential zone of the western Kenyan highlands. Vihiga district covers an area of 563 km^2 and borders Kakamega on the North, Nandi on the East, Kisumu on the South and Siaya on the West (Figure 1.2). The district is further subdivided into six administrative divisions, 27 locations and 115 sub-locations. The six administrative divisions are: Luanda, Emuhaya, Vihiga, Sabatia, Tiriki East and Tiriki West (Figure 1.3). This study was carried out in Luanda and Emuhaya divisions. In 1999, the estimated population of Vihiga district was 498,883 persons (Republic of Kenya, 2001a). Population growth rates are high despite widespread incidence of HIV/AIDS. Currently population density stands at over 1000 persons/km^2 (the district has one of the highest population densities in the country).

Siaya district, on the other hand, covers an area of 1,520 km^2 (almost 3 times larger than neighbouring Vihiga district). It has an estimated population of 480,184 persons (Republic of Kenya, 2001a). Population growth rates are also high, and densities increased from 253 persons /km^2 in 1989 to 316 in 1999. This is less than half the population density of Vihiga district. Siaya district has had the highest prevalence rates for HIV related mortality in the country, and this has had an impact on the adoption of labour intensive agroforestry technologies. Siaya district borders Busia on the North, Bondo on the South, Vihiga to the East (the West is covered by Lake Victoria, Figure 1.2). There are seven administrative divisions, namely Ukwala, Boro, Karemo, Ugunja, Uranga, Wagai and Yala (Figure 1.4). This study was carried out in Yala division, Yala Township sub-location (Figure 1.4).

Due to high population pressure, diminishing land holdings and the absence of local employment opportunities, western Kenya has according to David (1997) been a major exporter of labour. As a consequence, this has implications on the adoption of labour intensive agroforestry technologies. Farming in both districts is largely undertaken by smallholders, practicing a mix of food and cash crop production. The main food crops grown are maize, beans, sorghum, finger millet, sweet potatoes, cassava, indigenous vegetables, groundnuts, cowpeas. Cash crops in Vihiga are mainly coffee and tea while in Siaya it is mainly sugarcane. The two districts are close to the equator at altitudes ranging from 1400 to 1700 m above sea level. Rainfall is bimodal, ranging between 1300-1800 mm per annum. Although the selection of the two sites was by virtue of the fact that they have had a long history of agroforestry oriented soil fertility research, via the agroforestry programme in Maseno, they offer useful comparison because farm sizes vary greatly due to varying population densities. Vihiga is more densely populated than Siaya. As a result, Vihiga has been shown by Crowley and Carter (2000) to be characterised by very small farm sizes (less than 0.5 ha), livestock is tethered or stall fed, and most households rely on off-farm income, unlike in Siaya where farm sizes average 1 ha, livestock is free ranging, and farmers rely on on-farm subsistence crop farming, small scale businesses, and some livestock production, as well as fishing, for those villages neighbouring Lake Victoria. These contrasting settings have had an impact on the adoption of agroforestry technologies, as will be shown in chapters 5, 6 and 7. Farmers in both districts have relatively secure land tenure. There are two ethnic groups in the two districts, with the *Luyhia* occupying Vihiga and the *Luo* occupying Siaya. The *Luyhia* language is classified with the Bantu family while *Luo* is a Nilotic language. Both societies are patrilineal. Following convention throughout rural Africa the male head (if present) is in charge of most household decisions. Among the *Luo*, polygamy is common but declining, whereas the *Luyhia* form simple nuclear families.

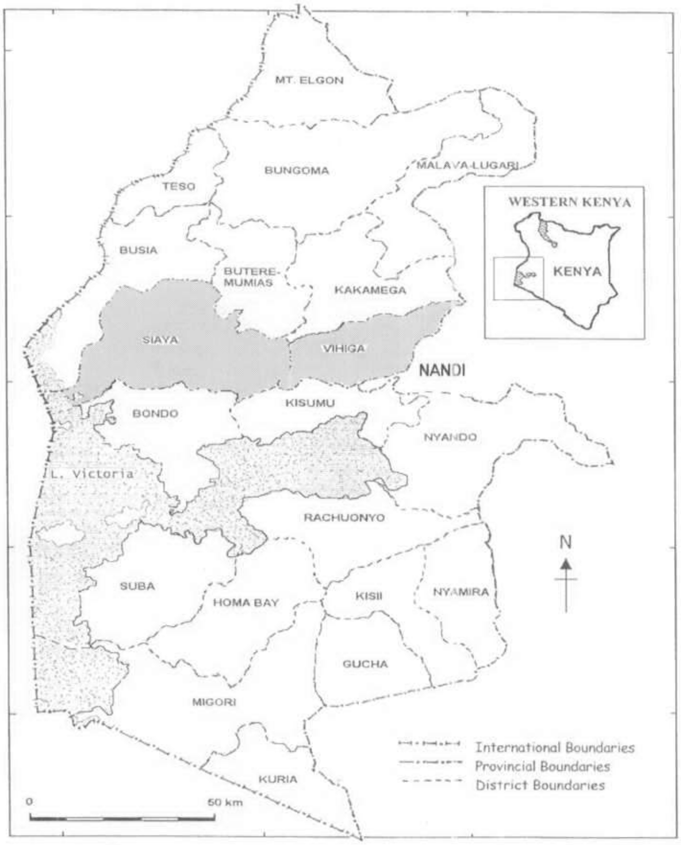

Figure1.2. Location of Siaya and Vihiga districts (shaded) in western Kenya

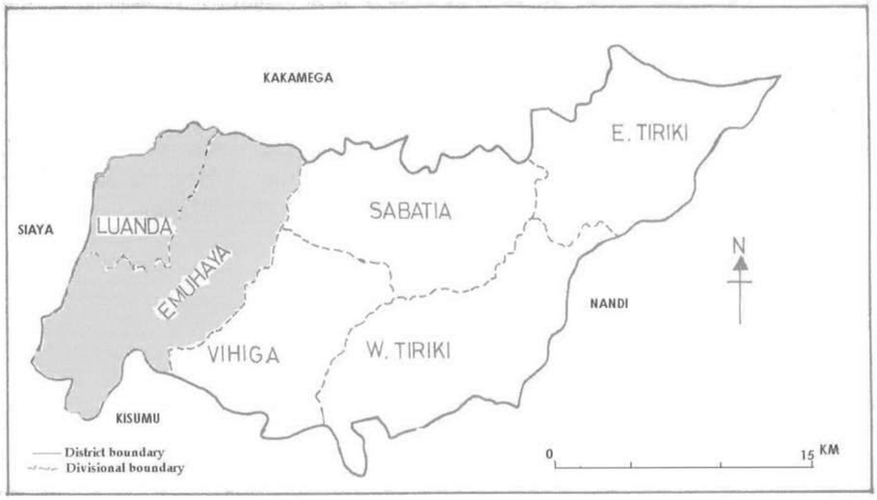

Figure 1.3. Map of Vihiga district showing study area (shaded).

Figure 1.4. Map of Siaya district showing study area (shaded).

Definition of key concepts as used in the thesis

Participation (in rural development) is defined as a process through which beneficiaries acquire influence and exercise some significant degree of control over initiatives, decisions and resources directly affecting them.

Community - Here the term is used very generally to refer to individuals and social groups who collectively make up the social groupings in a locality. Use of the term is not intended necessarily to imply a sense of social cohesion or identity between those different individuals and groups, although this may exist. While boundaries are blurred, 'community' is generally used to refer to individuals or social groups outside the formal structures of government.

Community-based participatory approaches- This is an approach to participatory development whereby people and organisations affected by, or having an interest in a problem or development opportunity, take responsibility for it and participate in decision-making and action. The degree of participation may vary greatly, from simply consultation to having full control over decision making.

Institutions- Here the concept is used in a wider sense to refer to norms, shared expectations and patterns of behaviour that underpin the way a society functions. But at times I also use the term (qualified in places by the word "external") to apply more narrowly to an organization, especially one with legal recognition. *External institution* in this case refers to formal organisations such as KEFRI, KARI and ICRAF involved in technology development in collaboration with farmers. *Local level institution* refers to village committees and local groups involved in agroforestry.

Power is defined (simply) as the capacity of an individual or institution to impose her/his/its will upon others.

Adoption (of technological innovation) is a decision making process, whereby an individual decides to use a certain technology.

Adaptation is the modification of a certain technology.

Intervention is an idea, practice or object that is introduced either from within (endogenous) or outside (exogenous) the system with the purpose of bringing about change.

Innovation is an idea, practice or object that is perceived as new by relevant parties.

Diffusion is a process through which a new idea, practice or innovation spreads spontaneously through certain channels over time among members of a society or community.

Dissemination is the act of spreading/sharing information on technologies through various means.

First generation farmers are trained individuals working directly with development projects on improved agroforestry practices, who have at one time received seeds of agroforestry species.

Second generation farmers are individuals who have not had any direct contact with agroforestry development projects but who received information about agroforestry and seed of agroforestry species from first generation farmers.

Organisation of the thesis

This thesis is arranged in 9 chapters. Chapters 1 and 2 provide background information and literature review of key themes addressed in this study. Chapters 3 to 8 all revolve around agroforestry-based soil fertility replenishing technologies and farmers' participation in their dissemination in western Kenya. They are presented as independent articles. Some have been published in refereed journals; others have been submitted for publication and are under review, while others are to be submitted.

Chapter 1 has introduced the theme of the study, history, definition and development of agroforestry in Kenya. A background description of the agroforestry programme in Maseno sets the tone for this thesis, as it gives a general view of how agroforestry technology development was/is undertaken in western Kenya. This has been followed by a brief overview of theories of technology development. Thereafter, the objectives of the study, a description of the technographic approach and a realist evaluation framework of context-mechanism-outcomes configuration, methods of data collection and description of study site and definition of key concepts used in this thesis have been presented. Chapter 2 gives an overview of the evolution of agricultural and forestry extension models. The evolution of various models, such as ToT to relevant current participatory approaches are discussed in detail. Agroforestry is interdisciplinary in nature, and therefore cuts across two core ministries; Ministry of Environment and Natural Resources and Ministry of Agriculture, and therefore it is important that readers are put in the picture of how agroforestry extension has been/is carried out in the country.

Chapter 3 looks at the mechanisms involved when various actors in village committees and farmer groups interact as they participate in agroforestry. The social dynamics are discussed in detail. Chapter 4 presents an assessment of participatory learning of integrated soil fertility management among farmers. Learning is assessed in detail using a guiding framework based on who, what, how, why and from whom. Chapter 5 looks at how farmers share seed and knowledge of agroforestry practices. Limitations are identified and various recommendations given. Chapters 6 and 7 look at the adoption dynamics of improved tree fallows and biomass transfer technologies by farmers in western Kenya respectively. A detailed account of the social processes taking place over a span of eight years is presented. Chapter 8 looks at the diffusion of agroforestry technologies beyond the pilot villages, while the last chapter (ch. 9) offers a general discussion and conclusions.

Chapter 2

Evolution of agriculture and forestry extension models based on participation

CHAPTER 2

Evolution of agriculture and forestry extension models based on participation

Abstract

Agroforestry as practiced in Kenya cuts across various disciplines and extension activities are carried out mainly by two ministries, i.e. Ministry of Environment and Natural Resources and the Ministry of Agriculture. This chapter gives an overview of the evolution of agriculture and forestry extension in Kenya in these two ministries. A detailed account is given of how extension has evolved over the years to meet the changing needs of clients and to become more effective in response to economic and development policies imposed by the international donor community. The evolution of extension approaches from the linear transfer of technology (ToT) model to the holistic approach, with emphasis on integrated rural development and farming systems approach, followed by the Training and Visit approach to the current participatory approaches of the 1990s is described. Participation is discussed in detail, with emphasis on how it is understood in development circles and also highlighting various criticisms of the approach. The chapter further discusses the current status of extension in Kenya and prevailing challenges.

Keywords: agricultural extension, forestry extension, participation, training and visit

Introduction

Agroforestry as a practice is interdisciplinary in nature and therefore cuts across various disciplines. In Kenya, agroforestry extension is undertaken by the Ministry of Agriculture (MoA) through its Soil and Water Conservation Branch, by the Ministry of Livestock and Fisheries Development which was recently carved out of the larger Agricultural Ministry, by the Ministry of Environment and Natural Resources (MENR) through its Forestry Extension Services Branch and by the Ministry of Energy through its biomass division. Before discussing extension in the two main ministries carrying out agroforestry extension (MoA and MENR) I give some account of the purposes of extension.

What is extension?

The term extension, according to Leeuwis and van den Ban (2004) is very recent; it originated in academia, with its use first recorded in Britain in the 1840s in the context of university extension. This was the name given to educational activity by a university beyond the campus walls, often in the form of lectures to the general public. Extension was therefore a form of adult education in which the teachers were staff members of the university. In line with this tradition many definitions of extension emphasise an adult educational dimension. A sample of some definitions is as follows. Agricultural extension, according to Purcell and Anderson (1997), is the process of helping farmers to become aware of and adopt improved technologies from any source to enhance their production efficiency, income and welfare. Others such as Swanson et al. (1997) define agricultural extension as extending relevant agricultural information to people. Moris (1991) calls it the promotion of agricultural technology to meet farmers' needs while Maunder (1973) defined extension as a service or system which assists farm people, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living, and lifting social and educational standards. If there are many definitions of extension all have one thing in common - the notion of information delivery by agents, especially to farmers and especially concerning technologies.

Evolution of agricultural extension models

The Transfer of Technology Approach (ToT) - 1960s to 1970s

During the late colonial and immediate post colonial period - 1960s-1970s - state extension was a major service provider for farmers. During this period, the extension system used the top-down approach following the linear model of Technology Transfer (ToT). This approach was based on the US extension system which assumed that agricultural ministries had useful information for farmers, and the extensionists job was to transfer this information (Schwartz and Kampen, 1992). According to this approach, research, ideas and priorities were determined by scientists who generated the technologies in research institutions. These technologies were then handed over to extension agencies for dissemination to farmers (Chambers et al., 1989). The focus of the international donor community during this period was on increasing production of staple food crops through investment in agricultural research and extension and related technical services to address the problem of food security. The Kenyan government at that time received funding from the United States Agency for International Development (USAID) to promote new technologies through this approach, which was commodity based. Hybrid maize was one commodity that was successfully promoted through this approach. The ToT model - in fact based on the diffusion of innovation theory (Rogers, 1962) - tended to start with a predefined innovation of which the uptake was in principle regarded as desirable. At the time, the thinking prevailing was that those who did not adopt were ignorant, and the cure was more extension teaching (Chambers, 1983). This strategy divided farmers into various categories from innovators to laggards (Rogers, 1983). The approach survived in Kenya up until the early 1980s.

The Holistic Approach: Integrated Rural Development and Farming Systems Approach

In the 1970s, the international community realised that conditions faced by farmers in developing countries were not improving, and donors shifted their focus from commodity based extension to the integrated rural development approach (IRD), a policy response to the recognition that increased crop yields alone would not solve rural poverty. For the first time the complexity of rural life was taken into account. The IRD approach gave priority to the improvement of physical infrastructure in rural areas, in addition to emphasis on modern seed varieties and fertilizer, in effect undermining many local agricultural practices. With funding from the World Bank the Kenyan government started using the IRD extension approach in 1976. The IRD goal was to provide inputs and infrastructure, in addition to extension services based on ToT (Moris, 1991). These inputs included research, irrigation, credit, roads, water, electricity and sometimes schools and health centres (Venkatesan and Kampen, 1998). Crucial issues such as training, and linkages with research, were left out, and as a result, the position of average rural farm households did not improve. By the late 1970s, a strong wave of criticism started to challenge the bureaucratic nature of the IRD approach, which critics viewed as being top-down, often with little regard to local circumstances and few links to other structures such as research.

At about the same period, there was concern by the international community that developing countries were at a risk of famine due to shortages of major staple crops. Many thought that agricultural research would help address this problem. In response to this concern, donors started to support agricultural research in order to help address the risk of famine in developing countries (Hansen & McMillan, 1986). This period coincided with the first output from international agricultural research centres in Africa, Asia, Latin America funded by the World Bank consultative groups on agriculture in various countries under the umbrella of the Consultative Group on International Agricultural Research (CGIAR) launched in 1971 (CGIAR, 2007). The various international agricultural research centres tackled research on staple food crops. One CGIAR centre was the International Maize and Wheat Improvement Centre (CIMMYT) with its headquarters in Mexico, was important for Kenya, because of the significance of maize as a staple. A regional office was established in Nairobi. It was about this time that concern arose in some CGIAR circles, especially CIMMYT, that the ToT approach, which was commodity oriented, overlooked the relationships between food production and other farming and non-farming activities in the livelihood strategies of farmers. These deficiencies led to the emergence of the farming systems approach to research and extension (FSRE). In East Africa, FSRE was initiated through the work of Michael Collinson when working with CIMMYT (Collinson, 2000). It was argued that the commodity-oriented research and extension approach was not meeting the multiple needs of farmers in marginal environments. The underlying rationale of FSRE was that various farming activities undertaken by farmers were closely interlinked in terms of production resources. The holistic approach looks at the entire farm as a system composed of various subsystems and provides for greater dialogue with and input from farmers, while seeking enhanced linkages between research, extension and farmers. This model was marked by the participation of farmers in on-farm trials and by interdisciplinary linkages and a systems approach to extension.

Biggs (1983) summarises the main features of FSRE as:

- An interdisciplinary and multidisciplinary approach to technology generation and diffusion that aims at bridging the gap between farmers' indigenous knowledge and researchers' conventional knowledge;
- A comprehensive understanding of farm operations and farmers' aims as well as their resource use decision criteria which is viewed as a major factor in the formulation of agricultural development policies;
- With respect to poor farmers' farm production aims, it is assumed that the economic profit is not necessarily the main aim and that food production for household consumption is an overriding factor.

In summary the FSRE approach (Norman, 2002), was characterised by:

- An approach viewing the farm as a whole;
- Involvement of farmers and their priorities;
- Research reflecting the various sub-systems' interactions and linkages;
- Reliance on informal surveys or rapid rural appraisals (RRA).

Advocates of FSRE argued that by focusing on farmers' problems as the basis of agricultural technology generation, technologies more adapted to farmers socio-economic and environmental conditions would be generated, thus paving the way for extensive diffusion.

The 1980s Training-and-Visit Approach

In early 1980s, the World Bank shifted its focus from IRDP to the development of national institutions in developing countries (Venkatesan, 1994). This meant that the Bank began to support national extension and research systems instead of research and extension efforts linked to special (and short term) IRDP. This was due to the recognition of the need to reach more farmers and to equip extension staff with the necessary skills. These were deemed to include how to:

- diagnose field conditions and opportunities, bringing them to the attention of research systems and making these systems respond;
- analyse whether the research being carried at the research centres was in line with farmers' priorities;
- conduct periodic training sessions for frontline extension workers; conduct monthly subject matter specialists (SMS) workshops, and formulate extension recommendations relevant to farmers' needs for different agro-ecological zones and level of farmers;
- prepare extension programme for an administrative unit;
- get farmers to understand and implement in their fields the extension messages they have decided to try;
- identify the skills to be imparted to farmers and incorporate such skills in the extension programme;
- analyze the reasons for farmers' adoption and lack of adoption of the extension recommendations etc. (Venkatesan, 1994).

This new system of extension was referred to as the Training and Visit (T&V) approach. T&V was designed to address some of the weaknesses in previous extension approaches, such as weak linkages with research and low training of field extension workers. It was introduced as a pilot project in Kenya in 1982 in two districts of western Kenya and in 1983 was expanded to cover 30 districts over a three year period (Venkatesan, 1994). Funds were provided by the World Bank in two phases known as National Extension Project (NEP I, 1983-1991, and NEP II, 1991-1998). The objective of NEP I was institution building and sustained increases in agricultural production in 30 of Kenya's 41 districts, all in medium to high potential areas (Gautum, 2000) while NEP II was to stimulate the development and adoption of technical packages to enable smallholder farmers to increase their productivity and incomes.

As the name suggests, T&V entailed frequent visits by frontline extension workers to contact farmers, periodic training and strong linkages with research. Under this approach, SMS advised extension agents, and also provided a link between extension and research. They organised monthly workshops where frontline extension workers (FEWs) were trained, after which they returned to the field to impart acquired skills and knowledge to contact farmers in the hope of inducing a multiplier effect. Each FEW was to divide farm families in their area (about 400-800 farmers) into 8 groups. Each group was to be visited every fortnight. Since the farmers were too many, five to ten contact farmers were selected from each group, and the FEW were to mainly work with them so that other farmers within their groups could also learn from the contact farmers, in order to achieve the intended multiplier effect.

NEP II began in 1991. It sought to continue to strengthen extension services and to support neglected areas. For instance, T&V was introduced to new areas, and when 4 of the original districts were split, T&V extension was applied in 40 of Kenya's 45 districts. It also provided funds to improve transportation, fostered the use of mass media and communications, refurnished Farmers Training Centres (FTC) and promoted links between research and extension. This phase ended in 1998.

Even before the end of NEP II, the T&V system was the subject of much criticism, not only in Kenya but wherever it was applied. Some development professionals felt that the system focused so much on training that it lost sight of the goals of meeting farmers' needs and improving their livelihoods (Davis, 2004). At the end of NEP II, The World Bank Operations Evaluation Department (OED) commissioned a review of NEP in Kenya. The review concluded that the T&V had some beneficial aspects but several operational deficiencies. In addition, it was found not to be sustainable (Gautam, 2000). It was essentially a supply-driven and top-down system, promoting agricultural messages that had been designed and developed by research scientists, with limited input from farmers. Furthermore, the messages were often irrelevant, according to farmers surveyed. In addition, farmers felt that the frequent visits by FEWs were not necessary, as they kept on repeating the same messages. One of the major shortcomings of T&V was the fact that it relied on contact farmers, who were selected by the extension agents. These tended to be wealthier farmers, and the larger rural population was neglected (Moris, 1991). According to Gautam (2000), there was no criterion for choosing contact farmers. These criticisms led development professionals all over the world to look for more inclusive extension approaches, flexible enough to take into account farmers needs and priorities, hence the emergence of the participatory approaches described in detail in the following section.

The 1990s Participatory Approaches

'Participation' and its companion concepts of 'empowerment' and 'sustainability' have since the early 1990s become fashionable concepts in contemporary development theory and practice. According to Cleaver (2001) participation has become an act of faith in development, something people believe in and rarely question. To begin with, it was a preserve of civil society and non governmental organisations (NGOs), but in recent times it has also been taken up by government agencies. Participation has become so common in development activity that it is quite out of the ordinary to find a development project that does not subscribe to the concept. Participation has been presented as a discourse that promises unrealistic outcomes: it is crucial to the success of projects, it can transform development, empower poor people, gives the poor and the marginalised a voice, etc. Participation has a strong populist following but suffers from limitations which are rarely questioned. However, despite its popularity, the past decade has witnessed growing criticism of participatory approaches. These criticisms are not only directed at the approach itself, i.e. at philosophical shortcomings embedded in the participation discourse, but also at the way it is implemented. Surprisingly, these criticisms have come from the proponents of participatory approaches themselves. Notable critics include, for example, Chambers (1997), Cornwall and Pratt (2000), and Cooke and Kothari (2001) in a book entitled *Participation: A new tyranny*. Many critics have argued that participatory approaches are mere rubber stamps undertaken to please donors. Chambers (1997) and other proponents of participatory approaches are more concerned with the incorrect use of the approach and the use of the term participatory as a 'mere label.' Chambers describes it as the 'bad practice' of an otherwise 'good approach'. Others such as Cleaver (2001) and Leeuwis (2000) are more concerned with the conceptual limitations of the approach. These criticisms are addressed in detail later in this chapter.

Because participation means different things to different people, I will look at various definitions of participation and how it is implemented in practice. An attempt will also be made to review the definitions of the equally popular concepts of 'empowerment' and 'sustainability' in the context of participation. This is because the village committee approach used in western Kenya by the agroforestry programme had the ultimate goal of empowering farmers with various skills and knowledge on agroforestry so that they could be able to make informed decisions on what options to use, based on their circumstances, in addition to the fact that the approach envisioned a situation whereby at some point in time a sustainable process of joint learning would develop in the community, even without the support of a donor project. After review of the various criticisms mentioned above, the following chapters will look at the mechanisms involved in the implementation of the village committee approach to participatory development and dissemination of agroforestry technologies. In presenting the case studies in chapters 3 and 4, I discuss the process through which farmers are involved and point out the anomalies, implementation difficulties, lessons learned and challenges, not only to the approach but also challenges faced by farmers seeking to practice agroforestry in western Kenya.

Definition of Participation

Participation is not a new idea or concept in development theory; it existed under different names since the 1960s. What is new is a certain taming of its radical impetus, according with the increasing emphasis placed by donors, civil society, NGOs and more recently central governments on invoking the approach. According to Buchy and Hoverman (2000), the literature on participation and participatory processes originates from political science, in discussions around democracy and citizenship, and secondly from development theory, especially within the context of the debates about sustainable land use (Nelson and Wright, 1995; Chambers, 1997). This thesis will concentrate on the latter. Most of the literature on participation from development theory looks at participation from two perspectives. These are: 1) participation as an approach and 2) participation as a method, i.e., a set of guidelines of involving local people or the general public in planning specific activities. Because of the multiplicity of meanings and uses of participation discourse, many scholars have developed classifications of types of participation. Notable classifications are those of White (1996), Deshler and Sock (1985), Cohen and Uphoff (1980), and Okali and Sumberg (1994). White

(1996) distinguished four levels of participation, namely nominal, instrumental, representative and transformative (Table 2.1). Each type of classification is characterized by divergent interests of different actors. White's classification demonstrates that stakeholders do not share the same expectations of participation in development projects. At each of the first three levels, planners and beneficiaries have conflicting definitions of participation. At the nominal level, people are enlisted in projects or processes as objects, so as to secure compliance and minimize dissent. At the instrumental level, participants are used as a means or instruments to achieve project objects. At the representative level, participants are viewed as actors and are consulted. It is only at the transformative level that both groups of stakeholders have the same interest - empowerment of beneficiaries.

Table 2.1. Interests in participation

Form	Top-down	Bottom- up	Function
Nominal	Legitimisation	Inclusion	Display
Instrumental	Efficiency	Cost	Means
Representative	Sustainability	Leverage	Voice
Trasformative	Empowerment	Empowerment	Means/End

Source: White (1996)

The Deshler and Sock (1985) typology underlines the importance of the relative power of outsiders and beneficiaries as a key characteristic in defining participation. Their classification is based on a scale which measures the extent of control over power, ranging from pseudo-participation (the manipulation of beneficiaries by development agents to meet the needs of elites) to genuine participation in which participants are empowered by having control in planning and management of projects (Table 2.2).

Table 2.2. Participation levels as distinguished by Deshler & Sock

Genuine participation		
	Empowerment	Citizen control
	Cooperation	Delegated power
		Partnership
Pseudo-participation		
	Assistncialism	Placation
		Consultation
	Domestication	Informing
		Therapy
		Manipulation

Source: Deshler and Sock (1985).

The Cohen and Uphoff (1980) typology is more practical, and pays less attention to theoretical divisions. It takes into account different kinds of participation, who participates and how participation occurs (Table 2.3). The kinds of participation are organised with regard to the different phases of a project cycle - from planning through to evaluation. Cohen and Uphoff (1980) mention various actors, ranging from local residents, local leaders, government personnel to foreign personnel, as participants, while the "how" of participation describes various mechanisms through which participation can take place (including attention to basis, form, extent and effect).

Other scholars have differentiated participation into two types. For instance, Nelson and Wright (1995) have described this distinction simply as 'instrumental and transformative,' while Okali and Sumberg (1994) distinguish between participation as a means and as an end.

Participation as a means is basically using participation to complete a project. In this case if local people are involved they are used as a vehicle or tool to achieve this objective. This is what Nelson and Wright (1995) call instrumental participation. On the other hand, participation as an end is about empowerment of local people. If local people have control over the whole process of a project, decide on their own priorities and how to implement their own action plans in order to achieve their objectives transformative participation is attained.

Table 2.3: Dimensions of rural development participation according to Cohen & Uphoff

Kinds of participation	
	Participation in decision making
	Participation in implementation
	Participation in benefits
	Participation in evaluation
Who participates?	
	Local residents
	Local leaders
	Government personnel
	Foreign personnel
How is participation occuring?	
	Basis of participation
	Form of participation
	Extent of participation
	Effect of participation

Source: Cohen and Uphoff (1980)

Pretty (1995) adapting a scale from Adnan et al. (1992), distinguishes seven levels of participation: passive participation, participation in information giving, participation by consultation, participation for material incentives, functional participation, interactive participation and self mobilization (Table 2. 4).

Table 2.4. Pretty's typology of participation

Typology	Characteristics
Manipulative participation	Participation is simply a pretence, with people's representatives on boards/committees who are unelected
Passive participation	People participate by being told what has been decided or has already happened
Participation by consultation	People participate by being consulted or answering questions
Participation for material incentives	People participate by contributing resources e.g. labour in return for cash or food
Functional participation	Participation as a means to achieve project goals, especially reduced costs; objectives have been determined
Interactive participation	People participate in joint analysis, development of action plans and formation/strengthening of local institutions
Self mobilization	People participate by undertaking initiatives independently without the involvement of external institutions or if external institutions are involved, it is only for technical advise or resources but the locals retain control of the process and results

Source: Adapted from Pretty (1995).

Although these typologies of participation prescribe various levels, they do not define participation as used in development. Defining participation is in itself very problematic. This is because, according to Leeuwis (2000), it can be defined normatively, descriptively (as in the various levels mentioned above) or literally. Participation in development practice is often defined in normative terms, indicating that certain criteria must be met in order for something to count as participatory. The World Bank has defined participation as a process through which stakeholders' influence and share control over development initiatives and the decisions and resources which affect them (World Bank, 2001). This definition provides a basis for deciding whether a project can be considered participatory or not. But the bottom line (and position this thesis takes) is that participatory approaches are about greater engagement with or use of 'local' perspectives, knowledge, priorities and skills in development initiatives, and therefore encompasses principles of sustainability, relevance and empowerment.

Criticisms of Participatory Approaches

As mentioned previously, many practitioners have begun to point out the limitations of some popular notions of participation. According to Kothari (2001), the criticisms take two forms: those that focus on the technical limitations of the approach, which stress the need for a re-examination of the methodological tools, as used in PRA, for example, and those that pay closer attention to the theoretical and conceptual limitations of the approach. Cleaver (2001), for instance, points out that most projects have 'empowerment' as an objective, yet it is usually not clear who is empowered (the individual, the community or categories of people such as women, the poor or the socially excluded). The question of how such people are empowered is usually even less clear, or as Cleaver (2001) puts it 'conveniently fuzzy.' Unless such concepts are defined clearly, from a realist perspective, i.e. in terms of plausible mechanisms for which evidence is then obtained, achieving real participation will remain an illusion, since the levers of transformation will remain out of reach. Secondly, some authors – e.g. Chambers (1997) – argue that participation tends to be a good idea badly implemented. Bad practices, as outlined by Chambers (1997), include:

- Using the label without substance
- Extractive PRA
- Putting methods before process of empowerment
- Putting methods before attitudes and behaviour
- Ruts and routines, rushing
- Leaving out the poorest people

Biggs and Smith (1998) point out that participation is about inclusiveness but this should not make us assume that simply involving different kinds of people is sufficient to effect participation of the group they are taken to represent. No two people, even if they had same interests, are likely to respond in the same way to issues. Mosse (1994) and Guijt and Shah (1998) agree that participatory approaches tend to assume communities are homogenous, yet in reality, they are not, and therefore participatory development fails to get to grips with thorny issues of power relations. This failure, in essence, ends up bringing about conflicts, which according to Cleaver (2001) and Leeuwis (2000) are not then addressed by participatory approaches. Leeuwis further argues that the discourse is characterised by 'wishful thinking.' This is because it bases itself too much on communicative action and pays too little attention to resolving conflicts which may come about during the process of participation. These conflicts could be, for instance, participants failing to maintain an agreement, or to implement a compromise after it has been secured. Or there could be difficulties in agreeing in the first place, or failure to tackle the most significant problem initially (Leeuwis, 2000).

Despite the increasing tone of criticism, participation as a development concept and as an approach is being used more than ever by NGOs and the public sector. Thompson (1995) attributes this increasing interest to: i) an attempt by government bureaucracies and NGOs to ensure their continued survival rather than signalling any meaningful embrace of the ideals of good governance, democracy or empowerment, ii) the increased conditions placed by donors on governments, that require them to support participatory research and development programmes, iii) the recognition of the failure of past top-down programmes, which in turn has led development and government agencies to look for alternative approaches.

What is empowerment in the context of participation?
'Empowerment' of the poor, the less marginalized, women etc, is common rhetoric in participatory projects. What is meant is less clear. A review of literature reveals various definition of empowerment in the context of participation. Buchy and Hoverman (2001) indicate that at some level empowerment may mean that power is devolved and that people have a voice in the running of their affairs, whereas at an individual level, it reflects more of a state of personal development in which people engage in a learning process, develop increased critical awareness and self confidence, and are better able to use their own resources. Narayan (2002) presents empowerment as an approach for reducing poverty and increasing development effectiveness. Narayan defines empowerment as the expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control and hold accountable institutions that affect their lives. On the other hand, Crawley (1998) asserts that empowerment is about enabling people to understand their situation, reflect on factors shaping that situation, set their own agenda and take steps to change the situation. From the three definitions presented above, it is clear that they all revolve around enabling people to have a voice, set their agenda and become more confident. Chambers (1997) cautions that empowerment can either be good or bad, depending on who is empowered. If those who are empowered are for instance elites who then dominate more effectively than before, then the poor and the disadvantaged may be worse off.

What is sustainability in the context of participation?
Sustainability is another 'buzzword' associated with participation. One of the goals of participation is usually achieving sustainability. But what is sustainability? As simple as the word sounds, there are many different definitions of sustainability and therefore it is not possible to come up with a single correct definition. This is because sustainability itself, according to Pretty (1995), is a complex and contested concept. To some it implies persistence (i.e. capacity for something to continue over a long period). To others it implies resilience (capability to bounce back from adversity). In relation to the environment, it is generally taken to imply use of products or processes that do no obvious longer-term harm to the environment, or which promote longer term recovery from intensive use. As there is no single definition of sustainability, it is important to clarify what is being sustained, for how long, for whose benefit and at what cost, over what area and measured by what criteria (Pretty, 1995). In the context of participation we usually talk about processes and benefits. Projects are usually short term; limited to three years, or utmost five years. What happens after the end of a project? Concern for "what next" is why participatory approaches emphasise sustainability. So sustainability in the context of participation implies a situation whereby participatory processes are sustained even after the end of projects and in terms of longer-term benefits accruing to participants without external intervention. For example in the case of the

village committee approach, it would be deemed sustainable if joint learning, experimentation and feedback continue beyond the end of the agroforestry programme.

The emergence of participatory forestry extension in Kenya

Forestry extension in Kenya is carried out by the Forest Department, under the Ministry of Environment and Natural Resources (MENR). The mandate of the Kenya Forestry Department is to manage gazetted forests and forest law enforcement. It is also entrusted with forestry extension, where the main agenda item is to raise wood supply in rural areas beyond the subsistence level without compromising the environment, while improving overall agricultural productivity. The Forestry Extension Services Branch (FESB) is responsible for extension activities required under the Forestry Department remit. Forestry extension activities geared towards needs of individual farmers was first given emphasis in the agenda of the Kenya Forestry Department in 1971, when the Rural Afforestation Extension Scheme (RAES), now known as FESB, was established. However, the importance of farm forestry, the category within which agroforestry falls, was first recognised as a possible source of forest and tree products in the Kenya Government Sessional Paper No.1 of 1968 (Republic of Kenya, 1968). To avoid confusion, it should be recognized that farm forestry - synonymous with agroforestry in many eyes, in fact has a distinct meaning. Farm forestry is the term used to describe tree growing outside gazetted forest areas. It encompasses agroforestry, social forestry, village forestry etc. It also includes large scale forest production on private farms, an activity which would fall outside agroforestry as defined in Chapter 1. Initially, RAES had four branches, namely training and extension, monitoring and evaluation, media and communication, and nurseries and seed. Until 1986, RAES concentrated on the establishment of central nurseries to provide seedlings to meet the need for poles, timber, posts, fuel wood and other products at the farm level. It continued producing seedlings whether they were in demand or not; this led to the first policy statement on RAES that the country should produce 200 million seedlings annually. Since then, farm forestry activities have been intensified country wide, with many successful afforestation programmes and heightened awareness of the need for tree planting among farmers. In the 1970s, initial forestry extension strategies were supply-driven, resource-intensive and largely top-down. The 1980s saw a change to facilitation in which those interested in tree growing were supplied with basic nursery tools, equipment, chemicals and technical advice and provision of seed, where necessary and when resources were available. The 1990s saw a radical transformation in the FESB which actively sought to institutionalize participatory planning processes in their extension agenda. With funding from the Finnish International Development Agency (FINNIDA), FESB implemented a pilot participatory extension project (1990-1998) known as 'The Nakuru and Nyandarua Integrated Forestry Extension Project' with the slogan *miti mingi mashambani* (Swahili: 'many trees on farms'). The aim of the project was to develop participatory extension methods and incorporate the experiences learnt into the national forestry extension policy (Anyonge et al., 2001). The department currently faces a lot of challenges outlined below.

Current status of extension in Kenya

The 1980s saw a major economic crisis eventually leading to major budgetary cutbacks in extension services. The economic crisis reflected high import prices, especially for oil, coupled with drought, and a draining of resources by under-productive government parastatals

(Sanders et al., 1996). Constraints on development activity were to be seen in budget deficits, recurrent high personnel costs and declining administrative capacity (Cohen, 1993). In Kenya, a highly centralised government was inefficient and corrupt. Most government expenditure went on paying the salaries of a bloated and inefficient workforce. In an effort to help address these problems, typical of many African countries at the time, the World Bank and the International Monetary Fund introduced structural adjustment programmes (SAPs).

SAPs in Kenya were instituted to address budget deficits and kick-start the ailing economy. They included the reduction of the civil service payroll, parastatal reforms, liberalisation of markets and pricing policies, and removal of foreign exchange controls (Cohen, 1993; Ikiara et al., 1992 and Sanders et al., 1996). Although SAPs were in the long run meant to bring about more economic growth, they impacted negatively on small scale farmers. First and foremost, privatisation of input supply meant that smallholders no longer obtained subsidies on fertilisers and other inputs. Secondly, many extension officers were retrenched, leaving a skeleton staff. In addition, budgetary allocation to extension was reduced drastically, leaving very few funds for actual activities. Many extension officers sat in empty offices unable to reach farmers, with no fuel for vehicles or motorbikes. In theory, one FEW was supposed to cover no more than four villages, with an average of about 400 farmers. But in practice, in 1996, Vihiga district, with about 73,000 households distributed in 664 villages, had only 53 FEW and 26 Subject Matter Specialists (SMS). The ratio of FEW to households was therefore 1: 1,392, not 1: 400 (Niang et al., 1998b). At the moment, the government is still grappling with the fact that 80% of the budgetary allocation to ministries still goes on paying basic salaries.

The adverse impact of the economic crisis and structural adjustment programmes on state extension services led to a search for additional actors within the extension domain during the early 1990s. At about the same time the Bretton Woods institutions increasingly recognised that SAPs alone were not sufficient to bring about the desired change; they had to 'get institutions right as well.' This brought in the agenda of good governance, which has since dominated development thinking with its emphasis on decentralisation and democratically elected bodies. Governments were supposed to implement pro-poor policies and fight corruption (World Bank, 2000). This was to be combined with an active civil society in order to provide the necessary checks and balances. This led to a shift in donor support from the central governments to NGOs - seen to be more transparent and democratic. This thinking also coincided with the period that saw participatory approaches widely accepted in development circles. With donors shifting their focus to NGOs, organisations stepping into the gap to provide extension services have mushroomed. These organisations use approaches that put greater emphasis on farmers playing a central role in technology development and extension. Extension went participatory, and under new (and often non-governmental) management.

Western Kenya, the focus of this study, has not been spared this mushrooming of multiple players undertaking extension using participatory approaches. For instance, Care International currently uses an approach known as 'Training of Resource Persons in Agriculture and Community Extension' (TRACE) while the agroforestry programme has contributed the village committee approach, which is the focus of this study (details of its functioning are presented in the next chapter). The Ministry of Agriculture has tried to keep up by developing its focal area approach through the National Agriculture and Livestock Extension Project (NALEP) [MOA, 1995]. These approaches have one thing in common; they are client centered. They see farmers as central to the process of technology generation, providing inputs into the design process, and playing a greater role in monitoring and evaluation. The farm, and not the research station, is now the key location for technology development.

Whether these approaches live up to the expectation of being participatory will be discussed in chapters 3 and 4, via a focus on the village committee approach.

Conclusion

There are two major points to be stressed in the conclusion to this chapter. The first is that participatory approaches to technology development have become dominant in Kenya at a time when major protagonists, including some of the founders of the approach, are increasingly critical about where participation is leading, and whether the outcomes are desirable. The second point concerns the extension services in Kenya. Over time, these services have been strongly influenced by policies of the international donor community, and have not proven immune to the fashion for participation. Although the extension service is changing in tune with changing times, it still faces a lot of very basic challenges, limiting effectiveness. One of these is reduced budgetary allocation. Unless it is addressed, it is not hard to predict that current participatory approaches, intended to be more flexible and client centred, may in fact have little impact. While this thesis will, in fact, confirm a number of the criticisms levied against participatory approaches, it differs from some other accounts in taking a realist line, i.e. seeking mechanisms of participatory effectiveness. If reliable mechanisms of participatory engagement can be found, within the contexts of small farming as encountered in western Kenya, then limited resources might yet go a long way to trigger transformative outcomes.

Chapter 3

Village committees, groups and agroforestry dissemination in western Kenya: an assessment of the village committee approach

This chapter has been submitted for publication in a modified format to *Agriculture and Human Values* Journal as: Kiptot E., Farmer groups and agroforestry dissemination in western Kenya: their nature, contribution and shortcomings *(under review)*

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Abstract

The village committee approach (VCA) is a community based participatory initiative used by an agroforestry programme in western Kenya to jointly develop and disseminate technologies to farmers via groups. Despite the importance of groups in rural development, there are concerns that insufficient attention has been paid to their shortcomings in technology development and dissemination and if not addressed, may impact negatively on efforts that are being made to alleviate poverty. This chapter therefore explores these shortcomings by critically examining the functioning of the village committee approach, the nature of the groups associated with it and their role in agroforestry dissemination. The findings are based on formal and informal surveys which were complemented by case studies used to explore issues under study. The case studies presented in this chapter give practical examples of how farmers use their social networks to access resources and also how agroforestry technologies are disseminated within the groups. The findings illustrate the diversity of the groups and multiple activities they are engaged in. A typology of groups based upon the nature of resources mobilised to improve livelihoods is presented. Various factors that have enabled groups to sustain collective action are also analysed. Further findings show that although the village committee approach has its merits as a development tool, there are significant shortcomings as some farmers were excluded, mainly on the basis of lack of resources, and also due to village elites withholding information about development initiatives. In regard to agroforestry dissemination, the training of trainers concept used by the village committee approach was found not to be effective as the trained representative farmers did not often share technical information with other farmers within their groups. This chapter argues that if poor resource farmers are to benefit from development initiatives, then the agroforestry programme should: (1) change its focus from working with pre-existing groups via the VCA to encouraging farmers with a common interest in agroforestry to form groups, (2) use other dissemination methods to complement the use of the VCA so as to help overcome marginalisation and social exclusion evident in groups, (3) embrace a culture of genuine participation and not 'participation by proxy.'

Keywords: agroforestry, collective action, farmer groups, social exclusion, social capital

Introduction

The growing importance of groups in rural development activity is increasingly apparent. This is because central governments in many developing countries are unable to provide rural small-scale farmers with services such as credit, markets, water, electricity and education. To address these shortcomings, rural people have combined efforts through collective action to improve their livelihoods and enhance household security. As a result, groups are seen to bring about empowerment (Seyed et al., 1996), enable members to access loans and services, improve bargaining power in market transactions (Lyon, 2003), establish stable client relationships with suppliers and traders (Stringfellow et al., 1997) and share knowledge on agricultural practices (Davis et al., 2004).

In the wake of the failure of state agricultural extension services to reach many poor farmers, groups are increasingly recognised for the role they play in sharing information on improved agricultural practices. In central Kenya, for instance, farmers organised in groups shared *Calliandra calothyrsus* (a fodder shrub) and *Desmodia* (*Desmodium uncinatum*) planting material with other farmers in their communities (Sinja et al., 2004). Similarly Kiptot et al. (2006) found that groups were the second most important avenue through which farmers in western Kenya shared seed and knowledge on agroforestry technologies. It is for reasons like this that groups are hailed as one of the most promising means of scaling up improved technologies within the community (Davis et al., 2004; Place et al., 2004). Most donors and development organisations now consider groups an important means for spreading new technologies. In fact, the use of groups as a tool in rural development has, according to Place et al. (2004), become so popular that it is hardly possible to find a development organisation that does not work with groups. Donor organisations are increasingly funding projects that put emphasis on groups. Lucey (1997) estimates that 50% of British aid-supported natural resource sector programmes have a component of self-help organisation (implying group mobilization).

The history of groups in Kenya dates back to the colonial period when farmers were required to organise themselves into groups, and forced to construct soil conservation structures on their farms, which they resisted (Thomas-Slayter et al., 1991; Tiffen et al., 1994). When Kenya attained independence in 1963, group formation continued to be encouraged in order to pool resources for nation building in the spirit of *Harambee*. *Harambee* is a Swahili word that translates to *'Let's pull together.'* It is also Kenya's national slogan. *Harambee* self help projects consisted of community members working together towards a common goal (Thomas-Slayter, 1987). Working in groups was further reinforced in the 1970s when the Ministry of Agriculture - with funding from the Swedish International Development Agency (SIDA) - encouraged farmers to work in groups to construct terraces for soil erosion control on their farms. Machakos district in eastern Kenya was used as a pilot area, and farmer groups known as *mwethya* became a success story. Encouraged by the early success of these *mwethya* groups in Machakos district the Ministry of Agriculture, through its soil conservation programme, extended the lessons learned to other districts in the country. Since then, development practitioners have continued to use groups as a tool in agricultural development.

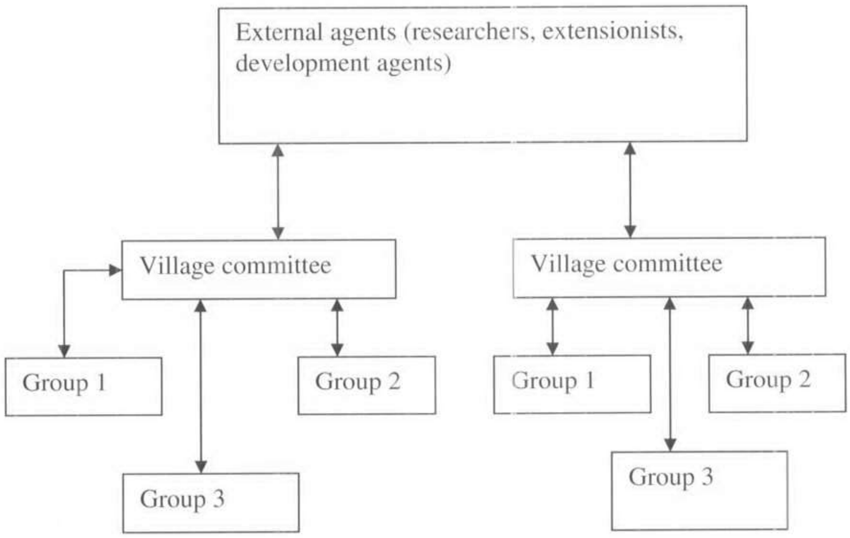
Western Kenya is a region with a very high number of groups. It is estimated that 80% of farmers in western Kenya belong to at least one such group (Noordin et al., 2003). Based on this assumption, most development organisations work with groups in the region in their endeavour to scale up agricultural practices. This is because social networks can be accessed via groups, and interaction between people is higher (de Haan, 2001). Place et al. (2004) point out that groups also provide safety nets, i.e., allow individuals better to cope with risk, especially in cases where governments are not able to provide insurance against risk. It is also argued that working with groups rather than individuals is cost effective, in that more people are reached more quickly, a version of the training of trainers concept (Noordin, 1996). It is according to this rationale that a collaborative agroforestry project in western Kenya spearheaded by the Kenya Forestry Research Institute (KEFRI), the World Agroforestry Centre (ICRAF) and Kenya Agricultural Research Institute (KARI) has been working with groups via the village committee approach (VCA), in order to help spread the benefits of agroforestry.

Although the use of groups through the VCA has exerted a strong appeal, there are many shortcomings that are for the most part overlooked, and if not addressed will have a retrogressive impact on efforts to scale up the benefits of agroforestry. It is ironic that in spite of the extensive use of groups in the VCA to technology development and dissemination there has been little systematic assessment of operations and shortcomings. It is, thus far, only an assumption that benefits derived from individual members within groups will spread to other group members and society at large. The present study therefore sought to examine the functioning of the VCA by exploring how committees were formed, and how they function (or malfunction), in addition to examining social processes within groups associated with the VCA, through for example assessing the nature of associated groups, how they access resources and sustain collective action, whether representative members disseminate technology to their group members, and what contribution they make in dissemination of agroforestry technologies.

How the agroforestry programme worked with groups via the village committee approach (VCA)

Agroforestry research in western Kenya began in 1988 with the inception of the agroforestry programme at KEFRI's Maseno Centre. This followed a diagnostic study carried by ICRAF in western Kenya in the early 1980s that identified low levels of soil fertility as a major factor contributing to low agricultural production in the region. One of the mandates of the programme was to carry out soil fertility research, develop & test relevant technologies on-farm, and disseminate promising ones to a large number of farmers in the region. Several years of participatory research identified two promising low cost agroforestry technologies found to substantially increase crop yields. These technologies were improved tree/shrub fallows and biomass transfer. Improved tree/shrub fallows have been defined as the deliberate planting of fast growing species, which are usually legumes in rotation with crops for rapid replenishment of soil fertility (Sanchez, 1999). Biomass transfer involves cutting leaves from trees or shrubs grown on or off farm and incorporating these leaves as green manure when planting crops.

In the endeavour to upscale the above technologies to many farmers within the region, the agroforestry programme began to use, in 1997, a community-based participatory approach known as the VCA. It was understood in the early stages of participatory research that the government extension system was not efficient due to limited staff and resources, and therefore an alternative approach had to be applied. The VCA entailed working with all farmers from a village via their groups. Farmers from existing diverse groups (youth groups, women groups, clan groups etc.) appointed members to represent them in village committees (Figure 3.1). A typical village in western Kenya consists of from 39-379 households (own survey). Each village would have one committee, with the village elder as the patron. Representative farmers in the committees would then be trained on various aspects of agroforestry, so that they could pass on the knowledge and technologies to other members in their group and thus to the community at large (Noordin et al., 2001). The committees were also used by external agencies as an entry point to the villages. Any information or technology would be channelled through the village committees. If training opportunities arose - for instance a seminar, tour or field day - the external organisations would inform committee members through the village elder who in turn passed on the message to the respective groups through their leaders so that they could select farmers to go for the training. This approach was tested on a pilot basis in 17 villages in Siaya and Vihiga districts in western Kenya and later expanded to other villages.



Adapted from Noordin et al. (2001)

Figure 3.1. Village committee approach

Methodology

About Siaya and Vihiga

These two western Kenyan districts share a common border. They are inhabited by two different ethnic groups; the *Luo* in Siaya and *Luhyia* in Vihiga. The region falls within the high potential agriculture zone, but agricultural activity is constrained by declining soil fertility, diminishing land holdings as a result of high population density, low use of agricultural inputs and high incidence of *Striga*, a parasitic weed that substantially reduces maize yields. Maize is the staple food crop. Most households depend on off-farm income (salaried and manual jobs, remittances from relatives working in urban centres, pensions and small scale business). A high proportion of households are headed by women due to male out-migration to urban areas in search of jobs.

Methods

The study involved formal and informal interviews with officials of groups, representative farmers who were members of village committees, and 60 randomly chosen farmers from 10 groups in various villages of Vihiga and Siaya districts. A case study approach - of two village committees - was also used to assess how the committees were formed, their functioning and their shortcomings. Individual farmers, women, youth, project officials and village elders were interviewed. The two committees chosen for the case study approach were purposively selected due to the fact that the two villages have been extensively involved in agroforestry research through collaboration with the agroforestry programme. Initial on-farm trials were set up in the two villages in the early 1990s. In addition, they were the first to be involved in the formation of village committees. Since the purpose was to learn more about how the formation took place, it was imperative to select villages that currently have the same village elder as in 1997 when the committees were formed.

The groups surveyed in this study were selected from villages where the agroforestry programme had worked extensively. A list of various groups was constructed from information in project records and in possession of village elders. Thirteen groups in Vihiga and 18 groups in Siaya were listed. Since the aim of the study was to find out detailed information about the nature and functioning of these groups and their position relating to agroforestry activities, it was important to narrow down to a few groups from which detailed information could be collected. In order to arrive at a final selection of groups with unique (but varied) characteristics (in terms of, for example, composition, nature of activity involved, etc.) they were purposively selected. Many groups shared activities and in such situations I only selected the ones with unique activities. From a total of 31, I selected 10 groups, as shown in Table 3.1. The condition for the selection of the 10 groups was that they needed to have at least one of their members in the village committee (VC) or had worked closely with the agroforestry project (i.e. had participated in seminars/workshops). In order to identify issues for further in-depth study using the case study approach, it was necessary that I carry out a formal survey. The 60 farmers interviewed were chosen randomly from a list of farmers constructed from the 10 groups (the list contained 268 farmers; 204 from Siaya and 64 from Vihiga). Since I wanted to capture the uniqueness of each group, a 25% sample of farmers was picked from each group, which resulted in a total of 67 farmers. But because of illnesses, death and engagements, only 60 were interviewed. Based on the results of the formal survey, issues that needed further probing were identified and five groups with striking characteristics were purposively selected for this purpose. To ensure representativeness in relation to the type of groups selected, I selected a clan group, a youth group, a group consisting of women only and two mixed groups (both men and women). Of the mixed groups, I selected one from Siaya and the other from Vihiga, because each had unique characteristics in terms of group formation and how they accessed resources.

Groups for the purpose of this study are distinct associations formed at the community level involving people with shared interests, who voluntarily come together to undertake a common activity. These groups generally have a name and a defined structure. The groups in this study do not involve bureaucratic farmer organisations, such as cooperative societies, in which the government may have a role. Case studies of five of the groups were undertaken in order to understand (1) the social processes that take place within diverse groups, especially how farmers manipulate their social networks and use their social capital to gain resources, and (2) how agroforestry is situated within groups. The choice for a case study approach to complement the formal survey was determined by the fact that cases generally provide practical examples and in-depth insights into the social processes of everyday life. In addition, case studies entail long term engagement, allowing time for development of trust and rapport with farmers. Once trust is built, farmers can discuss sensitive issues candidly without fear, thus exposing topics that would not otherwise be accessed through formal interview.

Formation of village committees

According to villagers, a *baraza* (public meeting) was called by the village elders/headmen in mid 1990s, in which farmers were informed that they needed to form village committees based on existing organisational structures. This involved identifying all groups within a village, including women's groups, church groups, youth groups, etc. After group identification, members of each group were supposed to identify a delegate to represent them in the village committee. For instance all youth groups within the village were required to select one representative; women's groups and clan groups were required to do the same. During informal discussions, many farmers indicated that selection of representatives was done by the villagers themselves. When they were asked about the method used to select representatives they claimed that elections were held. But when probed further, it became clear the method of selection was acclamation, i.e. one villager would propose a name, another one would second, and then the group would be asked whether they supported or opposed the nomination, at which point most farmers would give their approval by acclamation (cf. Richards, 2007b). Those farmers who were proposed were in most cases officials of their respective groups. The officials of village committees - i.e. chairman, secretary and treasurer - were also elected by acclamation.

Composition of village committees

A look at the composition of two of the village committees (names withheld for reasons of confidentiality) reveals a number of issues. The members are typically people with higher social status in the village. For instance, the first village has 7 committee members. Of this group the secretary used to work in Nairobi before he retired in 1994, and the chairman used to work in Kisumu (third largest city in Kenya) for a printing firm before he also retired in 1994. The treasurer, a lady, is a housewife, but her husband worked in Mombasa (second largest city). Of the other four members of the committee, one was elected even while still working in Nairobi, and another is a wife of the secretary of the committee. A third member did not have a job but was a very active farmer and was elected by virtue of having participated in a number of on-farm experiments with researchers during the experimental phase and therefore had interacted a lot with project staff and high profile visitors.

In the second village, the situation was not any different. There are 10 committee members. The chairman had been very active in agroforestry on-farm experiments and comes from a prominent family in the village. The secretary of the committee used to work in Nairobi before he retired. The treasurer is a housewife but her husband worked in Kisumu at the time. The other members either used to work in the city or their husbands had jobs in the city before they retired or were retrenched. Furthermore, in this particular village committee, three members come from the same family.

Role of village committees

Mobilisation of farmers to attend field days, barazas, tours

Tours, field days and seminars are used as forums where farmers learn, share experiences and provide feedback to researchers. Whenever development practitioners organised field days, they would inform the village committees, who in turn mobilised other farmers to participate. Because of structures in place, it is easier for information to trickle down to other farmers within the community. Field days are normally held at either one of the farmers' homesteads or at a demonstration plot run by researchers. The field days are held so that farmers can see for themselves the technologies first hand. Tours, on the other hand, are organised visits to other regions while *barazas* are community meetings within the village held to create awareness about important development issues.

Link between development practitioners and farmers
Village committees also act as an entry point between development agents and farmers. Whenever development agents want to work with the community, they link up with committee members who in turn pass the information to farmers in the village. One case of how development agents worked in the past with farmers via their village committees is presented below.

> In 1998/1999, during the experimental phase of biomass transfer technology using *Tithonia diversifolia* (*Tithonia*), researchers had, through on-station experiments, found out that when *Tithonia* is combined with phosphate fertiliser, it tremendously increases the yield of maize. So researchers wanted all farmers in the villages to see for themselves the benefit of *Tithonia* combined with rock phosphate (RP). The researchers informed village committees, who in turn organised *barazas* in their respective villages. All farmers in the various villages were informed of the intentions of the researchers. According to one village elder, most farmers were at first very reluctant, because it was a new idea and they were not willing to take a risk. A few accepted to take RP fertiliser, which was distributed through village committees. They experimented with a combination of *Tithonia* with RP on maize. During that year 1998/99, farmers who had accepted RP, had a bumper harvest. In the following year, almost all farmers volunteered to try in their farms. Thereafter, field days were organised in which researchers and farmers shared experiences and perceptions of the new technology.

Coordination of agricultural activities in the village
During the initial phase of village committee formation, various committees agreed to undertake collective action for activities such as soil and water conservation. With the involvement of the Ministry of Agriculture, the committees mobilised farmers to construct terraces, and to plant napier grass and *Tithonia* along terrace risers in their effort to manage their soils in the village. They were quite successful; almost every farm has either terraces or napier grass from plantings along the contours acting as soil erosion barriers.

Shortcomings of village committees

Composed of village elites
As was mentioned previously, the village committees are composed of village elites – people of a higher social status and wealth ranking than the members they are supposed to represent. However, some farmers I talked to argued that it was in order to have these elites to represent the community because they are well known in the village; have interacted with high profile personalities, and therefore are in a better position to represent ordinary and less-well connected people adequately, and even to lobby for more development to be brought to the village.

Withholding information about development initiatives
Some farmers were bold enough to inform me that whenever development practitioners wanted to involve some farmers to go on tours or seminars, they would leave the responsibility of selection to the village committees. But more often, the committee members would not involve other farmers; they would select themselves, their friends or relatives. One farmer indicated that they did this because whenever they went for tours, they were paid substantial allowances.

Distortion of information as it passes through various hands
Many times, farmers would receive contradictory or false information about the date and venue of events. These at times caused a lot of confusion among farmers. I was a victim of such confusion or misinformation myself on one occasion when I sent a message to a committee member saying I wanted to meet one of the groups.

Inadequate institutional support for the committees
The committee members are generally required to mobilise farmers using their own resources. They have no institutional support for what is in fact quite a time and resource consuming activity. Since the activity is undertaken only on volunteer basis committee members find themselves forced to skip their own activities to mobilise other farmers to participate in development initiatives.

The nature of groups

The groups I came across are diverse with multiple and overlapping activities (Table 3.1). Many farmers belonged to more than one group. Among the activities, 'merry go rounds' or rotating and saving credit schemes, reciprocal labour, and assistance in times of crisis were the three most frequently mentioned reasons for group formation. Other common purposes were to buy household utensils, to produce and market maize, beans or horticultural products, and activities such as dairy production, pig rearing, construction of wells, bee keeping, construction of pit latrines and poultry keeping. Most women belonged to groups that had a savings and credit scheme to provide assistance during crises, while men belonged mainly to groups with activities in dairy, horticulture, bee keeping or napier grass production. Male youths were mainly interested in pig rearing projects and horticulture. These activities are testimony to the variety of needs rural people have and the way they network and pool resources in order to satisfy these needs. It is interesting, however, to note that only one group had formed for the express purpose of engaging in agroforestry activities. The groups had six main activities: pooled savings and credit, reciprocal labour, marketing, agricultural and livestock production and moral support, as discussed in the following section.

Pooled savings and credit
Savings and credit services have become popular in groups due to the difficulty of getting money in times of financial crisis, and the failure of formal financial institutions to provide loans to rural people with no secure source of income. Of the 10 groups, 7 of them are engaged in savings and credit activities commonly known as "merry go round" in Kenya, while one group had both a rotating and non-rotating savings and credit scheme. These saving groups loan funds to group members for various productive activities. There are two types of schemes. The first very common type is the rotating savings and credit association (ROSCA).

Table 3.1. Groups, composition and activities

Name	Village	District	No of members Men	Women	Activities
Pambana youth group	Emabuye	Vihiga	7	6	Horticulture, Napier grass production Merry go round and Reciprocal labour
Jisaidie youth group	Ematioli	Vihiga	5	22	Awareness creation on HIV/AIDS Merry go round Construction of pit latrines
Maendeleo zero grazing group	Emabuye	Vihiga	6	9	Dairy production
Urafiki women group	Muhanda	Siaya	0	14	Merry go round Buying and selling of maize and beans Assist each other when there is a crisis Reciprocal labour
Undugu welfare group	Sauri	Siaya	28	20	Assist each other when there is a crisis Reciprocal labour Poultry keeping
Upendo women group	Sauri	Siaya	0	32	Bee keeping Merry go round Reciprocal labour Assist each other when there is a crisis
Umoja welfare clan group	Nyamboga	Siaya	0	55 (20 active)	Merry go round Assist each other when there is a crisis Buying of household utensils
Maridadi self help group	Muhanda	Siaya	19	11	Tree nursery Reciprocal labour
Ujuzi women group	Soso	Siaya	5	20	Dairy production, Merry go round, Reciprocal labour
Akili youth group	Eshikhuyu	Vihiga	4	5	Horticulture, Pig rearing Dairy goat production Marketing of agricultural produce Merry go round

NB. The names of groups have been changed

In ROSCAs, participants periodically contribute fixed amounts and use lotteries to allocate turns to borrow the entire pot (Kimuyu, 1999). This process is repeated during subsequent meetings until every member has received money once. If 12 members make monthly contributions, the "merry go round" will last 12 months and may immediately be resumed, perhaps with additional or fewer members. The money received is mainly used to pay school fees, buy household utensils or boost small scale business activities. The second type, which is becoming quite common, as most farmers are unable to get loans from formal financial institutions, is the accumulating savings and credit association (ASCRA) (Bouman, 1995). The difference between the two is that in the latter association savings accumulate against which members borrow money for emergencies and repay with interest. At the end of the year (or at whatever time the members decide to end the round) accumulated funds, including profits from interest payments, are split equally among members.

Reciprocal labour

Pooling of labour is a common practice in African agriculture. This is done to guarantee timely labour for household subsistence purposes in the face of increasing ecological hazard and agricultural production decline and growing poverty (Thomas-Slayter, 1994). Labour clubs also serve an important social function, since people enjoy working together rather than by themselves. Labour has become a very scarce resource in rural Kenya, especially now that most children go to school. Another factor that has immensely contributed to scarcity of labour is HIV/AIDS. Rural-urban migration has further constrained household labour, as most men have migrated to urban areas in search of jobs. As a result, more than half of the households in western Kenya are headed by women (Wangila et al., 1999). Most rural farmers in the region have no ready cash to pay for hired labour, and unless they farm, their households will have no food. Cash shortage thus makes labour sharing attractive, as one of the few resources at the disposal of the poor. Members of a labour group will come together to cultivate, weed, harvest or dig terraces on members' farms in turn. The member who requires assistance is the one who requests the services of the others. He/she will be required to prepare lunch for the members of the group, and is then obliged to work on other members' farms when requested to do so. Pooling of draft animals for ploughing is also practised, since most households own only one work oxen, which by itself is not enough to operate the plough, while others have none. A substantial number have none as a result of theft, or distress sales of animals to pay school fees/hospital expenses, or meat for funeral ceremonies[4]. Farmers pool their draft power with other farmers who may contribute either an oxen, the plough set, or labour for ploughing. Reciprocal labour is also provided during funerals, weddings and when a labour club member has visitors. Other instances of labour pooling occur on common property resources, for construction of wells, rural roads or afforestation of water catchment areas, etc.

Marketing

Collective action among farmers in marketing agricultural produce increases their bargaining power and at the same time ensures continued supply of products to traders. Lyon (2003) points out that it also reduces the time and the cost of marketing. Group members often select one farmer with good marketing skills (i.e. knowledge of marketing channels or excellent bargaining and negotiating skills) to market products for the whole group. Groups engaged in this kind of activities include especially those dealing with horticultural crops such as cucumbers, tomatoes, onions and kale. Buying and selling of maize and beans is also a common practice that women's groups engage in, especially during harvest. They take advantage of low prices during harvest to buy, and then store and sell the produce later when the commodity is scarce and prices are high. The proceeds are shared among members.

Agricultural and *livestock production*

Some groups, such as those engaging in horticulture and livestock production, are formed for specific purpose of increasing agricultural productivity. Others such as "merry go rounds" are formed in the first instance for credit and savings, but may take on an agricultural component.

[4] In both the Luhya and Luo communities, it is a tradition for bereaved families to slaughter livestock during funerals. According to Kristjanson et al. (2004) this is a major reason cited by 52% and 73% of farmers in Vihiga and Siaya districts respectively for remaining poor.

For instance one group, known as Ujuzi women's group (Table 3.1), is a "merry go round" with a dairy component. The group keeps a dairy cow at one members' homestead, and the calves are given to members through a pass-on system[5]. A member with a new calf that later matures and gives birth is required to give the weaned calf to another member; by so doing it is hoped that in a few years every member will have a dairy cow, thereby boosting household nutrition and income through the sale of milk.

Improving the breeds of local livestock is another activity that farmer groups engage in. Members contribute money to buy an improved bull, which is used for servicing local cows. Group members pay a subsidised fee for the bull services while non members pay a much higher rate, used for the bull's upkeep. Dairy goat production is another activity that is increasingly common, especially in Vihiga district. Group activities for breeding dairy goats follow the same principle as for breed improvement of local cows. Members may raise money to buy an improved buck which is used to service local goats in order to improve milk production. Another strategy is for group members to contribute money to buy both an improved male and female goat, kept by one farmer with the understanding that offspring are to be given to members of the group through the pass-on system.

Moral support
In times of crisis, most groups lend a hand to the affected member. This could be in times of bereavement or sickness. The support might be financial or in kind. The most common organizational forms to meet such purposes are clan groups and "merry go rounds".

The five case studies

Each of the five case studies presented below has a very different history, range of issues that brought them together, and social network configuration. Two of the groups are from Vihiga district and three are from Siaya district. These groups are *Ujuzi* women's group, Umoja welfare clan group, *Maendeleo* zero grazing group, *Urafiki* women's group and *Akili* youth group.

Ujuzi women's group
Despite what the name implies, this group has five men and 20 women in its active membership. The group was formed in 1986 from the members' own initiative and attracted about 30 persons. The initial purpose for group formation was to improve livelihoods through various income generating activities. The purpose remains the same but the group has changed. Initially, it was as the name suggests a women only entity, but as the group developed and members began to gain tangible benefits, some men decided to join to benefit also. The group comprises farmers mainly from Soso village of Siaya district and most of them are linked by close kinship ties. All members belong to the same clan. Three members are from outside the village but joined because they had family ties to the chairperson. The group initially started with reciprocal labour. Later on a "merry go round" was added.

In 1997, the chairperson, who is influential in the village, was appointed by villagers to join the agroforestry VC as a representative of the group. Being an active member she took up agroforestry activities with enthusiasm. She began practicing improved fallows and biomass transfer in the early 1990s. Because of the impressive agroforestry technologies implemented

[5] The pass-on system has been popularised by Heifer International, an American NGO that has according to de Haan (2001) provided livestock to rural people in over 110 developing countries. It does this through a system whereby a farmer who is a beneficiary of a cow or goat is required to pay back two calves or three kids to other farmers in target areas. The system works as a type of pyramid.

on her farm over the years she was often frequented by high profile visitors, which greatly boosted her social status. She also benefited a lot by participating in seminars and tours organised by the agroforestry project. In 2003, she was visited by officials from an international donor organisation (one of the sponsors of the project at the time) interested to see the performance of agroforestry technologies under farmer management. Familiar through previous interactions with high profile visitors she was very confident and took advantage of the opportunity to request for a dairy cow on behalf of the group members. Since the officials were impressed by the agroforestry technologies implemented on her farm, they gave the group a dairy cow. The other members then benefited through the pass-on system, thus ensuring group momentum. Many farmers within her group also took up agroforestry after seeing the spectacular performance of the chairperson's maize crop planted using agroforestry techniques. The same year, the Ministry of Agriculture found itself impressed by the group's work, and linked them to the Heifer International project operating in the region at the time. Heifer International officials urged the group to write a proposal as a group requesting for dairy cows. After submitting their proposal, they were advised to plant napier grass, *Calliandra* (a fodder shrub) and build zero grazing units on their farms. In 2003, 12 group members who had met the requirements were given dairy cows. But the agreement was that any subsequent heifers were to be given to those members who did not initially meet the requirements set by Heifer International.

Out of the 25 active members, 15 are currently practicing agroforestry because they believe that it was through demonstrating a correct attitude towards agroforestry that they were able to get dairy cows. Most of them obtained their seeds from the chairperson and also from *barazas* (public meetings). Although the group initially had 30 members, some dropped out because they were unable to sustain monthly contributions, while others were unable to construct zero grazing units or plant napier grass. This meant they were unlikely or unable to benefit from access to cows. The membership fee is KSh.20 (KSh.70 is equivalent to US$1) while monthly fee is KSh.50. Although the group appears to be doing well in terms of accessing resources through its networks, members allege that it is only the officials of the group (the chairperson and secretary) who are selected to go on agroforestry related tours and seminars. They do not share what they learn with the other members of the group, it is alleged.

Umoja welfare clan group

This is a clan-based welfare group for all married women in Nyamboga village, Siaya district. The chairperson is a respected member of the village whose late husband worked with a government parastatal in Nairobi. The group has about 50 members but only about 20 are active. Most members are inactive because they are unable to pay membership and monthly fees, and therefore no longer participate in meetings. The group was formed in the early 1980s with the main purpose of assisting members in times of bereavement. Assistance is in the form of food donations, or providing labour for such activities as cooking or fetching water and firewood at funerals. Other activities have since been added, such as buying household utensils for members (they contribute KSh.30 for this whenever they meet) and an ASCRA. The members contribute KSh.50 per month for the ASCRA scheme and can borrow money which they repay with interest. Members pay an annual membership fee of KSh.200. Two members of the group were beneficiaries of agroforestry training and received seeds, but they never planted any of the trees/shrubs for soil fertility management, nor did they practice biomass transfer. None of the 20 active members has practised agroforestry; some claim that the farmers who were trained never passed on the information. Although most farmers have heard about agroforestry from project *barazas* they never took much interest. Some argue that if the technologies were really good, then the trained members would have adopted them, but since they did not there seems little point in the others trying.

Akili youth group

Akili youth group is in Eshikhuyu village of Vihiga district and was formed in 1998. The group has five men and four women, mostly under 40 years of age. Three farmers are over 50! They were purposively included in the group to inject wisdom, experience and advice. Most members are school leavers unable to find formal employment and currently engaged in horticulture as a source of livelihood. The chairman of the group, also a member of the VC, is a grandson of a prominent person in the village, now deceased. Membership fee is KSh.200 while the monthly contribution is KSh.25. The original purpose was marketing horticultural crops such as tomatoes, onions and cabbages. Another activity the group engages in is farming. The group at one time leased a farm which they used to plant horticultural crops for the group. The money they received from the sale of the horticultural crops was used to buy a dairy cow and a pig. The other members of the group will benefit from subsequent heifers and pigs through the pass-on system. At the time of the interview, all members of the group had received pigs, but the cow has had several miscarriages and the members are thinking of disposing of it so they can purchase another. In 2001, the project linked up with an NGO promoting fodder shrubs and benefited from a dairy goat, which is also supposed to benefit the other members through the pass-on system. In 2005, they submitted a proposal to the Constituency Development Fund (CDF)[6] requesting funds to boost their group activities; they got KSh. 20,000 which they intend to use for improving horticultural activities. One of the group members was in the agroforestry village committee, was trained and over the years has planted improved fallows and also practiced biomass transfer technology for soil fertility management. Four members at one time planted improved fallows after receiving seed from a fellow member but have since abandoned the practice. At the moment only one farmer in the group has improved fallows; he also practices biomass transfer technology. Two other members still practice biomass transfer. So far, only one member dropped out in 2004, because of lack of commitment, i.e. not attending monthly meetings and not paying monthly contributions.

Maendeleo zero grazing group

This group consists of farmers from Emabuye village, Vihiga district. Four of its members have benefited from agroforestry training. The group was formed in 2000 and has seven men and nine women members. The chairman of the group is a successful business man in the village, and their representative in the village committee is a retired civil servant. The initial purpose for group formation was to improve livelihoods through livestock production. To be a member, one must have a cow/goat or must have planted napier grass. The group started off by exchanging local cows for improved heifers (two local cows for one improved heifer). Later on the group contributed KSh.200 for registration. Part of the money was used to open an agro-veterinary products shop because they envisaged that since the improved cows were not adapted to local conditions they would require veterinary care. The shop was run by the secretary of the group. It operated for a while but then closed down after misappropriation of funds by the secretary. He was later demoted and the post reassigned. The former secretary of the group rarely attends meetings due to the shame.

[6] Kenya has 210 constituencies represented in parliament. In 2004, a Constituency Development Fund was established by an Act of Parliament in which 2.5% of the total revenue collected by the government is disbursed to each constituency annually for development purposes. The fund has helped constituencies to build schools, roads, bridges, pay school fees for needy children and support income generating projects in rural areas.

Not to be deterred by what happened, the group again came together and contributed money to buy 12 local goats for the members. The goats are supposed to be serviced by an improved buck which they got from the Kenya Dairy Goat Association (KDGA). The first female offspring is then given to a member who did not benefit from the 12 initial goats bought. The second belongs to the group. The third belongs to the custodian. Male offspring are kept by the farmer. It is hoped that in this way all members at some point will have dairy goats to supply farmers with milk. The group approached a local NGO (Kima Integrated) which sponsored them to buy the improved buck from KDGA. Before they were given the buck, the members were asked to send one farmer to be trained by KDGA in goat management. The chairman's wife was handpicked to participate in the training. This generated a lot of tension in the group.

As regards improved fallows and biomass transfer, none of the group members trained in the two practices is using them, nor are any other members. The group claims that although four of their farmers were trained, none of them ever shared knowledge with others. On the other hand, those trained in agroforestry indicated that they do not have sufficient land to plant soil fertility enhancing shrubs. Although other farmers in the group claim they have heard about agroforestry from village *barazas* they have not been keen to take up the technologies. One member left voluntarily in 2002/2003 because she was too busy with politics (she ran unsuccessfully for a civic seat in 2002) but rejoined the group in 2005. The group does not have monthly contributions, but there is a one time payment for registration. Members contribute money whenever they have a project they want to undertake.

Upendo women's group

Upendo is an all women group from Muhanda village of Siaya district. It was formed in 1998 and consists of 14 members. The members are women born in the same village in a neighbouring district, but married in Muhanda village. They engage in the business of buying and selling maize and beans when in season. They also assist one another in times of crisis e.g., during funerals, in digging of terraces and in house construction. In addition they have a "merry go round" whereby they contribute KSh.200 on a monthly basis and have a registration fee of KSh.100. The chairperson of the group and two other farmers have received agroforestry training and have even planted improved fallows. Five other farmers have also planted improved fallows after seeing the trees on their chairperson's farm. They got the seeds from the members who had planted previously. The three farmers who were trained in agroforestry never formally shared what they learnt with the rest of the group. Two of the members picked seed from the chairperson's farm on one occasion when they had gone for a meeting, while the other three had requested seed from members after they had seen the shrubs growing on their farms. Two members have since dropped out of the group because they were unable to sustain the monthly contributions.

What sustains collective action?

Because members of groups are people with diverse interests and objectives, sustaining a group is no simple task. There were certain groups that had had conflicts, perhaps occasioned by misappropriation of members' funds. In other cases members failed to sustain their monthly contributions or defaulted on loan repayments. Nonetheless, there some success stories and some groups in western Kenya have survived for many years, as is apparent from the five case studies. Various factors members indicated have contributed to sustaining collective action are discussed below. But looking at group cohesion in terms of context-mechanism-outcome configurations (ch. 1) we should also remain aware of "hidden" candidate mechanisms only glimpsed in the case studies above or the discourse of participants. Group formation and success depends on being able to exclude some of the most needy persons through imposing membership requirements, such as fees, etc. This suggests the possibility that wealthier farmers benefit from cooperation only when they can exclude laggards. Second, agroforestry is apparently treated as a kind of ritual requirement helping groups access assets that really make sense – namely livestock distribution through the pass-on system. The possibility must be faced that agroforestry is valued more as a networking opportunity than as a mechanisms for transforming land management.

Voluntary membership

The groups are voluntary and autonomous institutions with their own objectives and rules, usually unwritten. Individuals are under no obligation to join any group. A member can withdraw whenever he or she wishes, except in the case of rotational labour and savings groups in which members can only withdraw when the rotation is complete. The lifetime of ROSCAs and ASCRAs depends on the number of participants and the periodicity of payments.

Commitment

Members who join the groups are usually fully committed, although some drop out because they are unable to sustain their contributions. To ensure commitment, all the groups have a financial component which a member has to pay when joining the group. It might be in the form of a non-refundable registration fee, or a monthly payment to gain a stake in a ROSCA or ASCRA. By paying the membership or registration fee, the member will not lightly leave or lose interest. But it is (as just noted) a way of also ensuring that some of the more risky elements are excluded from membership.

Common interest and anticipated benefits

It is a sense of common interest and anticipation of benefits to be received that farmers sometimes claim drives them to join together and form a group. There is no doubting that many farmers sincerely believe they can improve their livelihood through joining groups. In addition to improving livelihoods, they also seek to gain empowerment. Through groups, some farmers are able to create linkages with non governmental organisations (NGOs) in the region. These NGOs have facilitated farmers' participation in various training courses on land husbandry, sponsored them for tours and seminars, and (above all) link them directly to foreign subsidies, e.g. in the case of livestock.

Trust

Most group activities involve some form of financial transaction, but members do not have the capacity to seek legal redress in case of default. Members do, however, have the option of seeking the services of the sub-chief or the village elder (*maguru*), even if this is usually a last resort. What most of them trust in is the moral support of the community to impose sanctions on members who go against the agreed rules and regulations. To secure the support of the community, most groups seek to base their membership on people from the neighbourhood or village, preferably linked by kinship. Community knowledge helps evaluate a potential member's personal attributes and the circumstances and background are common knowledge. Members are fully aware that it takes time to build trust and once it is lost it takes a lifetime to regain it. It is based on this that members strive to sustain trust among themselves. Once a member defaults, everyone in the village will know, and the affected member will then be excluded from joining any similar group in the village. Credit ratings are, in effect, based on local reputation.

Rules and regulations

All groups have formulated sets of rules to govern relations among members, and some even keep group records. The rules in most cases are informal (i.e. unwritten), but each member is aware of them. The complexity of rules tends to vary with the type of group activity. For instance, those groups which engage in savings and loans, such as the ASCRAs, maintain careful records. Groups engaged in "merry go rounds", livestock or napier grass production, or reciprocal labour keep relatively informal rules. These rules are mainly about attendance in meetings, punctuality, and penalties to be imposed on late comers or defaulters. For instance, to be a member of the *Maendeleo* zero grazing group one must have a dairy cow or goat or plant napier grass. In the case of *Umoja* group, failure to attend a meeting, results in a fine of KSh.10. In the *Urafiki* women's group, if the hostess does not serve members '*well brewed Kenyan tea*' she is fined KSh.20.

Structure

The groups have a formal structure. In general, level of organisation is quite high. All groups have a defined leadership, generally consisting of a chairperson, vice chair, secretary and treasurer. The function of the chairperson is to call meetings, chair them and generally provide leadership to the group. The secretary keeps records of group activities while the treasurer takes care of any financial transactions. These posts are normally on a voluntary basis and can be occupied indefinitely. In some cases voting is required and office bearers serve a specific term.

Regular meetings

Groups have regular meetings. Most groups meet once or twice a month, while some meet whenever there is a crisis. Regular meetings keep members active and also provide fora for solving conflicts which may arise as a result of power struggles or disputes over resources. The aim of regular or timely meetings is to sort out issues before they blow out of proportion.

Social interaction, moral support and reciprocity

In addition to any economic or developmental function groups also have a socialising component. Members use the time to catch up on the latest events in the village, gossip and form opinions. The "merry go round" groups do this over a cup of tea and snacks. In times of difficulty or a crisis, groups provide members support and a second "family." In case of a financial crisis, affected members are free to ask for support from their groups, who often readily give it, if they can, because other members believe that they too might need such support in time. To drive their point home, Mama Priscilla a member of *Urafiki* women group directed me to read Luke Chapter 6: 31:

> '*And as ye would that men should do to you, do ye also to them likewise.*' (King James Version).

Groups and agroforestry

Which groups had high rates of agroforestry adoption and why?

Among the five case studies, *Ujuzi* and *Urafiki* groups, had more members planting improved fallows and practicing biomass transfer. The common factor linking these two groups is that farmers trained in agroforestry included the chairpersons and trainees had planted improved fallows on their own farms, unlike *Umoja* welfare clan group and *Maendeleo* zero grazing group, where no trained farmer planted improved fallows. The fact that *Ujuzi* and *Urafiki* had adopters in their midst played a big role in persuading other farmers to use agroforestry technologies. The adopters served as role models. Adoption cannot be hidden since improved fallows are quite conspicuous in the landscape, for instance the beautiful bright yellow flowers for *Crotolaria*, or purple or white flowers for *Tephrosia*. No one visiting a homestead with these shrubs can miss noticing them.

Do farmers discuss agroforestry during their meetings?

All 10 groups (Table 3.1) interviewed indicated that they never discussed agroforestry issues in their groups, despite the fact that they had representative farmers trained by the agroforestry programme. This was because when they meet time is limited and they discuss only issues relating to the objectives of the group. The members usually meet in the afternoons, and most of them rarely keep time. It usually gets dark before the agenda is complete. The majority of members are women with other household responsibilities, so there is pressure not to waste time in discussions. Even so, it seems quite striking that agroforestry never once made it on to the agenda. This marginality must give researchers pause for thought about whether a more specific, targeted approach to agroforestry is required.

Mama Alice, the chairlady of *Umoja* welfare clan group was blunt; agroforestry is not on the radar.

> *'We never really have enough time to discuss most of the issues because we are so many and we have many things to discuss. We only discuss issues that are related to our objectives'*

When and how do they share information and agroforestry seed?

Several farmers from the groups, who had no direct link to the agroforestry programme, complained that those trained on agroforestry related issues did not share technical information with them formally. They only did it whenever they were asked by individual members, after seeing agroforestry trees/shrubs on their farms. The fact that agroforestry species can be readily seen makes other farmers curious. And since farmers met frequently at the homesteads of their members, they often see for themselves the agroforestry technologies. This is how requests for seed arise. For instance, Mama Ann saw improved tree fallows in the farm of one of her fellow group member when she had gone there for a "merry go round" meeting. She asked her what they were for. She was told that they are good for soil fertility management and also for chasing away moles from the farm. She borrowed *Tephrosia vogelii* seeds to plant with the initial purpose of chasing away moles.

> *'I planted them scattered in my shamba (field) to keep moles from destroying my sweet potatoes, but nothing has changed. The only positive benefit I have received so far is the firewood of* Tephrosia *which burns like gasoline but the fire goes off [i.e. consumes it] very fast.'*

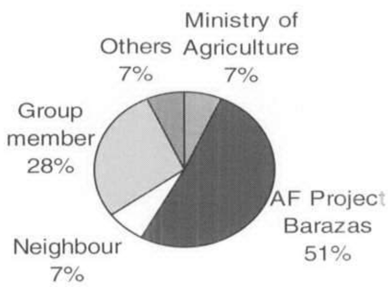
But not all farmer representatives had adopted the technologies, as was illustrated in the case studies. Out of 12 trained representatives interviewed, only five had adopted improved fallows. What this means is that members of farmer groups whose representative farmers did not take up agroforestry technologies had far fewer chances to learn about agroforestry, except from their relatives, friends or through *barazas* (public meetings).

It is curious that a technology so visible in farms, and about which farmers are in fact at times quite curious, is so invisible in group meetings. This physical visibility but lack of sociological visibility suggests that the real "mechanisms" of participation are not quite what development experts assume. In further work along these lines, more attention will need to be paid to the relation between (and the differentiated interests of) leaders and members in groups. The micro-politics of groups may be more about status advance (for leaders) than poverty alleviation (for ordinary members).

Main source of agroforestry information among group members

Since most group members did not get information and seed from their group members, I sought to find out whether they had ever heard of agroforestry, and improved tree fallows and biomass transfer specifically. A minority (3%) said "no" while the vast majority (97%) said they had heard about the technology. Figure 3.2 shows the main source of information on agroforestry practices by group members who have heard about agroforestry.

Figure 3.2. Main source of agroforestry information by group members



NB. The sample was drawn from across the 10 groups shown in Table 3.1

Most group members indicated that they had heard about the technologies from the agroforestry project staff during *barazas*. Most *barazas* were held in nearby market centres and all farmers in the respective villages would be invited by the village elder. Many women indicated that since *barazas* are held at nearby market centres it was easy for them to go, as they could combine attendance with other household chores such as taking maize to be milled at the market place, or when going to buy vegetables and other household items. They were often happy to take some time off to listen to the village elder and agroforestry project officials. It is usually the responsibility of the local administration, village elders, chiefs and divisional officers to host *barazas*. They normally do this when they have important issues to discuss with their people. Development projects normally take advantage of these forums to discuss development issues. *Barazas* are open to all, unlike the seminars, tours and fields days provided to selected farmers, including group leaders. The *baraza* is evidently a good forum for creating awareness, but the only limitation is that issues are not discussed in detail.

Just over a quarter (28 %) of farmers who were group members indicated that they had heard about agroforestry technologies from fellow group members trained by the agroforestry project. Furthermore, they emphasised that it was only after they had seen the shrubs/trees at the homesteads of their fellow group members and had asked about them specifically that they acquired any information. It is important to note here that most groups met regularly at the homes of their members, as was indicated previously, and if a member has improved fallows on the farms, others become curious. Only a small minority of farmers (7%) heard from the Ministry of Agriculture or neighbours respectively. The Ministry of Agriculture, with a mandate to carry out extension service in Kenya, is faced with a number of problems such as low staffing, lack of facilities for work (no vehicles, motorbikes or fuel) and low morale. Rarely do extension staff get an opportunity to visit farmers or even to call a meeting to give farmers technical advice, as reflected in the figure just cited. Other organization mentioned by farmers were the Tropical Soil Biology Fertility (TSBF) institute of CIAT (International Centre for Tropical Agriculture) and local NGOs.

Source of seed for agroforestry species
Farmers within various groups who had received seed were asked where they had got the seed for agroforestry species from. Results are indicated in Table 3.2

The single largest source (37%) for seed was the *baraza,* while 16% received seed from group members, and 5% from Ministry of Agriculture.

Table 3.2. Main source of agroforestry seed

Main source of seed	% farmers (n=60)
Agroforestry (AF) project *Baraza*	37
Group member	16
Ministry of Agriculture	5
Neighbours	3
Others	3
None	36

NB: 36% of the group members interviewed have never received seed of agroforestry species.

Discussion

Exclusion of the poorest members of society due to lack of resources
It is clear from the case studies that resources are needed for any farmer to join a group as noted by Thorp et al. (2005). These resources could be in the form of labour, capital, social status or land. In most groups money also had to be contributed in the form of a membership fee to join a group. Even for joining farmers, some were unable to sustain contributions and ended up withdrawing from their group. Apart from money, there were cases of farmers withdrawing because they were unable to construct zero grazing units or because they did not

have sufficient land to plant napier grass. The implication for this is that many farmers interested in joining groups are excluded by poverty. Development through participation is a club for the better off. Raising KSh.100 per month is a significant task for many farmers. The majority have no monthly source of cash income, but rely on uncertain and risky subsistence farming. Monthly contributions already signal that groups aggregate people with salaries, pensions or savings. Many poorer farmers are excluded from participation, therefore, not by choice but because of poverty, as pointed out by Place et al. (2007) in a study of rural poverty and investment in agriculture in western Kenya. This has important development implications. Working with groups may seem a good idea to help spread technologies – though as we have seen it is not very effective for agroforestry, since this is rarely a group priority - but any potential benefits are denied to the very poor since they do not command the resources needed to join in the first place. The implication is clear. Development projects need to use other methods than group participation to reach the chronically poor.

It is quite ironic that most development projects claim to work with 'the poorest of the poor' and yet by working with groups the people they intend to empower are excluded, leaving the field clear to the empowerment of village elites with resources through which they can develop their farms, should they choose, without the intervention of development projects. The issue of the local elites benefiting from development interventions at the expense of the rural poor is not new in the literature. The problems has been pointed out by, among others, Platteau (2004), Kumar and Corbridge (2002), Esman and Uphoff (1984). What is disturbing is that despite these critiques, development projects still continue working with groups, which in essence, as apparent in the case studies, tends to marginalise the chronically poor.

Why is the group fetish so enduring? Two possible explanations are advanced here. First, development programmes in most cases rely on donor funding, and work on the assumption that by working with groups, more people are reached quickly and therefore will impress donors about rapid and extensive impact, thus ensuring the flow of funds. No one questions who really the beneficiaries were. Second, one might also argue that officials of development projects are out of touch with grassroots realities, since they deal in most cases with the elite officials of the various farmer groups. They probably have no sense of the magnitude, in farmer terms, of the resources required to join groups. For the poor to benefit from development interventions in future, development practitioners need to change their tactics by embracing other approaches/mechanisms less liable to exclude the very poor, so that no one is left out in development. One possibility lies in the field of what Richards (2007b) calls "performative participation" (the attempt to hitch a ride on existing farmer-based technological transactions). Otherwise the very poor members of our society will continue to be marginalized, and efforts at eradicating poverty may never succeed, through failing to address the right beneficiaries.

Participation by proxy: village elites, power relations and exclusion within groups

Even within groups, officials of various groups consisted of mainly village elites, and it was these elites who often then exerted their power to exclude other group members from participating in agroforestry activities. Several farmers alleged that whenever there was an opportunity for members of groups to be trained, those in leadership positions would not inform the other farmers. Such training therefore ended up benefiting those in leadership positions and therefore basically empowering a few individuals in the community. The problem lies in project planners misconceiving the mechanisms of training. They assume that training imparts knowledge of technique. But from the perspective of village elites it is also (and perhaps more importantly) an opportunity to build their status through networking. In addition, when farmers go for tours or seminars they are paid allowances, and these allowances are material attractive benefits, and enough reason for elites to want to monopolise them. This in turn contributes to social tensions within various groups. Most group members interviewed indicated that they often learnt about such benefits only long after the activity had taken place. They have no proper way of making their grievances known, since group procedures tend to be informal. Thus they suffer silently. Ideally, the VCA works in such a way that any feedback from the farmers within groups has to be channelled through leaders who in turn pass the feedback to the VC and eventually to development practitioners (Figure 3.1). This mechanism is disadvantageous to the aggrieved farmers since the culprits are the very same people through whom they are supposed to channel their complaints. Esman and Uphoff (1984) point out that working with groups through leaders in effect establishes a power relationship open to abuse. This is because development practitioners, as mentioned earlier, have little or no direct communication with the people they are supposed to empower except through group leaders.

The whole idea of the VCA working with farmer groups reflects cost effectiveness concerns i.e. reaching more people more quickly. The rationale is sound, but the practicalities are counterproductive because development practitioners end up working with a few individuals supposedly representative of the others (participation by proxy). This in actual fact goes against the philosophical ideals of participation. Participation is intended to give everyone a voice, i.e. an opportunity to share control over development initiatives that affect them. Working with a few representatives motivated by selfish reasons contradicts the ideal. For the VCA to be effective in future, genuine participation has to be organised through real democratic accountability; "participation by proxy" is insufficient, as has been shown in the case studies presented. This entails working with all farmers within groups to empower them with leadership skills, knowledge and bargaining strength. It also means investing more in actual group procedures (in for example literacy and numeracy training, and in record keeping and decision making procedures). If development projects do not spent time and resources to ensure that the rural poor are empowered directly, and not through proxies, genuine participation will remain elusive, and efforts to alleviate poverty by 2015 are doomed.

Training of trainers is not an effective approach in technology dissemination

Although "training of trainers" (or representative farmers) has been hailed in the past as a cost effective and efficient way of reaching many farmers (Noordin, 1996; Davis et al., 2004), this study has shown the approach leaves much to be desired. It may help spread technologies informally, but where representatives do not adopt the technologies, training efforts are wasted, because there is (literally) nothing to show. Even for those who adopt the technologies, they do not seem to invest any time or effort in seeking to train other farmers. Others may lack confidence to pass on knowledge they have only just acquired, perhaps because they are afraid that they will not pass the right information. They respond informally, but only if approached by fellow farmers, and then the quality of the information is often suspect. It is a fact that different individuals have different learning abilities, and therefore it is dubious to assume that all those trained fully understand what they have been taught. This is in fact a critical issue, considering that agroforestry technologies are quite complex and require a lot of general understanding of underlying principle, before implementation. If a farmer does not understand the concepts during training, then it is not right to expect him/her to train the others. In a study of farmer to farmer dissemination of agroforestry technologies in western Kenya, Kiptot et al. (2006) found that farmers more readily shared seed than information about technical principles, which some farmers found to be too complex to understand. In order to enhance the spread of the technologies to more people, development practitioners need to spend a little more effort by training all group members rather than a few representatives. It may be better to work with fewer groups and train all members than work with many groups but train only a handful of farmers.

Women and groups

Women throughout Africa have been known to work together in groups to pursue livelihood goals. This is because women often lack material resources such as land and cattle. Even if they have access to land owned by their husbands, they cannot access loans because they lack collateral. In western Kenya, more than half the households are managed by women (Wangila et al., 1999) and for families to survive they have to look for other means of accessing resources, hence the proliferation of women groups. Men on the other hand are not known to form groups. During this study, I did not come across any groups composed of men only. The most common types were women's groups followed by those of mixed composition. Through the formation of groups, women are able to access other resources. Thus for example they access loans through ASCRAs which enable them set up income generating activities, acquire assets such as cows, goats, and even obtain assistance & moral support in times of bereavement. Such groups will remain important to women's advancement and should be promoted, even though, as argued above, efforts to reach the poorest women excluded from groups need to be stepped up.

Group membership and social capital

Putnam (1993) highlights the importance of horizontal social networks, as aspects of social capital, because they create a sense of generalised reciprocity, which builds trust, and which in turn lubricates social life. Coleman (1998) gives a broader definition of social capital and includes also vertical relationships. The very notion of social capital presupposes a trusting relationship among individuals with obligations within the groups. Being a member of a group is in itself an asset, as it enables members to access resources within their networks. Each group, in the five case studies, used social networks in different ways to access resources, although some groups with both horizontal and vertical links had access to more resources. For instance *Ujuzi, Akili* and *Maendeleo* groups used their social capital to gain access to resources mobilised within horizontal social networks and from external institutions. This was based on the fact that some members of these groups knew about the existence of various external organisations and the resources that they provided, and therefore were better able to request for them. Besides accessing resources, social capital was also an extremely important factor in the decision of some farmers to take up agroforestry technologies. Cases in point were the farmers from *Ujuzi* and *Urafiki* women groups, who took up agroforestry technologies after observing the impressive performance of maize grown using agroforestry technologies in their chairpersons' farms. That group membership is itself a form of social capital is apparent in the investments required to maintain membership. As already emphasised, it is clear that groups work, but only for those who have assets to begin with. They cannot create social capital from nothing. The truth of the Biblical adage that "to those that have shall be given" is confirmed.

Barazas (public meetings) are important platforms for information dissemination

Indeed this study has shown that most group members got information and seed of agroforestry species from *barazas*; an indication that *barazas* are useful *fora* for information dissemination, not to be overlooked. Similar observations were made by Davis et al. (2004) in a study of farmer groups and technology dissemination in central Kenya. *Barazas* or public meetings are cheaper, and reach many people, but quality is compromised. This, according to Bentley et al. (2003), places development practitioners in a quantity-quality dilemma of how to reach more people without compromising the quality of information on improved agricultural technologies. Other approaches such as radio and the print media could also have been used to disseminate information on agricultural practices. According to Muruli et al. (1999) most farmers in Vihiga district and other rural areas of Kenya listen to agricultural programmes on the radio which could be exploited as a potential avenue to reach many rural people.

Conclusions

There are three main conclusions to be drawn from this chapter. First and foremost is that groups are important in rural social development. They operate on the basis of relations of trust, reciprocity, common rules, norms and sanctions. Through the groups, members - and especially women - are able to access resources which would otherwise be beyond the reach of many. Despite the importance of groups, it was also evident from this study that working with groups using the VCA automatically excluded some farmers from participating, either as a result of certain technical requirements or through the reinforcement of power relations by those in leadership positions. Although it is difficult to avoid the manifestation of power relations in participatory development, exclusion can be minimised if different approaches to technology development and dissemination are explored. It is especially important not to set resource or social status criteria that automatically exclude disadvantaged members of society from participating in development initiatives.

Secondly, by working with leaders of various groups, development practitioners are taking a shortcut that in actual fact is counterproductive, as it ends up empowering a narrow village elite. This is a serious problem that goes against the principles of participation. Real participation can only be achieved if development practitioners take time to empower all community members, especially resource poor farmers at the grassroots, with knowledge, leadership skills and resources, so that they can have the confidence to assert themselves and thereby stand against challenges imposed by village elites. If specific steps are not taken development projects will continue to be dominated by village elites acting on behalf of the poor, who will continue being marginalised. This is therefore a challenge to development practitioners; for change to occur at the grassroots there has to be a radical shift in the way development programmes are implemented. This can happen if development practitioners stop promoting "participation by proxy" and instead start to embrace a genuine participation ethic, and invest the requisite commitment, resources and time.

Third, the use of groups in the VCA has been shown in this chapter to be misapplied. These groups did not play a major role in agroforestry dissemination, as was hoped by the programme. This may partly be attributed to the fact that agroforesty as a technology was not high on the agenda of most groups and therefore farmers did not give it much thought. The use of representative farmers to train others was also not effective, as some of the representative farmers never adopted the technologies and therefore had nothing to show to farmers within their groups. In addition, working with representative farmers from various groups created the opportunity for those farmers in leadership positions to use their social capital negatively, by monopolizing information on development initiatives. This raises fundamental questions about the use of existing groups in technology dissemination. The fundamental justification for using existing groups was the fact that the groups already had a viable structure, and therefore it was easier to deal with them. However, what may have been overlooked by the agroforestry programme was the nature of these groups, i.e. the fact that none of these groups really had the same agenda as the project. Nonetheless, the approach could probably have been somewhat more effective if (1) groups used in technology development had been formed around a common problem of general interests, rather than having to deal with technologies imposed upon them that are not part of their agenda, (2) all members of groups had been given the opportunity by development practitioners to participate in all activities; as it was, there was too much focus on the leaders.

Chapter 4

Participatory learning of integrated soil fertility management among farmers in western Kenya

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A shorter version of this chapter to be submitted for publication to the *Journal of International Agricultural and Extension Education* as:
Kiptot E. Participatory learning of integrated soil fertility management among farmers in western Kenya.

CHAPTER 4

Participatory learning of integrated soil fertility management among farmers in western Kenya

Abstract

This chapter explores how farmers, researchers and extension officers were involved in a participatory learning process on integrated soil fertility management (ISFM). Facilitation was undertaken jointly by researchers from the Kenya Forestry Research Institute (KEFRI), World Agroforestry Centre (ICRAF) and Kenya Agricultural Research Institute (KARI) under the auspices of the agroforestry programme. This was done in collaboration with extension staff from the Ministry of Agriculture. Assessment of the learning process was guided by a framework asking who, what, how, why and from whom. The methodology used was formal interviews with a random sample of 120 farmers from Vihiga and Siaya districts who had participated in the learning process. Informal interviews and participant observation were also used to complement the formal survey. Findings from this study showed that learning resources among farmers include formal agricultural institutions, neighbours, farmers' own experience, friends and relatives. Forums for learning are field days, seminars, tours and *barazas* (public meetings). Different farmers had different reasons for participating. The reasons were to gain knowledge, share experiences, secure a place in future development initiatives, and handouts. Although a substantial number of farmers had an opportunity to attend these learning forums, some were excluded. Exclusion was either by choice or circumstances. Members of village committees - mainly village elites - excluded some farmers from participating. As regards self-exclusion, this mainly affected women, because involvement in household chores restricted time to participate. Furthermore, those women who made it to field days ended up as passive participants. This chapter concludes that participatory learning approaches play a useful potential role in technology development, but for them to be effective, considerable efforts have to be made by development practitioners to come up with approaches that are more inclusive.

Keywords. integrated soil fertility management, exclusion, village elites, passive participants

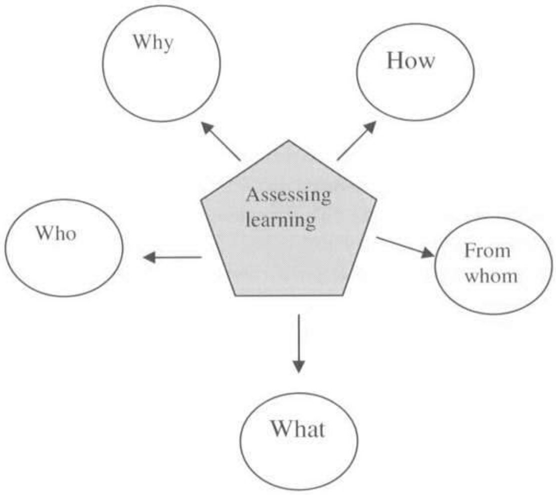
Introduction

Recent years have seen an increase in participatory approaches to learning, in the context of agricultural development (Pretty 1995; Chambers, 1994). This shift from top-down to bottom-up (from blueprint to learning processes) is currently widely implemented by development organisations in many countries. Approaches focus on enhancing farmers' capacity building/empowerment, thereby improving farmers' ability to adapt and innovate, make better decisions and/or influence decision making authorities, and also to provide feedback to researchers. This is because agro-technical systems are dynamic, and therefore farmers have continuously to engage in a process of learning and adaptation in order to keep up with the changing circumstances and requirements. Locations and roles are reversed, with farms and farmers taking the central role, instead of research stations and scientists. For extension practitioners, this means that they cease to be mere channels for concepts and technologies imposed from outside, but catalysts and facilitators helping communities define their own goals. This means learning to learn to interact closely with various local communities and constituencies, and becoming better listeners and facilitators in developing a responsive, two way communication process (Hagmann et al., 1998). The participatory learning process often involves collaborative learning between scientists and/or extensionists and farmers. During this process, all parties learn from each other. Together they explore possible options and decide on what to try, based on both scientific concepts and farmers' local knowledge.

Such learning approaches are currently used in western Kenya by research and development institutions in collaboration with farmers to address problems facing the region. One major problem is declining soil fertility. In the past decade, researchers from a collaborative project involving KEFRI, KARI and ICRAF have worked with farmers in two districts of western Kenya - Siaya and Vihiga – using a community-based participatory approach known as the village committee approach to develop agroforestry technologies responsive to local needs through joint experimentation and learning. The village committee approach aims at reaching all farmers in a village by working with representatives from existing farmer groups. The link between farmers and researchers is via a village committee selected by farmers themselves. Details of how this approach is organised are documented by Noordin et al. (2001). The approach recognises that natural resource management is not characterised by defining problems for which answers must be sought, but rather around issues that need joint learning, reflection, negotiation and feedback. While there is considerable literature on learning processes and their role in agricultural development, very little is documented and understood about actual processes at the grassroots. Are these learning approaches living up to the expectations of being participatory, empowering, transformative and sustainable? This study therefore sought critically to examine the learning process for integrated soil fertility management (ISFM) by farmers in western Kenya. ISFM according to TSBF (2005) is a holistic approach aimed at understanding and managing the full range of socio-economic, biological, chemical, physical and political processes that influence soil fertility. According to Vanlauwe et al. (2002), it involves the use of locally available organic resources in combination with the use of mineral fertilisers to enhance the efficiency of use of both types of inputs. I start by asking two key questions; does learning take place and how can it be assessed? In order to understand the learning process, this study adapted a guiding framework developed by Maarleveld and Dangbegnon (1999) which asks five questions: who learns, what is learned, how is it learned, why is it learned and from whom (Figure 4.1).

Who learns?

"Who learns?" is a central question in participatory processes. The fact that individuals have the capacity to learn does not mean that they will actually do so. There are many factors that determine who does and does not learn. Key among them is power differences between stakeholders (Hall and Nahdy, 1999; Sutherland et al., 2001). Power relations determine who has the means to access learning resources and opportunities, and will be involved in learning. Often those in positions of power have undue influence in determining who should or should not participate in a learning process, as will be shown later in this chapter.



Adapted from Maarleveld and Dangbegnon (1999).

Fig ure 4.1. A guiding framework of assessing learning.

How does learning take place?

How learning takes place is also important in participatory processes. The literature distinguishes three modes of how learning occurs. These are namely direct experience, observation of others experience, and abstraction (Maarleveld, 2003). Various authors such as Dewey (1938), Lewin (1952), Piaget (1969) and Kolb (1984) have focused on direct experience as the central mode of human development (and thus learning). The learning mode is conceptualised in Kolb's (1984) experiential learning cycle. Human cognitive capacities also allow people to learn by observing other peoples' behaviour. Bandura (1977) has been a key figure in drawing attention to this anticipated consequence of behaviour based on observing other people's experiences in similar situations. This type of learning is referred to as social learning.

Why do people learn?

Motivation is the emotional aspect of learning. Learning will not happen if people are not motivated to learn. Motivation is the driver. It gives meaning to learning for the individual. If learning has no meaning for the learner it will simply not happen. In adult education, theorists distinguish between two different types of motivation to learn - intrinsic and extrinsic motivation (Boshier and Collins, 1985). Intrinsic motivation is the driving force behind much everyday social learning. Extrinsic motivation on the other hand stresses education as a means of achieving some other goal in life. According to Maarleveld and Dangbegnon (1999), external triggers - especially crises - are grounds for learning. When faced with a crisis, such as decreasing food production as a result of declining soil fertility, people will be motivated to learn techniques of managing soil fertility in order to increase food production. The literature also points to the fact that a desire to maintain the status quo may also trigger learning (Argyris and Schon, 1996). In this light, learning may be set off by an individual's desire to maintain his/her distinctive identity in the face of evolving conditions. According to Cacioppo et al. (1984, 1996) innovation may also trigger learning. Some people have an explicit desire to look for new combinations and relations among cognitive frames, actions and outcomes. People with a high need of cognitive enrichment find learning satisfying and will always look for new challenges.

What is learned and from whom?

In the context of this study, the focus is on integrated soil fertility management options, with emphasis on agroforestry technologies. The content of what is learnt about such technologies therefore forms the basis of this study and will be discussed in detail in the coming sections. Other sources of learning apart from the agroforestry programme will also be explored.

Methodology

Study sites

This study was undertaken in villages of Siaya and Vihiga districts where the agroforestry programme is working with farmers to develop low cost agroforestry technologies to address the problem of soil fertility among small holder farmers within this region. Like many other areas in western Kenya, farmers here are confronted with problems of poor infrastructure, lack of access to markets, high rates of HIV/AIDS infection, soil fertility decline as a result of continuous cropping without the use of inputs, high infestation of *Striga*, a parasitic weed, etc. These two districts receive relatively high rainfall in a bimodal pattern (1600-1800 mm per year) with rains falling in the first rain season (March to May) and again during the short season in September to October. Livelihoods are subsistence-based, and like everywhere in western Kenya, maize (*Zea mays* L.) is the predominant crop. Other crops include beans (*Phaseolus vulgaris* L.), sweet potatoes (*Ipomea batatas* (L.) Poir.), cowpea (*Vigna unguiculata* (L.) Walp.), sugar cane (*Saccharum officinarum* L.), tea (*Camellia sinensis* (L.) Kuntze), cassava (*Manihot esculenta* Crantz), sorghum (*Sorghum bicolor* (L.) Moench).

Methods

One of the objectives of the participatory learning approach used in the agroforestry programme in western Kenya is to build the capacity of farmers in ISFM so that they may be in a better position to make informed decisions on what options to adapt, based on their socio-economic and biophysical circumstances. Several assumptions were made. These are:

- Building capacity of farmers through learning of principles governing the practices will assist them in making informed decisions beyond situations in which the learning occurred.
- Learning does take place among farmers who are trained.
- The farmers who are trained disseminate knowledge/technologies to relatives, friends and neighbours within the community (this is reported elsewhere, cf. Kiptot et al., 2006).

In order to critically examine the learning process, this study followed the steps outlined below, based on the guiding framework of what, how, who, why and from whom.

i) In tackling the 'what' question, the contents of various farmer trainings were examined in detail to understand what had been taught over the years. This was complemented by participant observation in which the researcher participated in some of the forums to get first hand experience of the process.

ii) In answering the second question of how learning took place, participant observation was used in order to conceptualise candidate learning mechanisms, backed up by secondary data from project records.

iii) As for who participated, why and from whom, a random sample of farmers who had at any one time been involved in any kind of training was made. The list was constructed based on project records, extension officers, village elders and farmers themselves; 120 farmers from Vihiga and Siaya were included, selected randomly from a list of 301. Formal and informal interviews were carried out with these farmers to understand the details of the participatory learning process. Participant observation complemented the interviews.

A fourth objective was to assess learning and find out whether it really took place among farmers. The key questions are: "does learning really take place?" and "how do we assess it?" Few studies in the literature have attempted to assess learning of natural resource management strategies by farmers. A rare exception is Kirkpatrick (in Brookfield, 1986) who came up with a hierarchy for evaluating learning. This hierarchy has several levels: peoples' appreciation of the learning intervention itself, through evidence of their having learnt and what the interventions sought to convey, their application in practice, and finally the impact in terms of benefits received. These benefits could be social, economic or environmental.

The present study assesses learning among farmers who had at any time or another learnt about ISFM. This could have been through field days, seminars, tours, neighbours, relatives, NGOs etc. Assessing learning is quite challenging in that learning does not always translate to actual practice, and therefore it becomes quite difficult to tell who has learnt or not by observation, but one can adapt Kirkpatrick's hierarchy of asking people whether they learnt. Secondly, some farmers learnt several years ago and may have forgotten what they learnt. Thirdly, according to O'Connor and Seymour (1990), human beings have the capacity consciously to take in only a very small amount of information the world offers; we notice and respond to much more without being aware, and hence talking alone may not be enough to gauge what has been learnt, hence the use of participant observation to complement formal and informal interviews. With these challenges in mind, the study sought to assess learning using an approach influenced by Kirkpatrick's hierarchy (Brookfield, 1986). The elements were:

- Farmers' own account/assessment of what they learnt (recall method).
- Farmers' own assessment/account of any ISFM practices they had ever tried out (recall method).
- Researchers' observations and rating of current practices on-farm, i.e. whether the farmer followed the right agronomic requirements and made adaptations.

Results

What was learnt?

Over the last 10 years considerable research and development effort has been put into soil fertility replenishment in western Kenya by ICRAF and its national partners, KEFRI and KARI. Various agroforestry-based options have been developed by researchers in collaboration with farmers. Two of these options are biomass transfer and improved fallows. Improved fallows, according to Sanchez (1999), are the deliberate planting of fast growing species - usually legumes for rapid replenishment of soil fertility. The leguminous shrub/tree species enhance soil fertility by bringing up nutrients from lower soil layers, as well as contributing litter fall and fixation of atmospheric N_2. At the end of the fallow period shrubs/trees are harvested and the leafy biomass is incorporated into the soil while the woody biomass is used as fuel. The other technology, known as biomass transfer, involves cutting biomass from trees and shrubs that are grown away from the farm (or on-farm where land is available) with leafy biomass incorporated on the farm. These two technologies supply the required N, if used in sufficient quantities. However, P deficiency on most farms in western Kenya remains a problem and the addition of phosphate fertilisers is essential to overcome this problem.

The agroforestry-based soil fertility replenishment technologies mentioned above are knowledge-intensive, and for farmers to reap maximum benefits they needed knowledge concerning the best agronomic ways of using these technologies. And because ISFM options are many and varied, farmers need knowledge about the benefits associated with each option, so that they can make informed decisions on what technologies to adapt based on the socio-economic and biophysical circumstances on their farms, hence the requirement for a learning process.

Content of training workshops/seminars

Training materials (decision support tools) were designed in the form of posters, in consultation with farmers using very simple language that could be understood by farmers. These decision support tools enable farmers and service providers to carry out nutrient deficiency diagnosis on their farms and give corrective measures, e.g. ISFM options for *Striga* management and control, and also options for better land husbandry.

Nutrient deficiency diagnosis and corrective measures

During the farmer workshops/seminars, farmers are taught how to identify nutrient deficiency on their farms. For instance, if maize plants on the farm are yellowish in colour, then N deficiency is the problem, and if the plants have purple colouration, P is deficient. This is not something new to farmers, because they have always been able to tell by looking at their crops' vigour (performance), the soil areas that are infertile. Farmers are told that if no inputs are used yields will be very poor or they might not harvest at all. If the deficiency is both N and P, a common feature in many parts of western Kenya, they are advised to use various ISFM options to improve yields. These include use of triple super-phosphate (TSP) or rock phosphate (RP) with calcium ammonium nitrate (CAN) or urea, with high quality hybrid maize, planting of improved fallows with RP or TSP, and planting of leguminous cover crops such as soybeans or groundnuts with the application of RP or TSP and manure with hybrid maize (513 or 514). They are also told that leguminous shrubs replenish only N and therefore if farmers are to reap maximum benefits they need to add an external source of P, either in the form of TSP or RP.

Striga management

Striga hermonthica, commonly known as *witch weed*, is a parasitic plant on grasses, including most cereals (maize, millet, rice, sorghum, etc.). *Striga* stunts growth and causes yield losses as high as 85%. In Africa, *Striga* represents a major biological constraint to food production throughout the sub-Saharan region. The area infested is estimated to be 21 million ha, and a further 44 million is estimated to be in danger of infestation (Sauerbborn and Honisch, 1991). In western Kenya alone, it is estimated that 46,000 ha are infested with *Striga,* and this is likely to increase as population pressure forces farmers to take up continuous maize cropping. *Striga* produces large amounts of tiny, dust like seeds that are difficult to detect and they lie buried in the soil for several years, waiting for a suitable host to be grown. Its build up is associated with continuous cropping of susceptible host plants and depleted soils. In Kenya, the districts most severely infested are Kisumu, Siaya, Vihiga, Kakamega, Bungoma and Homabay (Frost, 1993). Given that *Striga* is more of a problem in nutrient depleted soils, the various strategies described in the previous section for restoring soil fertility have the potential to reduce its effects. For instance, high levels of N fertiliser are known to reduce *Striga* infestation. Since most resource poor farmers cannot afford fertilisers or a *Striga* resistant variety of maize they are encouraged to use other cheap organic options to supply N. This can include the use of improved fallows of leguminous trees and shrubs, biomass transfer technology using *Tithonia diversifolia, and* animal manure. Use of 'false hosts' (also known as trap crops) is another way of controlling the damage caused by *Striga* and reducing the seed bank within the soil. 'Trap' plants stimulate *Striga* seeds to germinate but because the seedlings cannot attach themselves to the roots of the 'trap' plant, the *Striga* withers and dies. Some of the 'trap' plants farmers are encouraged to plant are soybeans, *Mucuna* and groundnuts. Another option which farmers have long used is to uproot the *Striga* before it flowers. Some farmers concede that they have been uprooting the weed only after it has seeded, and hence the high incidence of the weed in their farms.

Options for better land husbandry

Due to land shortage and poverty, farmers in western Kenya tend to plant maize continuously on their farms, without sufficient inputs. Farmers insist on planting maize for home consumption because their first priority is feeding their families. As a result of continuous cropping without replenishing soil fertility yields are so low (less than 1ton/ha) that many farmers are no longer able to feed their families for more than a few months each year, let alone buy inputs for replenishing soil fertility. In order to reap maximum economic benefits from their farms, farmers are advised to plant hybrid maize using a combination of organic and inorganic inputs in the long rain season and plant high value crops such as beans, soybeans, groundnuts, tomatoes, kale, cabbages etc. in the short rain season. This is because the short rain season is unreliable and even if farmers planted a maize crop they rarely harvest much. The high value crops do not require much rainfall and therefore if farmers plant them they are more likely to gain a harvest which can be traded for maize.

How was it learnt?

The agroforestry programme used various kinds of events to train farmers on ISFM options. These events included field days, seminars/workshops, tours and *barazas* (village meetings).

Seminars/workshops

These were held in various villages specifically to facilitate farmers' understanding of the various soil fertility management strategies mentioned previously above. Common venues for seminars/workshops were churches and schools. During meetings, representatives of various village farmer groups were invited to participate. Information about workshops is normally passed on to the village elder who then passes it to village committees charged with the responsibility of selecting representative farmers to participate. This, it was envisaged, would permit representatives to pass what they had learnt to fellow farmers within their existing small groups.

Tours

Tours (or 'look and learn visits' as Hagmann et al. (1999) term them) are planned visits to certain regions within and outside the country to show farmers how counterparts elsewhere implement the technologies. Farmers have been taken to various parts of the country and even neighbouring countries to see the technologies implemented. These tours give farmers the opportunity to see for themselves concrete evidence of the value of improved practices. It is often said that 'seeing is believing.' Tours are very popular with farmers because they travel to places they have never been before, and receive a daily allowance as high (at times) as KSh.500 (US$7). This is considerable wealth by farmer standards.

Field days

These are usually held at the research station where on-station demonstration trials have been set up, or on farmers' fields in the village. The idea is to display to farmers some of the promising technologies in a working context in which farmers can see and learn directly how to implement some of the technologies. The field day may be hosted by a farmer, a school or a project operating within the locality. These are forums where farmers have an opportunity to share their experiences with each other in an organised way. The host could be an individual or a group, with an opportunity to explain to others what he/she/they did. Other farmers also give their experiences and by so doing mutual learning takes place. Such days are usually entertaining, with some farmers offering songs. Food and drink may be available in abundance. It is usually an event farmers look forward to attending. I had an opportunity of participating in a field day in 2004 that had been organised by the Ministry of Agriculture in Ebulonga focal area in Vihiga district so that farmers could share their experiences on different ways to use *Tithonia*. The field day was held at the homestead of a farmer experienced in use of *Tithonia*. During this particular field day, the local leaders (i.e. the assistant chief and the village elder), extension officers from the Ministry of Agriculture and two KEFRI staff were present. As is often the case with field days, there were many more male farmers than women (34 men and 8 women). Below is an excerpted account of the interaction between farmers, host, extension officers and researchers.

> The field day started with a welcome speech from the officers of the Ministry of Agriculture. Guests were introduced, and to observe protocol, the local assistant chief was

invited to give a speech. As is common with local leaders, he urged farmers to engage themselves in activities that bring prosperity and not in *chang'aa* and *busaa* (drinking local brew). He reminded his listeners that anybody found in possession of local brew would be arrested. The other guests were then invited to greet farmers and to tell them about the organisations they represented. The host was eventually given an opportunity to show farmers the crops he had planted after using *Tithonia,* and his impression of the technology.

Host: *Maridadi (Tithonia) is really good for those farmers who cannot afford fertiliser. During the last rains, I collected maridadi from my hedge, chopped into small pieces and applied it in the planting hole, after which I planted sukumawiki (kale). As you can see, my vegetables are doing very well. I also used it as a pesticide to spray on kale after the crop developed scale.*
Farmer1: *How much Tithonia did you put in a planting hole?*
Host: *I scooped a handful.*
Farmer 2*: Last season, I used Tithonia to plant maize in a small portion of my farm, but the maize did not germinate. I was very disappointed.*
Researcher: *There are two possible explanations. One is that you might have applied too much Tithonia in the planting hole, and secondly you might not have covered Tithonia with a thin layer of soil before sowing your maize seed.*
Farmer 2: *I actually sowed my maize seed directly without covering Tithonia with a thin layer of soil.*
Farmer 1*: You mentioned that you used it as a pesticide, how did you do that?*
Host: *I mixed chopped Tithonia leaves with ash and pilipili (chilli) leaves and soaked them in water for about a week, after which I sieved the mixture and sprayed it on my sukuma (kale). It actually killed all the scale.*
Farmer 2*: This is really useful for those of us who cannot afford pesticides. They are really expensive.*
Extension officer: *There are many other ways in which Tithonia can be used; can anyone share their experiences?*
Farmer 1: *Last season, I used it to plant my tomatoes, and they did very well.*
Farmer 3*: I have been using it to make compost, what I do is that I dig a pit, line it with Tithonia, after which I put farmyard manure; at about halfway I put in Tithonia again and then fill it up with farmyard manure. The compost I have been getting from this is really good.*
Farmer 2: *I have planted Tithonia along terraces in my farm, and sometimes when I do not have sufficient time to chop Tithonia into small pieces, I trim the hedges and throw the Tithonia on the surface of my farm, and later when I cultivate, it is automatically incorporated in the soil. Portions where I throw Tithonia usually have better maize yield than elsewhere in the farm.*

During question time, the discussion was dominated by two male farmers and the extension officer. None of the women present asked a question or shared experiences. After the field day, I had an opportunity to interact with some farmers to find out why they attended the field day. There were varied reasons. One farmer indicated that he had tried using *Tithonia* before when planting his maize, but his crops did not germinate and therefore he wanted to find out what the host of the field day did, so as to have a good crop. Others indicated that they had all been invited by the village elder, and not attending without a good reason would be construed as disobedience, which could have serious consequences. For instance if in future any development project was brought to the area, only farmers known to be receptive to development would be involved, and no one wants to be left out.

Barazas

Baraza is Swahili for public meeting. It is usually the responsibility of the local administration, i.e. village elders, chiefs and divisional officers to hold a *baraza*. They normally do this when they have important issues to discuss. Development projects like to take advantage of these forums to discuss the development initiatives they are spearheading. *Barazas* are open to all, unlike seminars, tours and fields days, which are limited to the chosen few. *Barazas* are good for creating awareness but the main limitation is that issues are not discussed in detail.

Who participates in the learning process?

Farmers were asked if, and if so, what kind of training forums they had attended covering soil fertility management. The responses are summarised in Table 4.1

Table 4.1. Percentage of farmers who participated in various types of training

Type of training	Siaya n=60 % of farmers	Vihiga n=60
Field day	78	65
Seminar/workshop	53	75
Tours	58	32
Seminar organized by village committee	27	17
Barazas	85	72

NB. Farmers gave multiple responses

It transpired that the largest percentage of farmers had participated in *barazas*. These are public events, and everyone in the village is invited, so many people get to attend. Somewhat fewer farmers - 78% and 65% in Siaya and Vihiga respectively – had participated in field days. Field days are usually held within the locality and many farmers are invited. Since they are held locally projects do not incur expenses such as transport, accommodation and allowances. The only expense is to offer lunch and drinks for participants (usually a soft drink and bread). Tours had been attended by over half the farmers in Siaya (58%) and just under one third of farmers in Vihiga (32%). Information about tours and other training opportunities (objectives and venue) is usually passed on to village elders who also double as patrons of village committees. They then pass on the information to the village committee through the secretary or the chairman who then selects participants for the seminars and tours. Most farmers I talked to had a lot of complaints about this. They alleged that officials of village committees only chose people close to them (such as friends and relatives) to join tours. One farmer from Sauri sub-location, Siaya district said this about tours.

> *'There's a lot of favouritism in our sub-location about who goes for tours. Only a few individuals go, the chairman, his son, the secretary and his two brothers. Some of us have no chance at all.'*

Another farmer from Musikuku village in Vihiga looked very sad when I asked him if he had attended any of the tours.

> *'The tours are only for the well off. Whenever there's a tour, the leaders who are well off, inform only their friends and relatives. We only get to hear of the tours long after they have happened.'*

Places where farmers have been taken for tours are Kitale (Rift-valley province), Embu (Eastern Province) and Uganda (a neighbouring country). When farmers go for tours, they are paid a daily allowance, up to US$7 per day. In a region where most farmers survive at less than US$1 a day, US$7 is a real incentive. It is because of the economic benefits associated with tours that officials choose themselves and their relatives. A farmer from Musikuku village of Vihiga who has participated in several tours stated:

> *'Tours are really good. When we went to Embu (eastern Province) and Uganda, we saw how farmers can maximise production in a small portion of land, and when I got back, I changed the way I have been farming. We were also paid good allowances. I saved KSh. 11,000 (US$157) which I used to buy a dairy cow when I came home.'*

When I raised the issue of selection with the agroforestry programme staff, they indicated that all they do is organise the trainings, and then ask village committees to select individuals to participate. One of the project officials had this to say,

> *'We leave everything to farmers to decide on who is to participate; we do not influence this because we do not want to be seen to be interfering in village activities.'*

The secretary of one of the village committees indicated that once they get word from project officials to select farmers to participate, they call a meeting to pass the information to other members, who are requested to propose names of farmers within their respective groups in the village. Because most farmers are illiterate, they often choose those they think will be able to learn from the tours and train other farmers; hence the same people are chosen all the time.

In addition to field tours, there are also seminars organised by the village committees to pass on information from tours, and seminars organised by project officials. Only 27% and 17% of farmers interviewed from Siaya and Vihiga districts respectively have ever participated in these seminars. Seminars organised by village committees are usually not popular, and attended by few farmers. One young man maintained that he never attends such meetings. He had this to say:

> *'Those seminars in the village are conducted by farmers who have been to tours and seminars. They are trained for one day, and then when they come back, they claim to be experts. How can they be experts? We (also) want to be trained by officers who are knowledgeable about these technologies.'*

There are other reasons why seminars organised by village committees are not popular:

i) The facilitators are villagers who have participated in the trainings organised by projects and other farmers have the mentality that they do not know much and hence may not give them quality information, unlike project officials.

ii) Resentment towards farmers who participate in tours. Since most farmers are not given an opportunity to participate in tours, they feel that only those ones who are favoured should participate in seminars; they are the ones perceived to benefit.

iii) Seminars are organised in the afternoons, and no soft drink or bread is served, in contrast to seminars organised by funded projects where farmers are served with drinks and bread at a midday break. A meeting without bread and soda would be attended by very few farmers.

iv) Religious differences. Some seminars are held in local churches, and some farmers feel that if they do not belong to that particular church they have no reason to participate. Religious differences are particularly common in Vihiga district whereby the majority of farmers belong to the Church of God. There have been leadership wrangles within the Church of God for quite a while, involving the current church leader, and his rival, and hence the emergence of two factions. Some particular churches support the current leader while others support his rival. If a seminar is held in a church whose leaders support the current leader, then farmers supporting his rival would not participate.

Characteristics of farmers who have participated in various trainings

Findings summarised in Table 4.2 convey a picture of the background of participants in learning events. From this table it is clear that it is about four times more likely that males will have received training as females, even though women are a very important group of farmers, and many of the poorest households are female-headed. Also the trained group of farmers has an average age of 50-52 years, i.e. they are at the older end of the age spectrum of farmers. Trained male farmers have generally completed primary school, and have more education than female farmers in the sample. Because there is no control sample of non-trained farmers against which to compare trained farmers it cannot be ascertained whether the trained population is typical of the larger population. The Siaya and Vihiga samples are broadly comparable, except that farm sizes are smaller in Vihiga (something known to be generally true for the district) but improved cow ownership higher, and the number of trained farmers living in thatched houses (the poorest type of accommodation) is less than half the number in Siaya, which might indicate that the project was less good at attracting the poorest farmers in this district (since there is no reason to suspect that the more densely populated district has a better average quality of housing stock).

Table 4.2. Characteristics of farmers trained on ISFM

Characteristics		District Siaya n=60	 Vihiga n=60
Average Age (yrs)		52	50
Gender (%)	Male	80	75
	Female	20	25
Type of main house (%)	Grass thatched	22	8
	Semi-permanent	73	85
	Permanent	5	7
Average no. of years of schooling	Male	7.5	7.2
	Female	4.7	4.2
Average no. of groups		2	2
Access to hired labour (%)		67	60
Average farm size(ha)		1	0.47
Ownership of improved cows (%)		23	43

It can be added that in a study conducted by Place et al. (2007) on rural poverty and investment in agriculture in western Kenya, ownership of a grass thatched house was considered by farmers as one of the indicators of 'poverty' while farmers with semi-permanent houses are considered to be of 'average' wealth status while those with permanent houses are considered 'rich' or 'above average.' On the low participation of women in training it can be added that although women perform most of the activities on farm, it is their husbands who participate in seminars, workshops and tours. This is so with tours because some take more than a day. Women who have school-going children cannot afford to go for tours because of family chores. It is right to ask, therefore, whether seminars/workshops or tours are the most appropriate vehicles to train a target group with many women. One woman who participated in a tour experienced an unfortunate incident which has made her determined never to participate again in a tour. She had this to say:

> *'One time the agroforestry project took us to Kitale Manor house, but unfortunately the bus broke down on the way, which forced us to spend two days away from home. We never made it to Kitale; we had to come back. My husband was not happy, and therefore I would not ever want to go for a tour.'*

Does learning take place?

What farmers learned

Farmers were asked what they had learnt over the years about integrated soil fertility management options. Aspects mentioned were different types of ISFM options, species used for fallow, species used for biomass transfer, N_2 fixation, crop rotation, composting, *Striga* control, use of *Tithonia* in compost, use of *Tithonia* as liquid manure, when to plant an improved fallow, soil conservation and the preparation and use of animal manure (Table 4.3).

Table 4.3. Aspects of ISFM options farmers have learnt

ISFM options	Siaya n=60 % of farmers	Vihiga n=60
Different types of ISFM options	100	100
Species used for fallow	93	82
Species used for biomass transfer	93	92
N_2 fixation	26	13
Crop rotation	58	58
Composting	17	40
Striga control	60	38
Use of *Tithonia* in compost	42	17
Use of *Tithonia* as liquid manure	18	8
When and how to plant a fallow	42	30
Mineral fertiliser application	13	18
Soil conservation	*	*
Use of animal manure	*	*

NB: There were multiple responses

Animal manure application and soil conservation were mentioned by farmers as technologies they already knew, and although they learnt about them in seminars, they did not consider them to form part of what they had learnt. Composting, though not new in western Kenya, was in most cases not prepared in the right way. Farmers who had been composting before the trainings said that they used to leave the pit open, thereby giving room for nutrients to escape, and that through seminars and field days they had learnt new ways of managing compost manure.

Species used for fallow
Although all the interviewed farmers new about the improved fallow technology, not all of them new about the tree/shrub species used for fallow: 93% and 82% of farmers in Siaya and Vihiga respectively said they knew about the species used for fallow. Only a minority in both cases had no idea what species were used for fallowing. Not all the farmers knew the species by name, but they had their own way of describing the species. They either described the species, or used a local common name, for particular species. For example, *Tephrosia vogelii* is known to some farmers as the mole tree (farmers claim the tree repels moles); others call it the "ICRAF tree with white flowers" or "the fertiliser tree used to capture fish." *Tephrosia candida*, a related species, is described as "the fertiliser/ICRAF tree with purple flowers that grows quite tall". *Crotolaria grahamiana* is described as "the fertiliser/ICRAF tree that attracts many caterpillars and produces beautiful yellow flowers" while *Crotolaria paulina* is known as "the fertiliser/ICRAF tree that is related to *C. grahamiana* but with big broad leaves and a soft stem". *Crotolaria ochroleuca,* which has a close resemblance to a local indigenous vegetable known as '*mitoo*' (*Crotolaria brevidens)* is referred to as "exotic *mitoo*". *Sesbania sesban,* an indigenous leguminous tree used for fallowing is called *sabi sabi* by the *Luhya* while the Luo call it *oyieko,* though not very popular because it is difficult to germinate, takes long to mature, and hosts nematodes.

Farmer knowledge of fallow tree and shrub species
Thirty three percent of farmers in Vihiga knew only one species for improved fallow while in Siaya 35% knew about four fallow species (Figure 4.2). The most common fallow species mentioned by farmers in Siaya are *Crotolaria grahamiana, Tephrosia candida, Tephrosia vogelii, Sesbania sesban and Crotolaria paulina.* Most farmers in Vihiga only knew about *Crotolaria grahamiana,* because it is a species widely used by farmers practicing improved fallows. *Sesbania sesban*, the first species tested for use in improved fallows in western Kenya (Swinkels et al., 1997), although no longer recommended as an improved fallow, is widely scattered in farms, and farmers do not consider it a fallow improving species. One farmer, Martin Onanda from Siaya, knew eight species of improved fallows, and has tried them all. Martin is a village elder of Luero village and the patron of the village committee. He was one of the first 'research' farmers whose farm was used by the agroforestry programme for on-farm research trials in the early 1990s. He has been working closely with the project by virtue of his position as a village elder. It is through him that researchers came to be linked with other farmers in the village. The other farmers mentioning as many as seven species have also been working closely with the agroforestry programme as research farmers.

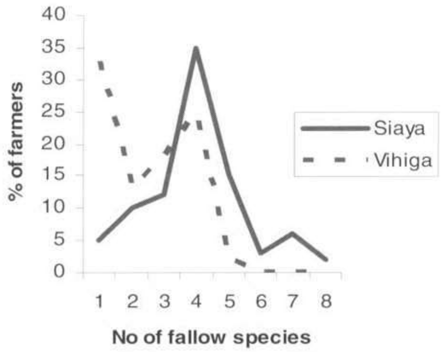


Figure 4.2. Numbers of fallow species known by farmers

Crop rotation

Crop rotation as a strategy for replenishing soil fertility was mentioned by 58% of farmers in both districts. They indicated that they had learnt about alternating legume cover crops with pulses. It is interesting to note that most farmers had a different notion of crop rotation before the training. They indicated that they were practicing crop rotation by alternating maize with millet, sorghum or sweet potatoes, but not leguminous cover crops. Even though many farmers thought crop rotation is good for the soil, they also often indicated they cannot practice it because farms are so small.

Species for Biomass transfer

A majority of farmers - 92% and 93% from Siaya and Vihiga respectively - knew about *Tithonia diversifolia* as a species used for biomass transfer. Most farmers referred to it by its generic name, *Tithonia*. Those who could not remember its name generally used either the local name or described it. The Luo call it a*ketch* which literally translates to bitter. The roots of the species are commonly used to treat stomachache in both communities, and are indeed very bitter. The Luyha refer to it as *maua malulu* meaning a flowery bitter plant, or *maridadi,* which translates as "something beautiful or appealing to the eye". Others simply referred to it as "the fertiliser tree that is used as a hedge and has beautiful yellow flowers".

Nitrogen fixation

A minority (26% and 13%) of farmers in Siaya and Vihiga districts indicated that they had learnt about N_2 fixation and could confidently explain what the leguminous plants do to the soil. Most of them are farmers with some secondary school education. A few with little education knew about the nodules and indicated that species with nodules added fertiliser to the soil, but could not name the type of nutrients added to soil when leguminous trees/shrubs are planted.

Striga control

Striga control had been learnt by 60% and 38% of farmers in Siaya and Vihiga respectively. On probing further about how *Striga* is managed, farmers gave different options such as uprooting before flowering, using *Striga*-resistant maize, using 'trap' crops such as soybeans and groundnuts, and practicing the "push and pull" technology promoted by the International Centre of Insect Physiology and Ecology (ICIPE)[7].

Table 4.3. *Striga* control options learnt by farmers

Striga control option	Siaya n=60	Vihiga n=60
	% of farmers	
Uprooting *Striga* before flowering	60	38
Use of leguminous fallow species	47	13
Use of *Striga* resistant maize	0	6
Use of 'false' hosts/ trap plants	13	25
Use of the push and pull technology	6	32

Figure 4.3. A maize farm infested with *Striga* in Soso Village, Siaya district.

NB: there were multiple responses

Most farmers indicating knowledge of *Striga* control mentioned uprooting *Striga* before flowering. Uprooting *Striga* is a traditional practice, but the only problem is that many farmers continued to uproot *Striga* after it had seeded, which serves to spread the seed on their farms. During the participatory learning forums, emphasis was put on uprooting before flowering. Another option farmers mentioned is the use of fallow species; 47% of farmers in Siaya mentioned improved fallows as an option, but only 13% of farmers in Vihiga mentioned it. A possible explanation for this difference is that more farmers practice improved fallows in Siaya than Vihiga. According to this survey, in the year 2004, 56% and 10% of farmers in Siaya and Vihiga respectively used improved fallows on their farms. The use of *Striga* resistant maize was mentioned by a few farmers from Vihiga district, though the variety is still under screening on-farm (it has not yet been released to the market). This would explain why few farmers mentioned this particular option. 'Trap' crops or 'false' hosts were mentioned by more farmers in Vihiga than Siaya. This is probably because growing legumes, such as soybeans and groundnuts, is more prevalent in Vihiga than Siaya. 'Push and pull' technology, which is a new option introduced by ICIPE, is currently being promoted more in Vihiga than Siaya, hence the higher number of farmers in Vihiga reporting it.

[7] Push-Pull is a cropping strategy for the management of stem borers, *Striga* weed and soil fertility. Farmers plant napier grass (*Pennisetum purpureum)* and *Desmodium uncinatum* with maize. *Desmodium* is planted in between rows of maize. It emits chemicals (kairomones) which repel stem borer moths and 'pushes' them away from the maize crop. At the same time, it is very aggressive as it completely covers the surface, suppressing all the weeds including *Striga*. Once the stem borers are 'pushed', they are attracted by the napier grass planted around the maize plot as a 'trap crop.' It 'pulls' the stem borer moths, which later lay their eggs on the napier grass. Napier grass has a particularly clever way of defending itself against pest onslaught; once attacked by a borer larva, it secrets sticky substances that physically trap the pest and effectively limit damage, so that very few larvae survive (ICIPE, 2007).

Finally, it is worth adding some evidence that most farmers practised at least some of what they had learnt (Table 4. 4). Across the samples for the two districts soil conservation and crop rotation were the practices tried most and least.

Table 4.4. What farmers tried

Aspects ever practiced	Siaya n=60	Vihiga n=60
	% of farmers	
Improved fallows	71	38
Crop rotation	58	36
Biomass transfer	80	35
Soil conservation	72	85
Composting	70	42

Researchers' observation of ISFM practices on farmers' fields

Researchers were asked to assess what farmers had on-farm, and whether they had followed the right agronomic principles, and also to assess farmer adaptations. This proved to be quite challenging task, considering the fact that some of the practices could not be observed directly, as they were undertaken when planting, or (as in the case of crop rotation) two seasons are needed for the practice to be completed. In any case, the exercise was undertaken at the time of year when farmers had harvested the beans and cowpeas they had intercropped with maize and some had replaced them with rows of fallow species in between the maize. The only technology that could be observed directly was improved fallow. Improved fallow was observed on 56% and 10 % of farms in Siaya and Vihiga respectively. Out of 33 farmers in Siaya with improved fallows at the time of the assessment, 29 farmers had planted the fallows according to what had been learnt in seminars, although species mixtures varied from farm to farm. Four farmers had scattered the fallow crops in their farms. In Vihiga, only 6 out of 60 farmers had improved tree fallows, and out of this small group, one had planted the species at very low density, scattered in his farm. The other five had followed the formal procedures. When asked why he planted his fallow species scattered on the farm, the low-density fallow farmer indicated that he was trying to prevent moles from destroying his crops.

Farmer adaptations

As a result of discussions with farmers, and according to observation made in the fields, it turned out that many farmers had come up with various adaptations. Some of these adaptations are discussed below.

Use of Tephrosia for repelling moles

Some farmers believe that *Tephrosia vogelii* repels moles and therefore they planted *Tephrosia* along boundaries in their crop land, while others scattered it in their farms. The claim is not new in the literature; Douthwaite et al. (2003) reported that farmers in Uganda also believed that *Tephrosia* repels moles.

Using Tithonia for top dressing, compost, mulch and pesticide

Tithonia is used by farmers in a variety of ways, e.g. as a substitute for urea which is normally used for top dressing maize. They soak chopped *Tithonia* leaves in water for three days, sieve and use the liquid for top-dressing. Another adaptation which farmers use widely is as a pesticide. Some mix *Tithonia* with ash, others with chilli leaves, and then let the mixture settle for a couple of days after which it is sprayed on their crops. Another farmer adaptation is the use of *Tithonia* for making compost manure. Those using this technique claim that it is less labour intensive than chopping *Tithonia* into small pieces; additionally, they claim it makes the compost 'cook' very fast.

> *'Tithonia is really good when put in compost. It produces heat which 'cooks' the compost really well making it ready for use faster than usual.'* (Mama Selina, Soso village, when encountered incorporating *Tithonia* in her compost pit).

Planting Mucuna immediately after harvesting maize without having to weed

Some farmers plant *Mucuna* immediately after harvesting maize after the long rain season without having to weed. This is because *Mucuna* is very aggressive, chokes all the weeds; therefore, after it is harvested the field is free of weeds and a farmer can plant his/her maize without having to plough during the following long rain season. Mama Monica from Soso village (Siaya district) shared her experience thus:

> *'After harvesting maize planted during the long rains, I plant Mucuna in the short rains without having to weed my shamba (farm). The Mucuna grows very fast, suppressing all the weeds. The maize stalks left in the shamba provide support to Mucuna. After a while, it sheds all its leaves leaving the soil soft and dark without any weeds. Although I usually do not get any edible products, I am quite happy because Mucuna improves my soil and at the same time it saves me a lot of money which I might otherwise have used to buy mineral fertiliser and hire labour for land preparation and weeding.'*

Using species mixtures in fallows

Different farmers use a whole range of species mixtures for different reasons, such as to control pests, provide a thick canopy in order to increase biomass, and to cut off light to the undergrowth, thereby getting rid of weeds such as couch grass and *Striga*. For instance, the assistant chief of Nyamninia sub-location uses a mixture of *T. vogelii* and *C. grahamiana* to reduce the infestation of the lepidopterous caterpillars of the genus *Amphicallia*. He shared his experience thus:

> *'C. grahamiana attracts caterpillars which scare away my wives. In order to reduce their population, I mix C. grahamiana with T. vogelii. I plant one row of maize followed by either one of them followed by another row of maize. I believe that the smell of T. vogelii completely repels the caterpillars.'*

On the other hand, another farmer, Mzee Ochido from Sauri village, mixes *T. candida* with *T. vogelii* in order to form a dense canopy, thereby getting rid of the notorious couch grass and *Striga* weed.

Sources of learning (from whom)

Apart from ICRAF, KEFRI, KARI and the Ministry of Agriculture, farmers have learnt about ISFM options from other sources. I sought to find out from farmers the various sources of learning (Table 4.5). Apart from formal institutions, these results indicate that farmers' own experience is an important source of learning. A discussion with some farmers indicated that through learning from their own experience they are now able to manage soil fertility in their farms much better. For instance, Martin, a farmer in Luero village, shared his experience thus:

> *'Through the years, I have learnt that when T. Candida is harvested after 18 months the fertility of the soil is very high, the residual effect can last up to four cropping seasons. Usually after harvesting T. candida, fertility is 100%, I plant maize without any inputs; after harvesting maize, I plant kale, which after harvesting reduces the fertility to about 50%, then I sow maize again and later under-sow a short duration fallow of either 3 months (Mucuna) or C. grahamiana (6 months) to bring back the fertility to 100%.'*

Table 4. 5. Farmers' 'other' sources of learning

Sources	Siaya n=60 % of farmers	Vihiga n=60
Neighbour	10	15
Own experience	30	10
Farm Africa (NGO)	3	28
ICIPE (research)	8	45
TSBF (research)	5	3
Kin and affines	25	10
Group member	20	10
Other	8	6

NB. there were multiple responses

Mistaken learning, mis-information and misunderstanding

Different people have different learning abilities. Sometimes knowledge may be misinterpreted by the learner. This study found out that some farmers had different interpretations of knowledge passed onto them about integrated soil fertility management options. The cases are discussed below.

Case 1

When the agroforestry programme was testing the use of *Tithonia* as a green manure, researchers found out that supplementing *Tithonia* with phosphate fertilisers tremendously increased the yield of maize. As a result of these findings, the programme decided to test this out with many farmers in Siaya and Vihiga districts who were issued with free RP fertiliser to be used with *Tithonia* when planting crops. This was done so that the performance could be assessed by farmers on their own farms. Some farmers who tried out *Tithonia* with the free RP fertiliser got the impression that *Tithonia* has to be always used with RP fertiliser. During subsequent years when there was no more free supply of RP, farmers who had used it earlier stopped using *Tithonia* because they could not afford phosphate fertilisers. Mama Elizabeth from Siaya district stated:

'I planted maize using Tithonia biomass once when the agroforestry programme gave me free RP. I was told that in order for a farmer to get good yields, RP fertiliser has to be added to Tithonia. The following year, I waited for them to give me fertiliser, I never saw it and therefore have not planted using Tithonia ever since because I cannot afford to buy mineral fertiliser.'

Case 2

Another incidence of mistaken learning is the case of *Tephrosia vogelii*. Some farmers had heard that one of the ICRAF species was a mole repellant. Because they were not sure of the species, some planted *Mucuna* while others planted *Tephrosia candida*. This is due to the fact that they had heard that the species that repels moles was brought by ICRAF and therefore those who came across *Mucuna*, which had also been introduced by partner NGOs, planted it because they thought that it was the right species for repelling moles.

Case 3

When the agroforestry programme was promoting leguminous trees/shrubs for soil fertility management, the majority of farmers thought that the leguminous trees would work the same way as mineral fertilisers. In fact most farmers refer to the leguminous shrubs/trees as 'fertiliser trees.' When they planted and did not get spectacular results, as would have been expected had they used mineral fertilisers, they abandoned the technologies because expectations were not met.

Discussion and conclusions

Participatory learning in general refers to a process whereby people interact and learn from each other. In addition, local people are active participants rather than passive objects in the learning process. The cases presented in this chapter illuminate situations where extension officers and researchers are taking up new roles, such as convener of farmer meetings/field days, facilitator, and advisers in the participatory learning process. And the fact that some learning takes place on farmers' fields with farmers as hosts is an operational shift towards interactive participation. The type of scenario where farmers are given an opportunity to share their experiences, and engage researchers and other farmers in dialogue, creates an environment conducive to local adaptation and innovation, and is therefore more likely to generate sustainable adoption. The field day mentioned in this chapter generated a lot of feedback which researchers can use as a resource for planning new research to address farmers' concerns. Farmers, as has been shown, were also adept at hand picking knowledge they could adapt to their own situations.

The question of who participates and who benefits is fundamental to participatory processes. This chapter has also shown that despite attempts by project officials to put locals in the driving seat on technology initiatives, achieving genuine participation has remained elusive. Some people were virtually excluded from the learning process. Exclusion was either by choice (self exclusion) or a product of village power politics. Part of the reason lies in the fact that despite the shift from top down to bottom up in development circles, community structures remain paternalistic, with a few (better educated, better connected) elites (often older farmers retired from urban employment) controlling development initiatives. We had cases of farmers alleging that there was a lot of discrimination about who participated in learning programmes. One farmer alleged that only the chairman, his son and the secretary of the village committee ever attended seminars and tours. Such issues are not unique to western Kenya alone; rather they highlight key challenges which face many development initiatives. This is a major obstacle to participation, and unless it is tackled, efforts being made to involve marginalized members of society through up-scaling of development initiatives will have disappointing results.

Self exclusion comes about because of the gender division of labour, where women do most of the farm and household chores, thereby leaving no time for field days, seminars and tours. Women are excluded from participatory learning through the way it is organised, yet when it comes to implementation, they are the ones most involved. The point has been noted by several researchers - e.g. Mudege (2005) and Hagmann et al. (1999). Even for those few women who make their way to field days and seminars, rarely do they raise a voice, and hence their participation remains passive. How can we then talk of participation when some members of the community are left out? Unless efforts are made to enable marginal voices to be raised claims to inclusiveness often made by advocates of participation will be vacuous. Having women attend seminars, field days, etc is not enough; they need also to be active participants in the learning process. What is needed is specific attention to empowering women and the marginalised members of the community, so that they can have confidence, and therefore be able to assert themselves, and share their experiences with other members of the community. Leaving women out means that a substantial body of knowledge is not shared with the rest of the community.

Motivation is the driving force behind everyday learning. This chapter has shown that farmers had different reasons for attending field days, seminars and tours. Some farmers attended these learning forums not only to gain more knowledge on how to manage soil fertility on their farms but also as a way of securing their place in future development initiatives brought by external organisations. This observation was also noted by Mudege (2005) in a study of knowledge production and dissemination in Zimbabwe. In addition, some participated in tours in order to make some badly needed cash from the allowances paid to them to take part. Development professionals need to take the initiative in teaching farmers to appreciate the importance of interactive learning sessions as a means to generate knowledge exchange. Policy on handouts should be re-thought. Maybe films are better than tours, for example. Attitudes do not change overnight but gradually and eventually we may end up seeing situations where farmers participate even in forums for reasons other than securing a free lunch.

Finally, it can be concluded that inclusive and interactive learning processes are possible, but efforts are needed to limit the undue power and influence exercised by village elites (Chambers, 1997). The requirement is to create a space in which marginalised farmers can play a more significant part in participatory processes. In providing genuine space, it is assumed that, over time, marginalised people will come forward and participate more actively in development initiatives (Pijnenburg, 2004). For women to be involved, gender sensitive measures need to be implemented, such as holding meetings when women are free, having separate meetings for men and women, and encouraging women to share their experiences in meetings where male counterparts are present. With time their confidence will grow. Women's confidence may be as important an ingredient as biomass transfer in laying the foundations for stable, sustainable agriculture in western Kenya.

Chapter 5

Sharing seed and knowledge: farmer to farmer dissemination of agroforestry technologies in western Kenya

This chapter has been published in a modified format as:
Kiptot, E., Franzel, S., Hebinck, P. and Richards, P. 2006. Sharing seed and knowledge: farmer to farmer dissemination of agroforestry technologies in western Kenya. *Agroforestry Systems* 68 (3): 167-179.

CHAPTER 5

Sharing seed and knowledge: farmer to farmer dissemination of agroforestry technologies in western Kenya

Abstract

Although there is increasing emphasis on farmer led extension in rural development, very few studies have been done to understand the social processes involved. This study was undertaken to identify farm and farmer characteristics that may influence dissemination of seed and knowledge of improved fallows and biomass transfer, focusing on to whom, how and what is disseminated. This was done by carrying out a formal and informal survey involving a random sample of 120 farmers from Siaya and Vihiga districts of western Kenya involved in a pilot project on soil fertility replenishment by the World Agroforestry Centre (ICRAF), Kenya Forestry Research Institute (KEFRI) and Kenya Agricultural Research Institute (KARI). A second survey involved 40 farmers, selected using a snowball sampling technique, given seed and information by the first group of farmers. Descriptive statistics and logit regression models were used to analyse data. Results presented show that seed and knowledge were mostly shared along kinship lines. Furthermore, informal social networks were found to be more effective for seed dissemination than for knowledge sharing. This calls for simplification of technical information by development professionals, in order to help support farmers' understanding and communication of complex principles. Farmers with leadership status in their groups, those who belonged to many groups, and those with larger farm sizes were more likely to give out seed for improved fallows. These categories of farmers could be targeted to enhance the spread of technologies.

Keywords: biomass transfer, improved fallows, kinship ties, knowledge generation, seed, snowball sampling

Introduction

In recent years, a number of research and development institutions working with farmers have initiated successful sustainable agricultural practices in the developing world (IIRR, 2000). Despite the increasing number of successful agricultural initiatives, it is clear that most of them are still only 'islands of success' (Pretty, 1995). Whether the potentials and spread of these initiatives are realised will depend on levels of investments, appropriate policies and the development and promotion of new methodologies and strategies for up-scaling. New conceptual frameworks for facilitating scaling up/out are therefore needed.

In the past, public sector agricultural extension and research services in developing countries played a very important role in promoting technological innovation in agriculture. Between 1970s and the 1990s, the primary policy tool for sharing information about new agricultural technologies in developing countries was the Training and Visit (T&V) system (Benor and Harrison, 1977). Because of much criticism about the ineffectiveness of the T&V, the extension system in many developing countries has been changing to accommodate challenges presented by the linear model of technology transfer. A lot of emphasis is currently placed on participatory learning approaches, where the role of extension officers changes from agent communicating technical messages to facilitator. Despite this change, the extension system in most developing countries and Kenya in particular has not had the expected impact on small scale farmers.

A wide range of factors contributes to the current situation. First and foremost, many extension officers have been retrenched due to structural adjustment programmes imposed by the International Monetary Fund, leaving a skeleton staff to carry out extension. The situation on the ground is one of demoralised staff with limited resources to carry out extension. Secondly, because of high levels of corruption and mismanagement of donor funds in government circles, there has been a major shift in donor support to non-governmental organizations (NGOs) which stepped in to fill the gap in extension. Thirdly, NGOs services have often been patchy (Davis et al., 2004). Most of their activities are programme based and operate in an area for only a few years with no continuity after they leave. Furthermore, there is no uniformity in the extension approach used. So the question that needs to be asked is how can technologies that have been developed over the years by researchers in collaboration with farmers be extended or scaled up in such an environment? And this is not just a question of going to scale, but of finding mechanisms that sustain these processes.

In-order to address these challenges, new approaches based on community participation have come to the fore as a means of offering agricultural technologies to a wider audience (Franzel et al., 2001). These approaches promote farmers as the principal agents of change in their communities and focus on enhancing their learning processes and capacity, thereby increasing farmers' ability to adapt/innovate, make better decisions and/or influence decision-making authorities, and also to provide feedback to researchers. These approaches work on the assumption that if one farmer adopts a technology successfully, other farmers may learn the innovation from him/her, and share with others, thereby developing a multiplier effect.

One such approach used in western Kenya to disseminate information on agroforestry is the village committee approach. This approach aims at reaching all farmers in a village by working with representative farmers from existing groups in village committees (Noordin et al., 2001). The committees are formed on the basis of existing social organizational structures with the village elder as the patron. The groups delegate a member to represent them in the committee. The representative farmers go through a joint learning process with researchers and government extensionists, because most agroforestry technologies such as improved fallows and biomass transfer are knowledge-intensive technologies requiring understanding of the principles behind the practices before implementation. The choice of working with groups is because dense social networks are tapped within groups, where according to de Haan (2001), interaction between actors is greater, and groups are also able to provide social control and social capital.

The village committee approach works on the assumption that farmer delegates would facilitate further spread of agroforestry knowledge and seed in their social networks thereby generating sustainable processes and practices (Noordin et al., 2003). Although this approach has been operational for about eight years, several issues are not clearly understood. For instance it is not clear what is disseminated and to whom, what farm and farmer characteristics are likely to influence seed and knowledge dissemination, and whether dissemination of technologies goes hand-in-hand with the associated knowledge. Understanding these issues will help (i) identify the categories of farmers to be targeted to disseminate seed and knowledge of agroforestry technologies, hence contribute to efforts to tap or trigger community-based extension mechanisms for spreading improved technologies, ii) identify limitations experienced by farmers in disseminating seed and knowledge, hence enable researchers and other development agents target research and development to address these constraints, and iii) provide valuable information of use to policy makers in planning community based extension approaches.

Conceptually, this study takes the view that innovations and adoption processes take place in social contexts (Leeuwis and van den Ban, 2004; Mudege, 2005). Decision making processes involves social networks (groups, family relations, etc) as well as farmer relationships with agencies such as extension and research organizations. These relationships shape the degree to which new ideas are taken up and shared. According to Mango and Hebinck (2004), sharing ideas and resources (e.g. maize seed) is a function of the respect that people have for each other. This study therefore aimed to examine empirically:

i) Dissemination of seed/information/knowledge of improved fallows and biomass transfer from 'first generation farmers' (farmers in contact with researchers and extension agents) to 'second generation farmers.'
ii) Factors that influence a farmer to disseminate information and seed.
iii) How and what is diffused to second generation farmers.
iv) The reasons why second generation farmers obtained and established seed of specific species.
v) The experience of second generation farmers with leguminous species.
vi) The technical information given to second generation farmers in relation to establishment and management of improved fallows.

Research on improved fallows and biomass transfer in western Kenya

Research on soil fertility in western Kenya began in the late 1980s, after ICRAF carried out a diagnostic study in the area that found that low soil fertility was a key problem (Place et al., 2003). During the same period, Smaling (1993) established that nutrient outputs from western Kenyan farmers' fields exceeded inputs by a wide margin. Drawing from this evidence, ICRAF in collaboration with KEFRI and KARI established a research programme in western Kenya in 1988 to address soil fertility problems.

Initial technology design focused on the effect of hedgerow intercropping on crop yields. Later on (in 1991) research on improved tree fallows began. Fallowing of land has always been part of the farming system in western Kenya. However, pressure on land has forced most farmers to reduce their fallow periods. These shortened fallows can no longer restore the fertility of the soil, hence the promotion of improved tree fallows which are regarded as a valuable low cost option for restoring soil fertility in Africa (Kwesiga et al., 1999; Niang et al., 1998b). Instead of letting the natural vegetation develop freely, selected leguminous trees/shrubs or cover crops are planted at high density to replenish soil fertility.

The only species used in on-farm trials of improved tree fallows in the early 1990s was Sesbania (*Sesbania sesban* (L) Merr.), an indigenous species which according to Kwesiga and Coe (1994) had proven its potential in Southern Africa and was a prolific biomass producer under western Kenyan conditions (Onim et al., 1990). However, because of difficulty in germination and high incidence of nematodes (Franzel, 1999), its uptake by farmers was very low. Based on that finding, research on alternative species was initiated. Screening trials resulted in the selection of new species. In most cases these were shrubs with a shorter life cycle than Sesbania and could be direct seeded. The species were: *Crotalaria grahamiana* Wight & Arn, *Tephrosia vogelii* Hook. f., *Tephrosia candida* DC, *Crotolaria paulina* Schranck, *Crotalaria striata* DC, *Crotolaria ochroleuca* G. Don and *Crotolaria agatiflora* Schweinf (Niang et al., 1998b).

Additionally, testing of locally available shrubs was done from the mid 1990s in collaboration with the Tropical Soils Biology and Fertility Programme to look at their potential to supply nutrients to maize crops in a cut-and-carry system. One species, *Tithonia* (*Tithonia diversifolia* (Hemsley) A. Gray) was found to be the best bet among several because of its ease of establishment, easy handling (free of thorns or sharp leaves), high concentrations of nitrogen (N), phosphorous (P) and potassium (K) in its leaves, and good yield impact on crops (Jama et al., 2000). In the beginning, *Tithonia* leaves were gathered from roadsides or farm boundaries and applied to plots at planting time. Later, a whole range of management options were explored by farmers, but in all cases, a system of biomass transfer was practiced (growing the shrub in one place and applying the biomass in another place).

After a few years of on-station trials, the technologies were taken to farmers' fields on a trial basis in researcher designed/farmer managed trials. In the mid-1990s, this evolved into farmer-designed/farmer managed trials where farmers were invited to try out some of the species on their farms. Regular monitoring was undertaken at various stages of experimentation and adaptation (Noordin et al., 2003). In 1997, the KEFRI-KARI-ICRAF pilot project on soil fertility replenishment - hereafter referred to as the 'pilot project' - embarked on wide scale dissemination using community based participatory approaches. This was done in partnership with the Ministry of Agriculture and various NGOs in the area.

Description of the research area

This study was undertaken in Vihiga and Siaya districts of western Kenya because of the fact that they were used as sites for the pilot project. Both districts are faced with high poverty and low agricultural productivity due to nutrient deficiency, with the major limiting nutrient being P, although N and K are also important (Shepherd et al., 1996). The altitude is about 1500 m above sea level and rainfall bimodal, averaging 1600-1800 mm per year. The majority of farmers use animal manure, but typically the quality and quantity is insufficient to replenish soil fertility. The use of mineral fertilisers is rare as farmers are too poor to afford them. Farming is further constrained by heavy infestation of striga (*Striga hermonthica* Benth.,), a parasitic weed that substantially reduces maize yields. Farmers have secure rights to their land, although farm sizes have been declining, averaging 0.5 ha in Vihiga and 1 ha in Siaya. Maize *(Zea mays* L.*)* intercropped with beans (*Phaseolus vulgaris* L.) are the main subsistence crops.

Methodology

Two surveys were undertaken to understand farmer-to-farmer dissemination. The first involved a random sample of 120 farmers drawn from a list of farmers in eight villages participating in the pilot project from 1997. The list was based on project records, information from village elders and extension officers. The eight villages are among 17 villages in western Kenya serving as pilot sites for dissemination of agroforestry technologies based on the village committee approach. These farmers who have/had direct links with the pilot project are referred to in this chapter as "first generation farmers". They had received seed of improved fallows between 1997 and 2000 and had been involved in various trainings (field days, tours and seminars) on agroforestry technologies; farmers who have had no direct link with the institutions but received information and seed from the first generation farmers are referred to as "second generation farmers".

A second survey was undertaken with 40 second generation farmers. The sampling method used was an adaptation of snowball sampling, defined as a technique for finding research subjects in which one subject gives the researcher the name of another subject, who in turn gives the name of another (Vogt, 1999). According to Spreen (1992) snowball sampling can be placed within a wider set of link-tracing methodologies which seek to take advantage of the social networks of identified respondents to provide a researcher with an ever-expanding set of potential contacts. This process is based on the assumption that a 'bond' or 'link' exists between the initial sample and others in the same target population, allowing a series of referrals to be made within a circle of acquaintance (Berg, 1988).

First generation farmers were asked to give names of second-generation farmers, i.e. farmers to whom they had given seed and information. There were some limitations, however. Some farmers could not remember the people to whom they had given seed (and therefore the study may have missed out on some recipients), while others could not remember the specific years. The results presented are nonetheless deemed to be indicative of the kind of people with whom first generation farmers typically shared seed and knowledge. Based on this information, a list of second-generation farmers was constructed, and a random sample of 60 farmers picked from the list. Follow-up was made with this group of farmers given seed of improved fallows and information on biomass transfer. The research team ended up interviewing 40 second generation farmers. The other 20 could not be interviewed for various reasons: illness, death, pressure of work, and unavailability at the relevant time.

The research method used for the two surveys was detailed formal interview using a structured questionnaire, informal interviews and participant observations (e.g., the research team often interacted with farmers while they worked, or in social functions such as weddings, funerals and group meetings). Ten key informants (two village elders, two KEFRI staff, two extension officers and four farmers) were also interviewed using a semi-structured question list, to identify key topics for formulating the structured questionnaires.

Data collected included variables shown by Sinja et al. (2004) to play an important role in the distribution of seed of fodder legumes in central Kenya. These factors were status of farmer in the group (group official or not), number of groups a farmer belongs, and relative wealth (measured in terms of livestock ownership). Literature reviews such as Feder et al. (1985); Franzel (1999) and Keil et al. (2005) also point to the importance of farm size, education level, labour availability, gender of household head and age, as influencing adoption. This study tested these variables using a logit regression model, presuming as causal mechanism that adopters of improved fallows with access to seed share it with others in their social networks.

Results

Use of improved fallows and biomass transfer by first generation farmers

Generally the planting of improved fallows by farmers who were given seed by the project (first generation) was very low, except in 1999 and 2002, when the proportion shot up to 45% and 52% respectively. In 2003, the percentage of planters dropped to 31%, with a number of farmers abandoning planting of fallows (Table 5.1). By 2004, only 34% had improved fallows, 38% were using *Tithonia* directly as a green manure and 14% were using it in compost. The reasons given for not planting fallows, or for abandonment, were small farm size (63%), no noticeable increase in crop yield (18%), lack of a market for seed (18%), improved fallows do not provide edible products (3%), lack of labour (3%) and lack of knowledge (2%). Since there were relatively few farmers with the improved fallow technology, this has implications on farmer-to-farmer dissemination of seed. The direct use of green manure of *Tithonia* (biomass transfer) is generally low. This is because of its labour intensiveness, while a few farmers opt to use it in compost, which according to them is less labour intensive.

Table 5.1. Proportion of first generation farmers using agroforestry technologies in western Kenya.

Year	1997	1998	1999	2000	2001	2002	2003	2004
	% of first generation farmers (n=120)							
Improved fallows	20	28	45	27	33	52	31	34
Biomass transfer (Direct use of tithonia)	12	15	29	22	25	41	45	38
Tithonia in compost	0	0	0	0	0	3	20	14

Who is likely to give out seed of improved fallow species, and to whom?

Out of 120 farmers who received seed, only 47 (39%) farmers gave out seed of improved fallows between 1997 and 2004. Twenty-five percent of first generation farmers interviewed gave out seed to their relatives, 13% to group members, 12% to neighbours and 12% to friends (Table 5.2). Visiting relatives is a very common social activity in western Kenya (e.g. for funerals, weddings, group meetings or just as a courtesy call). Those who did not give out seed indicated that they did not have the technologies, and therefore the seed. Although all 120 did receive seed, distributed for free, not all planted.

Table 5.2.. Categories of people who received seed

People given seed	% of first generation farmers who gave seed (n=120)
Relative (kin and affines)	25
Group member	13
Friends	12
Neighbours	12
Others	10
*None	60.8

NB: There were multiple responses. 60.8% of first generation farmers did not give out seed at all).

Factors likely to influence giving out of seed and information

Four variables influenced farmers to give out seed, and all were significant at P< 0.05 (Table 5.3).

Table 5.3. A logit regression model of factors likely to influence giving out of seed of improved fallows and information on biomass transfer by first generation farmers

	Giving out seed of improved fallow (Y_1)		Giving out information on biomass transfer (Y_2)	
Parameter	Coefficient	Standard error	Coefficient	Standard error
Age	-0.02	0.02	0.01	0.02
Gender	0.10	0.51	-0.28	0.55
Farmers' status in group	0.95**	0.49	0.89*	0.49
Farm size	0.50**	0.20	0.15	0.19
Education (No. of years of schooling)	-0.16**	0.08	0.01	0.08
No. of improved cows	-0.39	0.25	-0.19	0.24
No. of adults working on farm (Labour)	0.05	0.30	-0.40	0.34
No. of groups a farmer belongs to	0.54**	0.24	0.11	0.25
Constant	-0.67	1.60	-1.40	1.68

Nigelkerke R^2
Model Y_1=0.22
Model Y_2=0.09

Dependant variables: Y_1=Giving out seed of improved fallows and Y_2=Giving out information on biomass transfer (0=No, 1=Yes). Definition of qualitative independent variables: Gender=dummy=0 if Male and 1 if female; Farmers' status in group, Non-official=0, Official=1. *, **, significant at 10%, 5% level of probability

In the regression model, statistically significant positive regression coefficients are found for the independent variables farmer status in group, farm size and group memberships (i.e. the number of groups a farmer belonged was positively and significantly associated with giving out seeds). There is a small but negative association between giving out seeds and education. Several variables had no significant influence on giving out seed for improved fallows: age, gender, number of improved cows (a proxy for wealth) and number of adults working on farm. Only one of the above variables significantly influenced giving out of information on biomass transfer ($P<0.10$). This was farmer status in the group – i.e. whether a farmer is an official of his/her group.

Who are the people who gave second generation farmers seeds of improved fallow species?

This looks at the same process as shown in Table 5.2, but from the standpoint of the recipient of the seed. The variable is the relationship between giver and recipient. An explanation for differences between Table 5.2 and 5.4 is that there is some overlap in roles; a person can be a neighbour and a friend, and the giver may say he/she gave seed to a neighbour while the recipient identifies the giver as a friend. Thirty five percent of the second generation farmers were given seed by their relatives, followed by group members, friends, neighbours; 8 % said they were given seed by members of their respective churches (Table 5.4). These results agree with the findings in Table 5.2 in showing that relatives (kin and affines) are the single most important source of improved fallow seed. Few farmers cited neighbours as an avenue for sharing seed. There were several reasons given by farmers for not seeking seed from their neighbours. One reason was that some neighbours had a higher social status and therefore other farmers would not feel comfortable going to their homes for seed. Secondly, farmers who have been collaborating with development projects have had a lot of attention from the pilot project i.e. being visited by dignitaries, taken for tours, participation in workshops etc. This in turn made other farmers develop some jealousy and resentment towards them.

Table 5.4. Source of seed given to second generation farmers

Relationship with the person who gave seed	% of farmers given seed n=40
Relatives (kin & affines)	35.0
Group	25.0
Friend	17.5
Neighbour	10.0
Church member	7.5
Others	5.0

Species/technology disseminated to second generation farmers

The species second generation farmers received seed the most was *Tephrosia vogelii*, followed by *Crotolaria grahamiana* (Table 5.5). *Tephrosia* was the most popular species because many farmers believed it repels moles, a major problem in western Kenya. Moles destroy crops such as sweet potatoes, bananas and cassavas, and farmers have no means of getting rid of them. There are a few people who trap moles, but they do it for a fee, which most farmers cannot afford. *Crotolaria grahamiana* was also in high demand because it is a prolific seeder and is also a short duration fallow crop. It takes only six months in the farm and therefore, if planted, farmers would only forego one season's crop, unlike *Tephrosia* which takes longer in the farm. And once planted, the seeds continue germinating every season. With the availability of a ready market for seed, farmers thought they might make money out of this species. A few (8%) planted *Crotolaria ochroleuca* - especially women - because its leaves are used as a vegetable (Table 5.5). But it is not very effective for soil fertility improvement because it produces little biomass.

Table 5.5. Seed disseminated to second generation farmers

Seed received	% of second generation farmers who received seed n=40
Tephrosia vogelii	68
Crotolaria grahamiana	33
Tephrosia candida	23
Crotolaria ochroleuca	8
**Mucuna pruriens* (L) DC	5
Others	5

NB – totals add to more than 100% because some farmers received more than one seed type
** a leguminous cover crop used for fallow that was introduced by partner NGOs so that farmers could have a wide range of species to choose from.*

Technical information given to farmers at the time of receiving seed of improved tree fallows
When second generation farmers were given seed, not all of them were given technical advice on how to establish and manage an improved fallow. Thirty eight percent indicated that they did not receive any technical advice. While 65% were given information about the benefits of improved fallows, only 30% were instructed on how and when to sow (Table 5.6). The study did not ascertain the quality of information given. But the fact that some established improved fallow trees/shrubs scattered in their farms instead of following the recommended spacing implies they may not have been given the right information, or that they rejected it in favour of an experiment of their own design or, most likely, they were anxious to prevent moles and thought scattering would be the best way to do it. Only 23% of second generation farmers indicated that they had also received information on the use of *Tithonia* as a green manure.

Table 5. 6. Technical information received by farmers

Information received at the time seed was given	% of farmers n=40
Benefits of an improved fallow species	65
No technical advice given	38
When and how to sow an improved fallow	30
Biomass transfer and its benefits	23
When to harvest seed from an improved fallow	20
Residual effect of an improved fallow	8
Information about other ISFM options	5
Nutrients replenished by an improved fallow	5

NB: The totals are more than 100% because some farmers gave more than one response

Farmers' expectations before planting improved fallows and their perceptions thereafter

Farmers' expectations differed considerably from researcher and extensionist motivations for introducing the practice. Although the shrubs/trees were mainly promoted for soil fertility management, second generation farmers obtained and used seeds for other purposes than soil fertility. The majority of second generation farmers (65%) indicated that they sought and received seeds of *Tephrosia vogelii* because of its mole repelling properties (Table 5.7). Fifty five percent planted improved fallows for sale of seed. Fuelwood was not a major reason for planting improved fallows, although it ended up being the most commonly mentioned benefit (Table 5.7). A few farmers, especially women, planted some shrubs – e.g. *Tephrosia candida* and *Tephrosia vogelii* - for firewood. As for soil fertility management, only a minority (28%) said they had noticed an improvement in crop yield which they attributed to an increase in soil fertility. Some did not notice any increase for a number of reasons. Firstly, some farmers did not plant the shrubs as recommended, but scattered them in their farms, and hence did not produce enough biomass to create an impact. Secondly, some of the farmers planted the shrubs on only a very small portion of their land, and only for one season, and hence the increase in soil fertility may have been too small for them to notice. A somewhat larger number (48%), however, did indicate that they had noticed an improvement in soil texture. They claimed that the soil was darker, softer and easier to till than before. There was also a reported reduction in *Striga* infestation (35% of farmers).

Table 5. 7. Farmers' expectations before planting improved tree fallows and positive aspects experienced thereafter.

	Farmers expectations (before planting)	Positive aspects experienced (after planting)
	% of 2nd generation farmers (n=40)	
Repel moles	65	5
Sale of seed	55	8
Soil fertility improvement	50	28
Fuelwood	18	93
Improved soil texture	0	48
Reduction of *Striga*	0	35

NB: The totals sum to more than 100% because some respondents gave multiple responses

The motivating factor for most farmers for seeking seeds of *Tephrosia vogelii*, was mole control and to generate income from the sale of seeds. But after planting it only 5% claimed that moles had reduced on their farms. If it has any beneficial effect in this respect, it is hard for farmers to quantify. After seeing little or no effect on moles, most farmers who had planted *Tephrosia* for that particular purpose abandoned it completely. Market for seed was another factor that motivated farmers to plant improved tree fallows, because the pilot project bought seed from farmers to distribute to other farmers. This explains why there was an increase in the use of improved fallows from 2000 to 2001, with a peak in 2002 (Figure 5.1). But by 2001, there was a glut of seed and the pilot project stopped buying. Most second-generation farmers came to learn about the seed market too late, and by the time they had planted the shrubs/trees the pilot project had stopped purchasing seed. They found no market for their seed, therefore, and some promptly stopped planting the shrubs/trees (Figure 5.1). In fact, only 8% of second generation farmers managed to obtain money from the sale of seeds (Table 5.7).

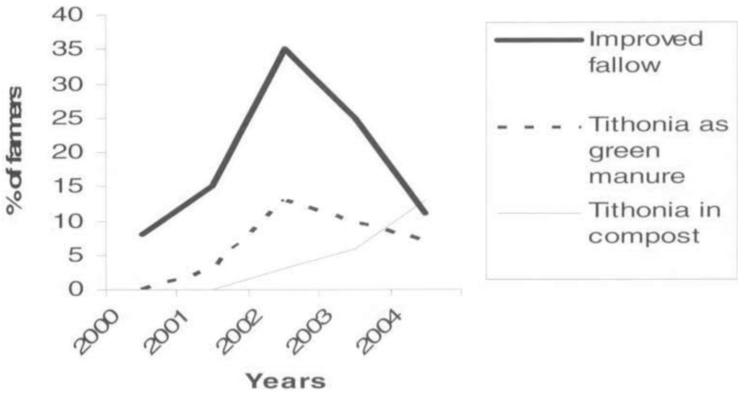


Figure 5.1. Trend in the use of improved fallows and biomass transfer by second generation farmers in Siaya and Vihiga districts from 2000-2004.

The scenario for biomass transfer changed from 2002, *Tithonia's* direct use as green manure declined but its use in compost increased (Figure 5.1). The direct use of *Tithonia* as green manure is a very laborious task. Farmers have to harvest the shrub, transport it to their farms and then chop the leaves into small pieces before using it for planting crops. An easier alternative, which farmers seem keener to embrace, is the use of *Tithonia* in compost. Instead of chopping *Tithonia* leaves into small pieces, the farmer separates the woody twigs from the leafy biomass, and adds the leaves to the compost pit with other farmyard refuse. By doing this, farmers save on the time and labour associated with chopping up *Tithonia*. Farmers claimed that when *Tithonia* is put in the compost pit, the farmyard material in the pit breaks down faster.

Discussion

Seed and knowledge sharing networks

The results confirm that informal social networks - relatives, friends and groups - are important avenues for spreading new technologies. The implications of the finding that knowledge is primarily shared along kinship ties are considerable. What this means is that family linkages may have a higher potential for expanding a network of seed and knowledge sharing than the development groups on which attention has so far been focused. The extent to which friends, relatives and development group membership overlap was not investigated, however, and further research is needed on this subject. Sharing of knowledge and seed through kinship ties has been indicated in a number of participatory learning programmes, such as farmer field schools. For instance, Nathaniels (2005) - in a study of cowpeas and farmer-to-farmer extension in Benin - reported that farmers shared information along kinship ties, with friends and neighbours. Other studies have made similar observations (e.g. Simpson & Owens 2002, and van der Mey, 1999).

The findings also suggest that kinship ties are more important in technology dissemination than physical proximity; more farmers received/gave seed to their relatives than to their neighbours. Jealousy was given as a reason for some farmers not asking for seed from their neighbours, with whom they have been collaborating in development projects. The implication for this is that development projects that give too much attention to some farmers, end up causing social tensions that undermine dissemination of agricultural innovations. Such problems might be avoided if projects paid more attention to social inequality and power relations in Kenyan rural life.

Groups featured as the second most important avenue for sharing seed and information among farmers. Development organisations prefer to work with groups in their endeavour to reach many farmers. Although groups can be a useful vehicle for rural development, not everyone belongs to groups. This may be because of the inability to pay membership fees or due to other personal or social issues. In up-scaling, other mechanisms for initiating spontaneous spread – notably family processes but also mass media, public meetings, and seminars - should not be ignored. According to Garforth and Lawrence (1997), mass media, especially radio, can be a cost effective way of informing a large population. On the hand, Davis et al. (2004), in a study of farmer groups in Kenya, found that traditional methods such as public meetings played a very important role in information dissemination, although some development professionals such as Bentley et al. (2003) suggest that quality is compromised at the expense of quantity. A general lesson seems to be that development projects should use a variety of approaches, and carefully evaluate what works, and how, but also which mechanisms can be combined to produce enhanced effects in specific contexts.

Factors that influence farmers to share seed and information

Farmers who were officials of their groups, and those who belonged to many groups, were more likely to give out seed. What this implies is that social capital is a major asset in dissemination. Farmers who belong to more groups interact with more people and therefore have more opportunities of sharing information than those who do not. Those who hold leadership positions in their groups also interact with more people by virtue of their positions. These people can therefore be targeted to spread information and technologies in their communities. Similar observations were made by Sinja et al. (2004) in a study of farmer-to-farmer dissemination of fodder legumes in central Kenya. But targeting the more educated may not be a priority, since farmers with more years of schooling were found to be somewhat less likely to give out seeds of improved fallows. The implication can be read in reverse - that even the less educated can disseminate seed and therefore they should be included among the groups targeted to assist in the informal spread of technologies.

As expected farm size influenced giving out of seed of improved fallow species. Farm size positively influences the adoption of improved fallows (Keil et al., 2005; Phiri et al., 2004; Franzel, 1999); therefore it is not surprising that it also influences farmer to farmer dissemination. Improved tree fallows occupy land that would otherwise be used by crops and therefore farmers with small farms are reluctant to forego a season's crop in order to have soil fertility enhancing trees/shrubs of no immediate benefit. These larger farms could be used as sites for field days and inter-farm visits so that other farmers could learn from them. But a problem is that they are not typical, so replication on the mass of smaller farmers may be hindered. Larger farms might belong to wealthier farmers, and the study has provided some evidence that poorer farmers might not be comfortable to visit larger farms used for demonstration, since this might evoke jealousies and fear of dependency. This possibility cannot be ruled out because the results presented showed that some second-generation farmers did not seek seeds from their neighbours because they belonged to a higher social grouping. Researchers confronted with such a dilemma must find other ways of learning and dissemination that do not marginalise the poor.

What is shared among farmers: seed versus knowledge

This study showed that not all farmers who receive seed plant it, and therefore development practitioners need to be aware that some farmers receive seed just because it is distributed for free, and may have no intention of planting. Follow ups should often be made during the initial phases of projects to ascertain whether farmers plant or not, and the reasons behind their actions. This will give development practitioners information about farmer perceptions of the technology. Secondly, not all farmers who receive seed from their fellow farmers are given the technical information that goes with it, and even for those who are given such information, the quality is at times suspect. Farmers indeed need support from institutions with the requisite expertise. Back-up information can often be effectively communicated through lower cost means such as radio.

The results also showed that seed is more easily shared than technical principles. Some technical issues, such as nutrient replenishment and the residual effects of technologies, may be too complex for farmers to understand and disseminate to other farmers. Similar observations were made by Simpson and Owens (2002), van Mele et al. (2005), and van Duuren (2003) in their studies of Integrated Pest Management (IPM) and farmer field schools. Here also, farmers more easily shared seed than information on agro-ecological concepts or principles. This poses a major dilemma for development professionals and their efforts to upscale. If farmers with the technologies cannot explain the underlying concepts to other farmers, then there is a real danger of farmers adopting technologies without sufficient information to get maximum benefits, and thus forming the idea that the approach is bad. What is needed are simple techniques and decision support tools developed jointly between farmers and researchers to help support communication and understanding of more complex principles. It will then be easier for farmers readily to share technologies and principles with other farmers irrespective of their literacy status.

Farmers also seem more readily to share information on secondary uses/benefits of the technology rather than the initial usages for which the technology was designed. For instance, second generation farmers got seed of *Tephrosia vogelii* and *Crotolaria grahamiana* mainly because of pest control and commercial possibilities, and not because of soil fertility management. This clearly demonstrates that farmers are indeed more concerned with technologies that have immediate benefits and are easy to implement. Future research on soil fertility should therefore emphasise improved fallow options that have other tangible economic benefits in addition to replenishing soil fertility. Farmer claims about mole repelling qualities of *Tephrosia* in western Kenya are not new (Place et al. 2003, and for Uganda Douthwaite et al. 2003), although these authors doubted the efficacy of *Tephrosia* in repelling moles. The fact that 68 % of farmers got seed of *Tephrosia* for this purpose and after planting it only 5% claimed that they had noticed a reduction in the number of moles seems to reinforce these doubts. It is perhaps useful that scientists study the chemical components of *Tephrosia* to ascertain whether it has mole repelling properties, but also (and more important) undertake work on low-cost alternative control options, since farmers in western Kenya are clearly signalling, by their keenness to experiment with *Tephrosia*, that the problem is a significant one for them.

Knowledge generation by farmers

This chapter has demonstrated that knowledge is dynamic. It is constantly produced and reproduced, shaped and reshaped and yields many types of knowledge, differentiated within and between localities (Mango, 2002). This means that knowledge that enters a locality is not simply internalised, but becomes transformed by various actors to suit their circumstances. According to Joshi et al. (2004), knowledge continuously evolves as farmers learn both by evaluating the outcomes of previous actions and by observing the environment. In the study presented here, improved fallows and biomass transfer technologies were introduced to address the problem of soil fertility in western Kenya. Farmers transformed the initial knowledge and came up with other uses of the technologies to address pressing problems such as pests and scarcity of labour. The original innovation of chopping *Tithonia* into small pieces and applying it as green manure did not fit in well with the socio-economic conditions of most farmers and therefore they came up with the less laborious alternative of using it in compost (Figure 5. 1). According to Jama et al. (2000), considerable labour is required for cutting and transporting biomass to fields, especially if *Tithonia* is far from the homestead. As for *Tephrosia*, some of them discovered that in addition to soil fertility improvement, it might also repel moles, a claim contested by other farmers after getting disappointing results (Table 5.7).

The implication of these findings is that knowledge generation is a continuous process and therefore researchers and extension staff need continuously to keep in touch with farmers so that they can capture new local knowledge. This new knowledge can then be fed back into the research and development (R&D) system to address outstanding issues, e.g. the mole repellent qualities of *Tephrosia* and the merits/demerits of using *Tithonia* in compost versus direct application as green manure. According to Tiwari et al. (2004), this demands new thinking and skills amongst researchers & extension staff, and new institutional mechanisms and tools to facilitate their interaction with farmers. One way is to create knowledge bases designed to capture new knowledge from farmers and feed it back into the R&D system (Walker et al. 1995). A carefully developed, managed and updated knowledge base provides a powerful central point of reference in the process of developing interventions to constraints to land use systems. A case in point that may offer some good practice lessons for western Kenya is provided by Walker et al. (1997) in a case study of the Pakhribus Agricultural Centre situated in the eastern hills of Nepal.

Conclusion

This study has confirmed that farmer to farmer dissemination provides a potential alternative mechanism for the spread of agricultural technologies. Kinship links may be more important than developmental groups. Also, it is important to recognise that as farmer-to-farmer dissemination takes place the message and uptake changes. Technology is re-shaped in the process of farmer-to-farmer transfer. However, more studies are now needed at different sites to see if the results reported here, and the mechanisms of trustworthy transfer (such as kinship) are found across different social contexts. More understanding is also needed on spread of knowledge and artefacts (such as seeds) across barriers between different socioeconomic groups, and whether mechanisms of transfer are the same among men and women.

Chapter 6

Adopters, testers or pseudo-adopters? Dynamics of the use of improved tree fallows by farmers in western Kenya

This chapter has been published in a different form as:
Kiptot E., Hebinck P., Franzel S. and Richards P. 2007. Adopters, testers or pseudo-adopters? Dynamics of the use of improved tree fallows by farmers in western Kenya. *Agricultural Systems* 94 (2): 509-519.

CHAPTER 6

Adopters, testers or pseudo-adopters? Dynamics of the use of improved tree fallows by farmers in western Kenya

Abstract

Although there has been increasing research on the adoption of agroforestry technologies over the last decade, few such studies have assessed uptake over a long period and many are based on a single snapshot in time. Furthermore, most of these studies have mainly looked at non-adopters and adopters; only recently have social scientists considered testers. A further category of users neglected in adoption studies has been re-adopters of technologies. Studying this group provides an interesting and more nuanced understanding of adoption and re-adoption. Methodologically, most adoption studies use quantitative methods and fail to link their findings to wider socio-economic, political and institutional settings. This paper presents a study of the dynamics of improved tree fallow use by farmers in Siaya and Vihiga districts of western Kenya over a period of eight years. It uses both qualitative and quantitative data critically to discuss the motivations of adopters, testers/rejecters and re-adopters. The results show that the process of adoption is highly dynamic and variable with farmers planting improved fallows and discontinuing or re-adopting them due to a whole range of factors, of which soil fertility management is just one. These factors included incentives from projects, the tying of adoption to credit programmes, prestige, participation in seminars/tours and the availability of a seed market from projects promoting improved fallows. Farmers planting improved fallows for such reasons may be termed 'pseudo-adopters.' There were significant differences in adoption between the two districts, with more farmers in Siaya planting improved fallows than in Vihiga. A majority of farmers in Vihiga (53%) who were given seed never planted improved fallows, even though they had been exposed to the technology. Some 40% of farmers in Siaya and 38% in Vihiga planted improved fallows but later rejected them. This has some important implications for research and development. For improved fallow technologies to be attractive to farmers, they must provide other tangible economic benefits besides soil fertility managment. This presents a challenge to researchers who must better attune themselves to the needs and demands of farmers if they wish to see their research findings widely adopted.

Keywords: adoption dynamics, agroforestry, opportunism, improved tree fallows

Introduction

Agroforestry as an applied science has made major technological advances in the last three decades (Sanchez, 1999). Yet, despite some successes, many agroforestry technologies in different parts of the world have failed due to low adoption rates. As a result, agroforestry researchers have argued for more socio-economic research to understand how farm households view and understand the technology (Sanchez, 1995; Current et al., 1995; Mercer and Miller, 1998). This has led to increased research on the adoption of agroforestry technologies in the last decade, and a comprehensive list of studies on adoption of agroforestry technologies has been documented by Pattanayak et al. (2003). Despite the increasing number of studies, some shortcomings remain.

First and foremost, most adoption studies are based on a single snapshot in time, whereas agroforestry adoption is a dynamic process that occurs over a long time period. It involves farmer experimentation, which takes longer than for agricultural crops because the benefits may not be realised immediately. According to Phiri et al. (2004), the experimental phase for improved fallows may take 2-3 years. The literature on agroforestry adoption mostly discusses early adopters and the use of the innovation at a specific point in time. Yet, understanding adoption over time provides lessons which can be used in planning future projects. Pattanayak et al. (2003) attribute the lack of a longer time focus in adoption studies mainly to a lack of adequate time series data sets.

Secondly, most adoption studies do not differentiate between different categories of users, such as those who are testing the technology and those who have adopted it. A review of literature shows that researchers have only recently come to differentiate between adopters and experimenters, notable examples being Adesina et al. (2000), Ogunlana (2004) and Keil et al. (2005). However, none of these studies recognises re-adopters (farmers who stop using a practice but then take it up again) or pseudo-adopters (farmers who use a practice not because it is useful but because they seek benefits from projects promoting the practices, such as credit, prestige or cash from producing project inputs).

Thirdly, a majority of adoption studies do not consider the wider socio-economic, political and institutional settings in which farmers are embedded. The studies are generally based on formal household survey data collected using questionnaires which are later subjected to statistical analysis. Most use regression models to explain the factors that influence adoption (Mercer, 2004). Long and Long (1992) and Long (2001) argue that adoption is not related alone to the technology, or to socioeconomic factors, or to the research and extension method applied, but is a result of complex interactions between people, technologies and institutions. Therefore formal household surveys alone are insufficient to understand the dynamics of adoption. Hence, a detailed case study and/or life history approach is also needed to understand and explain the patterns of adoption. This paper adopts such an approach to assess the dynamics of the use of improved tree fallows in western Kenya, taking account of temporal dynamics, different categories of use, and the wider socio-political environment that affects adoption. The study covers a period of eight years and is based on data collected in 2004 and 2005.

Problem context

One of the most serious constraints to the sustainability of agriculture in sub-Saharan Africa is declining soil fertility. In the past, African farmers managed soil fertility on their farms by fallowing their land. As population increased, partly induced by advances in health care, fallowing of land reduced, with many farmers adopting intensified land use practices that required fertilisers to replenish nutrients. Many African states subsidised fertiliser prices to stimulate fertiliser application, but these subsidies were later removed. In Kenya, for instance, subsidies were cut by 50% in 1972/1973 and completely withdrawn in 1978/1979 (Ruigu et al., 1985). The removal of such subsidies, due to structural adjustment policies, has substantially increased costs for many farmers (FAO, 2001) who now cannot afford to use fertilisers. This has exacerbated the problem of declining soil fertility, leading to reduced crop productivity (Cooper et al., 1996; Sanchez et al., 1997).

The use of improved tree fallows has been proposed as a sustainable low cost alternative for improving soil fertility on smallholder farms affected by soil degradation because of continuous cropping (Sanchez et al., 1997; Sanchez, 1999). Kwesiga and Coe (1994) argue that improved tree fallows, the deliberate planting of fast growing leguminous trees or shrubs in rotation with crops, have great potential for improving soil fertility in areas where nitrogen (N) deficiency is the main fertility constraint. Franzel (1999) points out that by providing N to crops, tree fallows can potentially help farmers improve their fields and incomes, thereby improving food security. Farmers are currently testing improved tree fallows in several African countries, including Kenya, Zambia, Cameroon, Tanzania, Malawi and Zimbabwe. These tests are being carried out in collaboration with national agricultural research institutions and the World Agroforestry Centre (ICRAF). Although farmers have been testing them since the mid 1990s, not much has been reported about their uptake, particularly in East Africa. Most published findings on adoption are from Western or Southern Africa, specifically Zambia. This paper analyses the adoption process of improved tree fallows by farmers in western Kenya since 1997.

Historical perspective: Research and development of improved tree fallows in western Kenya

A diagnostic study in western Kenya in the late 1980s identified poor soil fertility as a key developmental constraint (Minae and Akyaempong, 1988). During the same period, Smaling (1993) established that nutrient outputs from fields in western Kenyan exceeded inputs by a wide margin. These concerns led ICRAF, in collaboration with the Kenya Forestry Research Institute (KEFRI) and the Kenya Agricultural Research Institute (KARI), to establish a research programme at Maseno in 1988 to address soil fertility problems in western Kenya.

Initial research focused on hedgerow intercropping, but in 1991 research on improved tree fallows began as fallowing land has always been part of the farming system in western Kenya. However, pressure on land has forced most farmers to reduce their fallow periods, which are now insufficient to restore the fertility of the soil, hence the promotion of improved tree fallows. Initial technology design focused on both the technical aspects, that is, assessing whether improved tree fallows could indeed increase crop yields, and on socioeconomic issues such as feasibility, profitability and acceptability (Swinkels et al., 1997). The only species used in the first research trial was *Sesbania sesban* (L) Merr., an indigenous plant showing positive results in Southern Africa (Kwesiga and Coe, 1994) and which was used by farmers in western Kenya in traditional fallows. However, because of difficulties in germination, its uptake by farmers was very low (Franzel, 1999). Based on this, research on alternative species was initiated. Screening trials resulted in the selection of new species, mostly shrubs with a shorter life cycle (6 months to 1 year) than *S. sesban* and which could be directly seeded (Niang et al., 2002). The most promising and widely used species were *Crotalaria grahamiana* Wight & Arn,. *Tephrosia vogelii* Hook.f., and *Tephrosia candida* DC which brought about impressive maize yields in on-farm trials as well as providing fuel-wood and reducing striga (*Striga hermonthica,* Benth.,) (Niang et al., 1998b; Amadalo et al., 1998). Maize yields after relay cropping with *C. grahamiana* were 1% to 55% higher than in continuously cropped maize, while yields following *T. vogelii* were 42% to 85% higher.

Although many of these technologies showed positive effects in controlled research trials, there was less success in transferring them to their intended beneficiaries. This was partly because, for a long time, dissemination of research findings was left to extension officers. Given the retrenchment in the extension service at the time and the limited funds and materials available, including means of transport, the impact of these new technologies was localised (Noordin et al., 2003). On the other hand, the use of 'research farmers' in on-farm research trials organised by researchers to reach other farmers did not work any better. It became apparent that since 'research farmers' were selected by researchers and not by farmers themselves, they were not representative of the population (Place et al., 2005). They were locally often referred to as 'ICRAF agents' and some appeared to be of higher socio-economic status, and did not interact much with other community members.

Alternative approaches to technology development and dissemination: Community based participatory approaches

The KEFRI-KARI-ICRAF pilot project

In 1997 researchers initiated a pilot project on soil fertility replenishment and recapitalisation in 17 villages with 2035 households in Siaya and Vihiga districts of western Kenya to address the problem of low adoption. The project's objective was to test participatory approaches for wider dissemination of agroforestry technologies and it used an approach known as the village committee approach (VCA) (Noordin et al., 2001). This aimed at exposing all the farmers in an entire village to agroforestry by working with diverse groups and individual farmers who were appointed as representatives to village committees. Committees were formed on the basis of existing social organisational structures, with the village elder as the patron. The assumption was that farmer representatives would facilitate further spread of agroforestry knowledge and seed among their own networks (Noordin et al., 2003). The committees were used as contact points for the project to feed in information and to obtain feedback. They often organised meetings, field days, exchange visits and trainings. The approach aimed to support local innovation and adaptation and joint learning of scientific principles. To this end, it encouraged strong networking, partnerships and capacity building and was considered more likely to generate sustainable processes and practices. After four years of intensive dissemination using the VCA, the pilot project came to an end in the year 2000.

Sustainable Community-Based Input Credit Scheme (SCOBICS) Project (2001-2005): shifting focus to provision of credit and income generation

Based on experiences of the pilot project discussed above, it was realised that most households (unless they had a reliable source of off-farm income) needed to diversify into higher value crops than maize in order to feel the benefits of investing in soils. However, the combination of small land holdings and existing maize deficits meant that they also had to plant other crops if they wished to raise their incomes at the same time. This was only possible if they could access other services such as credit to purchase inputs, technical knowledge on how to manage their natural resource base and markets. In 2001, KEFRI and ICRAF in collaboration with the Imperial College at Wye, United Kingdom (UK) started, with funding from UK's Department for International Development, a five-year project, known as SCOBICS, to address these concerns. The project worked with local communities via the VCA to explore the potential for co-ordinated provision of support services, such as credit, to enhance livelihoods through promoting integrated soil and crop management. Working closely with farmer groups, the project produced biophysical decision support tools that present accumulated technical knowledge in a farmer-friendly way. These stressed the importance of combining organic and inorganic inputs, given their complementarity in enhancing soil fertility and the lower cost and risk involved compared to relying on inorganic inputs alone. The village committees were responsible for identifying credible farmer groups to benefit from the credit which was usually repaid out of the sale of the harvested crops.

Methodology

Study area

The study area is located in the highlands of western Kenya and comprises four villages each in Siaya and Vihiga districts. The main ethnic groups are the *Luo* in Siaya and the *Luhya* in Vihiga. About half of all the households are female-headed and the greater portion of household income comes from off-farm sources. Farmers have secure rights to their land. The average farm size has been steadily declining; in 1995, the average farm size in Vihiga according to Crowley and Carter (2000) was 0.6 ha, in 2004, the average farm size in the villages in Vihiga surveyed during this study was 0.5 ha. In Siaya it was 1.0 ha. Maize (*Zea mays* L.), often intercropped with beans (*Phaseolus vulgaris* L.), dominates the cropping pattern and the maize varieties planted are almost all local (Mango and Hebinck, 2004). Maize is predominantly grown for home consumption and yields average 700-1200 kg/ha. Most households own 1-2 local Zebu cattle and a minority own improved breeds.

Altitude ranges from 1250 to 1600 m above sea level and the landscape is undulating with slopes of 2-8%. Rainfall is bimodal, ranging between 1600 to 1800 mm per annum, divided between the long rains in March to May and the short rains in September to November. The region has a high agricultural potential with two cropping seasons per year, but low soil fertility is a widespread problem (Mango, 2002). According to Shepherd et al. (1996), phosphorous (P) is the major limiting nutrient, although N and potassium (K) are also limiting. Farming is also constrained by heavy infestations of *Striga*, a parasitic weed that substantially reduces maize yields. Food insecurity is high in both districts, with some areas experiencing up to nine months of food deficiency.

A large proportion of the labour force is engaged in agricultural and livestock production activities, although agricultural production increasingly suffers from labour being drawn into non-agricultural activities and off-farm work elsewhere. Furthermore, the HIV/AIDS pandemic is exerting its toll. HIV rates are very high, with a HIV+ prevalence rate in the year 2000 of 25% in Vihiga and 27% in Siaya (Republic of Kenya, 2001b). Furthermore, high population densities, which have increased over the years, continue to exert enormous pressure on the land. In Siaya, population density has increased from 253 people/km^2 in 1989 to 316 in 1999. Vihiga district on the other hand had a density of 800-1100 people/km^2 in 1999 (Republic of Kenya, 1994; 2001a). Poverty levels in both districts are among the highest in Kenya; in 1994, 53% of Vihiga district's population lived below the poverty line, and the number increased to 58% in 1999 (Republic of Kenya, 1998; 2003).

Survey methods

This chapter examines the impact of various attempts to disseminate agroforestry technologies in these districts. Because of the complexity of adoption processes, several methods were used to understand adoption dynamics. These included a formal survey with randomly selected informants, case studies with individual farmers, participant observation, and informal interviews with village elders and project officials. A random sample of 120 farmers was taken from a list of farmers in the eight villages who were directly involved in the pilot and the SCOBICS projects. The list was constructed from project records and information from village elders and extension officers. These farmers had received seed of improved tree fallows between 1997 and 2000 and attended various trainings (field days, tours and seminars) on agroforestry technologies. They were given seed on the understanding that future seed for expansion would be sourced from their own farms after planting and harvesting improved tree fallows.

Some issues could not be fully captured by the structured questionnaires and these were followed up through individual case studies. The case study approach focused on individual households and involved semi-structured in-depth discussions with individual farmers. Since most farmers began planting improved fallows in 1997, most of the responses were based on recall data, although information on improved fallow practices in 2004 and 2005 was cross-checked by field visits. Besley and Case (1993) proposed this approach of using recall data in adoption surveys to correct for the bias inherent in traditional cross-sectional studies due to analysts' inability to differentiate between late adopters and those who will never adopt.

The analysis of the results of the formal survey used a logit regression model to assess various farm and household characteristics previously shown by Feder et al. (1985) and Place et al. (2005) as influencing adoption of agricultural technologies. These explanatory variables are farm size, education level, access to labour, gender, household type, district, livestock ownership, number of improved cows and type of housing (the latter two are both a proxy for wealth). Tenure was not included because all farmers had secure land tenure.

Results

Trends in the use of improved fallows in Siaya and Vihiga districts

After the wide scale dissemination of improved tree fallows which began in 1997, there was a steady increase in the number of farmers using improved fallows in the two districts through to 1999. However in 2000 the number of farmers in both districts using these fallows dropped drastically, followed by an increase in 2001. Numbers again increased in 2002, followed by a decline in 2003 and a slight increase in 2004 (Figure 6.1). Results from the case studies and informal interviews with key informants indicated that these trends were mainly influenced by i) a market for the seed of improved fallow species, ii) credit, and iii) the implementation of the Millennium Development Project (MDP), described in the next section.

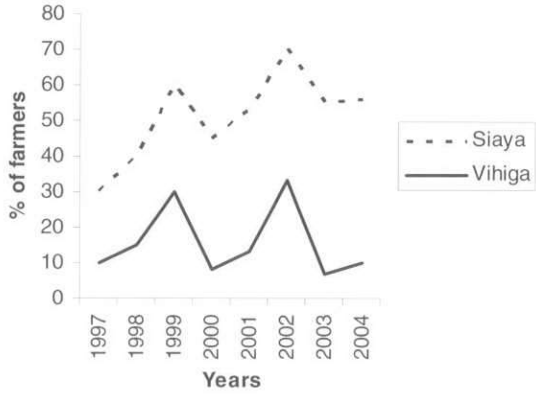


Figure 6.1. Proportion of farmers planting improved fallows who had received seed from projects, 1997-2004 (n=120).

Market for seed

When the pilot project embarked on the wide scale dissemination of soil fertility technologies in western Kenya in 1997, the biggest challenge they faced was availability of seed for up-scaling improved tree fallow technologies. The project encouraged farmers who already had improved tree fallows on their farms to sell seed to the project, so that they could distribute this to farmers in other areas. This prompted farmers to plant improved tree fallows between 1997 and 1999. By 1999, there was too much seed and, the project reduced the price, leading many farmers who had planted for the seed market to discontinue their use of improved fallows in 2000 (Figure 6.1)

Access to credit

The SCOBICS project started in 2001 and one of its activities was the provision of credit in the form of inputs. These were given on condition that farmers integrated the use of both mineral fertilisers and organic inputs such as improved fallows, biomass transfer and leguminous cover crops. Credit was given through farmer groups and ultimate responsibility for repayment lay with the groups, and not individual farmers. In 2002 many farmers in Siaya planted improved tree fallows as a means to get credit from the project, under the misguided assumption that the credit was free, even though the project had made it clear to them that they had to repay the credit with some interest once they had harvested their crops. This misunderstanding came about as some of these farmers who had previously worked as 'research farmers' with the agroforestry programme during the early years of experimentation had received free inputs to use in on-farm experimental plots and, they assumed the same was true of the credit. Towards the end of 2002 most farmers in Siaya district refused to pay back their loans and the SCOBICS project refused them any further credit in 2003, leading some of the farmers to discontinue the use of improved tree fallows (Figure 6.1).

The Millennium Development Project

In 2004, there was a small increase in the number of farmers practicing improved fallows in Siaya because of the inception of the Millennium Development Project (MDP) which started operations. The MDP, which continues to be implemented in Siaya district, aims to support farmers in villages sampled in this study to alleviate poverty by undertaking projects in pursuit of the Millennium Development Goals (MDGs), and includes the planting of improved tree fallows. Farmers in Siaya who re-adopted the planting of improved fallows in 2004 indicated that they did so because they expected that the MDP would require seed for establishment of improved fallows.

Classification of farmers based on their adoption status of improved tree fallows

The use of the term 'adoption' is in itself very problematic. According to Ajayi et al. (2005) researchers often consider farmers who are using a technology at a particular point in time as adopters. On the other hand, Phiri et al. (2004) point out that the farmers may just be testing the technology and may not continue using it. Further more, the farmers could be using the technology as a strategy to access inputs and credit, as shown in the previous section, and will discontinue once these benefits are no longer available. Drawing on the survey done in 2004, it is possible to attempt to classify the 120 farmers exposed to improved fallows, into four categories: adopters, non-adopters, testers/rejecters and recent re-adopters (Table 6.1).

Table 6.1. The adoption category of farmers in 2004 who received seeds for planting fallows between 1997 and 2000

Adoption status	District Siaya n=60	 Vihiga n=60
	Percentage of farmers	
Non-adopters	13	53
Adopters	36	3
Testers/rejecters	40	38
Recent re-adopters	11	5

Non-adopters are farmers who although having had access to the technology over the eight years, and even having received seed and training, never planted improved tree fallows. Thirteen percent of sample farmers in Siaya and 53% in Vihiga fall into this category (Table 6.1). By contrast, adopters are farmers who after trying the technology have used it continuously for at least three years (six seasons) or more. Most of these farmers have slightly bigger pieces of land and therefore can afford to spare some land for the improved fallow technology (Table 6.2). They normally plant fallows on a rotational basis on a different portion of land each year. Based on this definition, 36% of farmers in Siaya and 3% in Vihiga can be considered to be 'adopters' of improved tree fallows (Table 6.1).

Testers/rejecters are farmers who tried the technology for three years (six seasons) or less but who no longer practice it. Forty percent of farmers in Siaya and 38% in Vihiga fall into this category. Some tried for one year, others for two or three years. Their reasons for discontinuation are many and varied but they fall into two main groups: genuine testers/rejecters and pseudo-adopters.

Genuine testers/rejecters are farmers who genuinely experimented with the technology to see whether it was useful to them. They had heard about the benefits of improved tree fallow technology and wanted to try it out and see the results. Rogers (2003) describes the adoption of an agricultural innovation as a mental process where farmers go through various stages before making a decision. Many of these farmers had high expectations about soil fertility technologies, but their expectations were not met and so they rejected the technologies after one to two seasons. Others had limited land and discontinued because they also had to plant food crops for their families.

The pseudo-adopters are farmers who tried improved tree fallows with different objectives. These included a) getting free inputs from the projects, b) as a means of participating in tours and seminars which often involved payment of allowances, c) as a means to access credit, d) as a means to access the seed market and e) to gain prestige. Farmers' perceptions about these benefits were shaped by the soil fertility research programme, which had offered a number of incentives when conducting on-farm trials. There were three different types of on-farm trials: i) researcher designed and managed, ii) researcher designed and farmer managed and iii) farmer designed and managed. In the first type, research was conducted on land leased from farmers. Everything was completely under the control of researchers; farmers were merely landlords, paid for the land, benefiting from the crop harvests and providing labour for weeding. Some were also employed as watchmen to take care of the trials (Place et al., 2005). In the second type, participating farmers were referred to as 'research farmers.' They received free inputs (seed and fertiliser) for use in experimental plots and any harvests from the plots belonged to them. In addition, they were often visited by high ranking personalities. In the third type everything was under the control of farmers and no free inputs were given, aside from tree seed, but the farmers received considerable attention from researchers and extension officers. They often participated in seminars and tours and also enjoyed the prestige of high profile visitors assessing the performance of the technologies under farmer management. A detailed description of the different types of on-farm trials can be found in Noordin et al. (2003). So from the very outset, farmers had the impression, although not intentionally given, that association with the projects would bring other benefits, including the prestige associated with high status visitors.

In 1997, when the pilot project embarked on wide scale dissemination of soil fertility technologies using participatory approaches, 'research farmers' who had seed were encouraged to sell this to the project so that it could be distributed to those without. Many farmers had planted improved tree fallows because the project provided free seed for the improved tree fallows and rock phosphate fertiliser to farmers for experimental purposes (Niang et al., 1998b). When the project stopped buying tree seed and supplying free inputs, some farmers stopped practicing because they were not getting any benefits (Figure 6.1). But in 2001, when SCOBICS started its operations, supplying farmers with credit in the form of inputs, some farmers especially from Siaya, re-adopted improved fallows, to gain access to credit. As discussed earlier, they misconstrued the terms of the arrangement, refused to repay the credit and lost their entitlement to inputs from SCOBICS. In turn they discontinued the use of improved tree fallows, hence the drop in 2003 (Figure 6.1).

Recent re-adopters are farmers who after discontinuing the use of improved tree fallows started practicing again. The recent re-adopters fall into two broad categories:

i) Those who stopped because of lack of resources and re-adopted once the resources such as labour were available again.

ii) Those who re-adopted because of anticipated benefits from the projects.

Factors likely to influence adoption of improved tree fallows

Results of the logit regression model indicate that there were significant differences in adoption between the two districts at $P<0.01$ (Table 6.2). There was a higher rate of adoption of improved fallows in Siaya district than in Vihiga.

This can be partly attributed to farmers in Siaya having had a longer history of association in agroforestry research (via the pilot project) than those in Vihiga. The presence of the MDP in Siaya may have also played a role. Other variables such as gender, age, household type, type of housing, education, farm size, adults working on the farm, livestock ownership and improved cows were not found to influence adoption of improved fallows.

Table 6.2. A logit regression model of factors likely to influence adoption of improved tree fallows

Parameter	Coefficient	Standard Error
Gender	1.67	0.88
District	3.52*	1.00
Age	-0.00	0.01
Household Type	-1.88	1.06
Type of housing	-0.46	0.78
Farmers' status in group	-0.46	0.69
No. of years of schooling	0.06	0.10
Farm size	0.28	0.24
No. of adults working on farm (labour)	0.39	0.33
Livestock ownership	-0.09	0.71
Ownership of improved cows	0.64	0.36
Constant	-5.85	2.11
Nagelkerke R^2	0.49	

Note: Dependant variable =Adoption of improved tree fallows 0=No, 1=Yes; Independent variables Gender (Male=0, Female=1), District (Vihiga=0, Siaya=1), Household type (male headed=0, female headed=1), Type of housing (Grass thatched roof=0, Iron roof=1), Farmers status in group (official=1, non official=0, Livestock ownership (No=0, Yes=1); * Significant at 1% level of probability

Table 6.3. Farm and household characteristics of various categories of farmers

	Parameter					
Adoption category	Age (yrs)	Farm size (ha)	No. of improved cows	No. of groups a farmer belongs to	No. of years of schooling	No. of adults working on farm
Non-adopters N=40	50.8 (2.01)	0.5 (0.05)	0.6 (0.16)	1.8 (0.13)	6.9 (0.46)	1.9 (0.10)
Adopters N=25	50.0 (2.32)	1.0 (0.12)	0.9 (0.24)	1.8 (0.19)	8.2 (0.83)	2.0 (0.23)
Testers/rejecters N=45	50.8 (1.84)	0.4 (0.05)	0.5 (0.15)	2.0 (0.18)	6.2 (0.48)	1.6 (0.1)
Re-adopters N=10	49.9 (4.53)	0.6 (0.19)	0.4 (0.22)	2.1(0.28)	6.6 (1.56)	1.7 (0.21)

Note: Figures in parenthesis are standard errors of means

Farmers' reasons for non-adoption/discontinuation of the use of improved tree fallows

In all, 91% of farmers in Vihiga and 53% in Siaya district either stopped using improved fallows after initial experimentation or never adopted improved fallows at all. The reasons that farmers gave for not using improved fallows are shown in Table 6.4 and discussed below.

Table 6.4. Farmers' reasons for non-adoption and discontinuation of the use of improved tree fallows

	Reasons (percentage of farmers)						
District	Small farm size	No noticeable increase in crop yield	Lack of market	Lack of labour	No edible products	Lack of knowledge	No specific reason given
Siaya N=32	42	31	20	5	3	3	0
Vihiga N=55	84	5	16	2	3	2	2

Note: The totals are more than 100% because of multiple responses

Small farm size

It is clear that for farmers the largest constraint on adoption of improved tree fallows is lack of sufficient land. Forty two per cent of farmers in Siaya and 84% in Vihiga gave this reason. These results contradict the finding in Table 6.2, showing that land size is not significantly associated with adoption. The problem of land is more acute in Vihiga than in Siaya; Vihiga district is more densely populated; with farm sizes of around 0.5 ha. Small land holdings in Vihiga mean that most farmers are not willing to forego a seasons' crop for soil fertility enhancing trees whose benefits are not immediate.

No noticeable increase in crop yield

In Siaya, 31% of farmers who discontinued the use of improved tree fallows indicated that they did not see an increase in crop yield and saw no benefit of having improved tree fallows on their farms. Most parts of western Kenya, including Siaya and Vihiga, have severely depleted soils as a result of continuous cropping. The level of depletion is so severe that it requires great effort to restore the soil to a level where farmers will see benefits. Farmers had very high expectations of improved tree fallows, which were being promoted as a low cost option of restoring soil fertility; they even referred to the leguminous species as 'fertiliser trees.' They had the impression that these 'fertiliser trees' would act more or less in the same way as mineral fertilisers in replenishing soil fertility. Some farmers did not understand that while improved fallow species can supply enough N for crop growth, they do not supply enough P to meet plant growth requirements. P additions, either in the form of mineral fertilisers or from P-rich organic materials, are also needed (Niang et al., 2002) but the majority of farmers did not add any P as they were either not aware that they needed to or because they could not afford to.

Lack of a market for seed

When the pilot project embarked on wide-scale dissemination of integrated soil fertility management options in western Kenya, the main challenge it faced was the availability of seed. A few farmers were given seed and assured that when they harvested it they could sell it back to the project, which would distribute it to other farmers within the region. This prompted some farmers to plant improved fallows for the seed market. Between 1998 and 1999, one kilogramme of *Tephrosia vogelii* and *C. grahamiana* seed was selling for about US$ 21. In 2000, the price went down to US$ 7/kg; in 2001 it was US$ 2.8 and it later dropped to US$ 0.70. When seeds became widely available, the project stopped buying seed from farmers. As a result many farmers cut their improved tree fallows. Place et al. (2005) refer to this group of farmers as 'seed adopters.'

Lack of labour

Although very few farmers in the survey mentioned lack of labour as a reason for discontinuation of improved tree fallows, the case studies showed that this was also a contributory factor. Most households in the region are affected by HIV/AIDS, some family members are sick and cannot work, and others need to take care of the sick. This makes labour much scarcer and has an impact on agroforestry practices. During the interviews, farmers also stated that the provision of free primary education, introduced by the new government on taking power in 2003, and generally seen as a good thing, also contributed to labour scarcities, as most children now spend most of their time in school.

The lack of edible products

A lack of edible products was another important contributing factor to the non-adoption/discontinuation of the use of improved tree fallows. Although very few farmers mentioned this in the formal survey, this again emerged in follow-up discussions with case-study farmers. Since land is a constraining factor for most farmers who did not adopt improved fallows, foregoing a season's crop for a tree that does not produce edible products was not a feasible option. There is a clear opportunity cost involved in losing a whole season's crop, which strongly influences farmers' decisions not to adopt improved tree fallows.

Inaccessibility to credit

During formal interviews with farmers, none of them mentioned the issue of credit, yet discussions with key informants revealed that it was the main reason why some farmers discontinued the use of improved fallows. This inconsistency in data clearly demonstrates the utility of using qualitative data to supplement quantitative analysis. Farmers were afraid to mention credit as most of them had defaulted at some time, and some, according to key informants, even thought that the research team might have them arrested.

Farmers who defaulted did so because of their history of having benefited from free inputs from the pilot project, which they assumed would continue in the SCOBICS project. In addition, in the year 2002, the country voted overwhelmingly for the National Rainbow Coalition (NARC) Party, which formed the new government in 2003. Some farmers believed that the inputs were a token of gratitude from the new government in appreciation of political support and that the project was only asking them to repay the loans so that the staff could pocket the money themselves. Those who defaulted did not receive any further credit, and those farmers who planted improved tree fallows solely in order to access credit discontinued their use.

Discussion

Various issues identified in this study have implications for future agroforestry projects and the adoption of agroforestry technologies. These are discussed below.

The emergence of 'opportunists' (pseudo-adopters) in adoption dynamics

Results of this study clearly demonstrate that most farmers only planted improved tree fallows in order to sell seed to projects, obtain credit from projects promoting the practice, participate in seminars and gain prestige. Selling seed *per se* does not make a farmer a pseudo-adopter, but the fact that some of these farmers only took up soil fertility technologies when there was a new project buying seed or providing other inputs, and discontinued the use of the technologies the moment that these benefits were no longer forthcoming does make them pseudo-adopters. This behaviour may partly be attributed to the approach used by the agroforestry programme in Maseno when conducting soil fertility research. The use of 'research farmers' to test technologies during the initial phase of on-farm experimentation was a good idea at the time. Because the technologies were unproven, the experiments involved giving farmers free seeds and sometimes seedlings and fertiliser for use on experimental plots so as to enable a comparison between treatments. Furthermore, some 'research farmers' had relatives employed on the on-farm researcher designed and managed experimental plots (Place et al., 2005). This created the impression that farmers stood to benefit by associating with development projects. Even aside from material benefits, which were very small, many farmers felt that they benefited socially from receiving visits from outsiders. These benefits in turn led farmers to develop an 'opportunism syndrome' which led to the emergence of 'pseudo-adopters' and re-adopters. Opportunism, although new in the adoption literature, has been observed in Non Governmental Organisations by Meyer (1995). Williamson (1985) defines opportunism as 'self interest seeking with guile.' This definition is consistent with the behaviour of some of the farmers in the study region. Economists believe that rational beings make decisions according to self interest. Farmer behaviour as described here supports the assumptions of the economists, but does not necessarily yield sustainable, adapted technology. Part of the problem may lie in farmers' involvement in 'participatory research' without them having much understanding of how science operates, or any chance to gain recognition through science's reward structure. Participation, in this sense, unwittingly offers a set of 'perverse' incentives. There is therefore a need to help farmers to understand the scientific motivation of participatory research and to create a local cultural framework to motivate farmers to participate for the 'right' scientific reasons, and not for opportunistic ones. In effect this would presuppose the emergence of an African social movement for people's science (cf. Richards, 1985).

The complexity and dynamism of adoption

This study demonstrates that adoption is not a straightforward process. It is complex and influenced by many factors which do not lie solely within the household. These factors may include socio-economic, biophysical, institutional and even political ones (as in the case of farmers refusing to pay back credit). To classify farmers into two groups, adopters and non-adopters, is often an oversimplification. In fact, we can see an adoption continuum path, with farmers falling in different categories along the path, depending on how they use the technologies. It is not easy to classify farmers into various adoption categories, such as the four defined in this paper, as the boundaries are often blurred. Nevertheless, such classification provides a framework for understanding the perceptions of different categories of farmers. Seeing such differences may in turn improve understanding of the obstacles preventing initial adoption of a technology. There is a difference between the decision to discontinue a technology that one has tried and the decision not to adopt it at all. Similarly, discussions with farmers who discontinue the use of a technology may provide information on the features of the technology that proved unappealing to them under prevailing field conditions, and bring out other issues that had not been anticipated at all, such as of lack of ancillary benefits, or inaccessibility to credit. A further problem with any system for categorising adoption is that, adoption itself is a continuous process and the categories are therefore only relevant at a specific point in time. Farmers may oscillate between testing, adoption, discontinuation and re-adoption. Mechanisms of adoption are complex, and switched on and off by contextual factors. For this reason adoption research needs to probe beyond categorization and correlation, and frame its analytical questions in terms of the context-mechanism-outcome configurations advocated as the basis of a realistic evaluation methodology, as assessed in earlier chapters of this thesis (ch.1, cf. Pawson & Tilley, 1997).

The synergy between qualitative and quantitative methods

This study combined both quantitative and qualitative methods of data collection. The quantitative analysis relied on data collected from formal surveys while the qualitative analysis drew on data collected from case studies/histories and informal discussions with key informants. The quantitative analysis revealed the patterns of adoption of improved tree fallows and the variables likely to influence this, while the case studies provided more nuanced interpretations of the trends in adoption and use of improved tree fallows. The qualitative methods used in this study also revealed a wide range of issues which could not have been obtained from the formal survey, e.g. farmers adopting technologies as a means to sell seed, obtain credit and for prestige. The synergy derived from using the two approaches should be greatly encouraged in future research on adoption issues, as it provides more information than when either method is used alone. This observation is consistent with findings by White (2002) and Place et al. (2007), who used both approaches in poverty analysis. They observed that the integration of qualitative and quantitative data yielded more than the sum of the two approaches used independently.

Challenges associated with using recall data

Time is an important variable in the adoption process. In the absence of proper records, researchers often have to rely on recall data. In this study, this proved quite challenging as some farmers could not remember when they planted improved tree fallows on their farms and the research team had to rely on what farmers told them, and information could not be crossed checked as there were no proper records. Researchers and development practitioners should strive to conduct regular monitoring and evaluation, and above all, to keep proper records so that future adoption studies can draw on reliable data collected over a longer period of time.

Conclusions

Two main conclusions can be drawn from this study. First and foremost is that adoption is a highly variable and dynamic process influenced by factors that go beyond the household and the farm level. The changing levels of uptake of improved tree fallows shown by farmers in this chapter is at least partly because the study districts have seen many development projects undertaking soil fertility research since the late 1980s. Over this time, approaches have evolved from a linear model of technology transfer which provided incentives to farmers who participated in on-farm research trials to the current participatory approaches. However the farmers involved still maintain the perception that association with projects will benefit them, either socially or materially. One implication of this is that too much concentration of research effort in one area is counterproductive in the long run and leads farmers to test technologies for the wrong reasons (i.e., showing allegiance to project staff, prestige, incentives etc.,) creating a false impression about the adoption levels of a technology.

Secondly, the pilot project's buying of seed for improved fallows from farmers brought about an unanticipated set of challenges for researchers. While it did empower farmers economically, it also created a false impression about the adoption levels of improved fallows, as many farmers were planting for the seed market and not for soil fertility management, although it did also serve this purpose. These findings are supported by Giller (2001) who asserted that buying back seed of green manures often runs the danger of artificially inflating estimates of the potential of interventions. This study has shown that when the market for improved fallow seeds disappeared, farmers had less incentive to plant improved fallows and many discontinued their use. A surprisingly high number of farmers in Vihiga (53%) never adopted fallows and a substantial number (40% in Siaya and 38% in Vihiga) rejected the technology after trying it. This illustrates an important research and development issue, also emphasised by Giller (2001), that for the soil fertility potential of leguminous fallow species to be realised, more tangible and immediate benefits must be visible to farmers in order for them to consider foregoing a season's crop. Such benefits can take the form of fuel-wood, food, fodder or seed. It is imperative that researchers are in tune with the needs and demands of farmers so that they target their research to farmers' needs more effectively and thereby meet their goals of achieving higher rates of adoption.

Chapter 7

Dynamics of the use of *Tithonia diversifolia* for soil fertility management in pilot villages of western Kenya

This chapter has been submitted for publication in a slightly modified format to *Agroforestry Systems* journal as:
Kiptot E. Dynamics of the use of *Tithonia diversifolia* for soil fertility management in pilot villages of western Kenya

CHAPTER 7

Dynamics of the use of *Tithonia diversifolia* for soil fertility management in pilot villages of western Kenya

Abstract

Although much has been documented about the biophysical performance of *Tithonia diversifolia* for soil fertility management (SFM), scanty information exists about its uptake by farmers. This chapter presents results of a study that was undertaken to assess adoption dynamics of *Tithonia* in Siaya and Vihiga districts of western Kenya from 1997-2004. The study was undertaken among a random sample of 120 farmers from eight pilot villages exposed to the technology. Descriptive statistics and a logit regression model were used to analyse data. The findings show that farmers in pilot villages of Siaya are increasingly taking up the use of *Tithonia* in comparison to Vihiga. As of 2004, 52% of farmers in Siaya were adopters compared to only 8% in Vihiga. Results of the logit regression model show that the use of *Tithonia* biomass for SFM is more likely to be adopted in a context where there is animal manure scarcity, and where farmers are willing to plant it on farms and hire casual labour. Main constraints experienced are its labour intensiveness and the fact that farmers have no information on the quantities of *Tithonia* biomass required for different crops. Fifty eight percent of farmers in Siaya and 13% in Vihiga have planted *Tithonia* on their farms, for easier accessibility and to reduce labour requirements associated with transportation. This raises the question of whether planting *Tithonia* on farms is a sustainable option, due to the fact that it is a nutrient miner. Nevertheless, farmers who use it claim it increases crop yield, and reduces infestation by termites and *Striga* weed. Whether this is sustainable may be questioned. Further research on the long-term effects of on-farm *Tithonia* biomass production systems on crop yields and nutrient budgets is needed.

Keywords: adoption categories, biomass transfer, composting, green manure

Introduction

The decline of soil fertility in smallholder farming systems of sub-Saharan Africa is said to be the greatest biophysical constraint to increasing agricultural productivity (Sanchez et al., 1997). The need to improve soil fertility management (SFM) has become a very important issue in the development policy agenda, because of the strong linkage between soil fertility and food insecurity. For instance, in western Kenya, a region where soil fertility levels have been declining over the years, Wangila et al. (1999) reported that 89.5% of farmers had food deficiency while only 8.9% were food secure. Given the high poverty rates in most of sub-Saharan Africa, farmers often cannot afford to use fertilisers. Even for those who can, environmentalists have cautioned against their use, claiming that fertiliser residues are damaging in particular to soil structure and quality of water resources (Ahmed, 1995; Kang and Shannon, 2001; Goss and Goorahoo, 1995; UNEP, 1997). It is therefore apparent that a sustainable low-cost farming system is needed compatible with the socio-economic and technological practices of farmers, but capable of sustaining or improving production and soil fertility. Organic materials such as cattle manure and crop residues can be used to improve soil fertility but they are usually not available in sufficient quantities and quality. Typically most farmers in western Kenya have no more than one or two cattle, and a substantial number have none at all, as a result of theft or slaughtering of beasts for funeral purposes.

In order to address these challenges, scientists in Kenya have in the past decade experimented on low cost agroforestry options to replenish soil fertility. One of the more promising agroforestry options which researchers in collaboration with farmers have come up with in western Kenya is biomass transfer. Biomass from shrubs/trees grown away from the farm, or in some cases on-farm, is cut and incorporated in the soil as green manure when planting crops. A regular flow of nutrients becomes available for the crop when the green manure is mineralised under normal decomposition conditions. Biomass as used in this chapter refers to green tender twigs and green leaves. One species, *Tithonia diversifolia* (Hemsley) A. Gray subsequently referred to as *Tithonia* was identified as best among several species because of its ease of management, high concentration of nutrients in leaves, high decomposition rate, ready establishment through stem cuttings, ready availability, high biomass yield and ability to withstand multiple lopping.

Historical background: Research and dissemination of *Tithonia* in western Kenya

Tithonia is a shrub found growing wildly along roadsides and farm boundaries in western Kenya (Jama et al., 2000). It belongs to the family Asteraceae and is commonly known as the Wild or Mexican Sunflower, originating from Mexico. It is widely distributed in Africa, Central and South America and Asia. It was brought to Kenya by missionaries during the last century as an ornamental. In western Kenya it is mainly used for marking farm boundaries and to treat stomach ailments. The common practice of farmers is to lop *Tithonia* hedge once or twice a year to reduce competition with crops in adjacent fields, and provide a good looking hedge and fuelwood. Once lopped, the hedge rapidly grows. Other reported uses for *Tithonia* are fodder (Roothaert and Paterson, 1997; Roothaert et al., 1997), compost (Drechsel and Reck, 1998), and liquid manure (Obonyo and Franzel, 2004). Extracts from *Tithonia* have also been reported to have medicinal value for treatment of hepatitis (Kuo and Chen, 1997). It is also known to protect crops from termites (Adoyo et al., 1997).

Research on *Tithonia* in western Kenya began in the mid 1990s when researchers from the World Agroforestry Centre (ICRAF), Kenya Forestry Research Institute (KEFRI), Kenya Agricultural Research Institute (KARI) linked up with the Tropical Soil Biology and Fertility Institute of the International Centre for Tropical Agriculture (TSBF-CIAT)) in collaboration with 36 farmers from Siaya and Vihiga districts to assess the potential of locally available shrubs for their suitability as a nutrient source for crops. Screening of various species led to the selection of *Tithonia* as an effective source of nutrients for maize (Gachengo, 1996; Niang et al., 1996). Work in Malawi (Ganunga et al., 1998) and in Zimbabwe (Jiri and Waddington, 1998) also reported *Tithonia* biomass as an effective nutrient for maize. According to Jama et al. (2000), *Tithonia* leaves have a high concentration of nutrients, e.g. average concentration of nutrients of green leaves collected in East Africa were 3.5% N, 0.37% P and 4.1% K on a dry matter basis. The N concentrations are comparable to those found in nitrogen fixing leguminous shrubs and trees, whereas the P and K concentrations are higher than those typically found in shrubs and trees. It is important to note here that *Tithonia* is not a legume, and therefore does not biologically fix atmospheric N_2, but the high concentration of N in its leaves is due to the fact that it is especially effective at N retrieval from sub-soils (Jama et al., 2000). Apart from having high concentrations of N, P and K, *Tithonia* has been reported by Gachengo et al. (1999) also to have 1.8% Ca and 0.4% Mg in its green biomass. When planted with maize, Niang et al. (1996) found a substantial increase in maize yield of 4.8 t/ha compared to 1.6 t/ha in the control plot where maize had been grown without any inputs. Other locally occurring shrubs had a much lower increase of maize yield in comparison to *Tithonia*. Furthermore, combining *Tithonia* with phosphate fertilisers in phosphorous deficient soils increased the yield of maize two fold. Following these promising results, *Tithonia* was disseminated to farmers in 17 pilot villages within Siaya and Vihiga districts of western Kenya.

Wide scale dissemination of *Tithonia* by ICRAF, KEFRI and KARI began in 1997 after successful on-farm participatory trials. Dissemination was mainly through community based participatory approaches, public meetings referred to as *barazas* in Kenya, seminars, field days and exchange tours. Community based organisations (CBOs) and the extension officers of the Ministry of Agriculture also created awareness about the benefits of using *Tithonia* as a green manure. It has been several years since the benefits of *Tithonia* were disseminated to farmers and not much is known about its uptake, apart from a study that was undertaken by Obonyo and Franzel (2004) which looked at adoption of *Tithonia* in Vihiga district by farmers experimenting with the practice in collaboration with research institutions and the Ministry of Agriculture. The study by Obonyo and Franzel (*ibid.*) assessed the uptake in 1995-1998 when on-farm experimentation was still at its infancy. Another study, by Place et al. (2005), looked at the impact of agroforestry based soil fertility practices on poverty from 1997-2001. Since then, there has been no assessment undertaken to ascertain whether farmers are still using *Tithonia* for SFM and the constraints they may be facing. The study reported here therefore sought to assess the adoption dynamics of this promising species among farmers exposed to this technology in Siaya and Vihiga districts from 1997 to 2004. It was necessary as an initial step to undertake this study among farmers who had been exposed to the technology in order to understand the dynamism of the adoption process. If indeed, farmers are taking up the technology, then it can be up-scaled to other regions with similar agro-ecological and socio-economic conditions. But if there is little or no adoption lessons learnt can be used to improve the design of future agroforestry projects.

Description of study area

The study was undertaken in Siaya and Vihiga districts of western Kenya. This region is home to about 8 million people, and is one of Kenya's densely populated areas. Vihiga has an alarming population density, ranging from 800-1100 persons/km^2, while Siaya has a somewhat lower density of 316 persons/km^2 (Republic of Kenya, 2001a). As a result farm sizes are small, averaging 0.5 ha in Vihiga and 1.0 ha in Siaya. Soil fertility decline is a major problem in the area as a result of continuous cropping with little use of inputs. Farming is further constrained by heavy infestation of *Striga* (*Striga hermonthica*, Benth.,) a parasitic weed that substantially reduces maize yield. Land is privately owned and the farming system is characterized by a subsistence oriented mixed crop-livestock system with the major food crop being maize (*Zea Mays* L.) intercropped with beans (*Phaseolus vulgaris* L.). Cassava (*Manihot esculenta* Crantz), sweet potatoes (*Ipomea batatas* (L.) Poir.), sorghum (*Sorghum bicolor* (L.) Moench) and bananas (*Musa spp.*) are also commonly grown.

Methodology

To understand the adoption dynamics of *Tithonia* use, this study carried out a random sample of farmers who had received information and been trained on the use of biomass transfer technology by research institutions and the Ministry of Agriculture. A list of 301 farmers from eight villages was compiled based on project records, information from agricultural extension officers and village elders; 120 farmers were selected for interviewing, 60 from each district. The villages are among 17 pilot villages that were selected by the ICRAF, KEFRI and KARI pilot project on soil fertility replenishment and recapitalisation for research and dissemination of promising agroforestry technologies such as biomass transfer. Formal interviews were carried out using a pre-designed questionnaire. Informal interviews complemented the formal survey. Most of the responses were based on recall data which was limiting because some farmers could not remember the exact years they used *Tithonia* for SFM. This limitation was however addressed by thorough probing and asking farmers to relate the year(s) when they used *Tithonia* to events that took place in their village or households.

During the study, farmers were classified according to their adoption status in relation to *Tithonia*. It was necessary to undertake this classification because different farmers were at different stages in relation to whether they used the technology, or how long they used it. Adoption according to Rogers (2003) is a decision-making process in which an individual decides fully to make use of a technology. Most adoption studies have only assessed the use of a technology at a specific point in time, which in fact can give a false picture of whether a farmer has adopted the technology or not. According to Ajayi et al. (2003) and Keil et al. (2005), the fact that a farmer may be using a technology at a particular point in time, does not imply that he/she has adopted it; the farmer might only be testing/experimenting. This study, therefore, attempted to categorise farmers based on how long they used the technology since 1997 to 2004 (i.e. over eight years or 16 seasons). Obonyo and Franzel (2004) in their study of farmers collaborating with development projects in Vihiga district between 1995-1998 classified them into four categories: strong adopters, medium adopters, non adopters and testers. Place et al. (2005) in a study of the impact of agroforestry based soil fertility practices on the poor in western Kenya classified farmers into three categories; early users but later dropped the technology; recent users, and those who used throughout the period from 1997 to 2001. In any case, since farmers in both studies were still in their initial stages of experimentation, it was too early to tell whether they had fully taken up the technology or were only experimenting. The study reported here classified farmers into five categories: non-adopters, testers/rejecters, dis-adopters, adopters and re-adopters.

Non-adopters are farmers who, although exposed to the technology, have never tried to use, it while adopters are defined as farmers who have used the technology for six seasons continuously since first starting to use it. Dis-adopters on the other hand are defined as farmers who used the technology for four seasons or more but later stopped using it. Testers/rejecters are farmers who tried the technology for four seasons or less and then stopped using it. Re-adopters are farmers who stopped using the technology and then started using it again.

Data were collected to allow various farm and household characteristics reported by Feder et al. (1985); Obonyo and Franzel (2004); Keil et al. (2005) and Place et al. (2005) to influence adoption of agricultural innovations to be assessed using a logistic regression model. These variables are age of farmer, district, level of education, access to household labour, livestock ownership (a proxy of manure availability), type of household (whether female headed or male headed), ownership of improved cows (a proxy of wealth) and farmer's status in the group. Planting *Tithonia* on the farm and access to hired labour were also included, based on the hypothesis that they were likely to increase adoption of *Tithonia* for SFM.

Results and discussion

Dynamics of the use of Tithonia for SFM in pilot villages of Siaya and Vihiga districts from 1997-2004

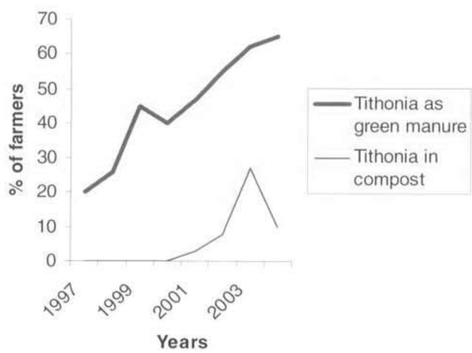


Figure. 7.1. Trend in the use of *Tithonia* for SFM in pilot villages of Siaya district

There was a steady increase in the number of farmers using *Tithonia* from 1997 to 1999, with a drop in 2000 in both districts. After which there has been a steady increase in the use of *Tithonia* as a green manure in Siaya district. Some farmers also used *Tithonia* in compost instead of direct application. From 2002 more and more farmers in Vihiga have opted to use it in compost rather than as directly applied green manure. This in essence has led to a drop of farmers using *Tithonia* directly as green manure (Figure 7.2). In Siaya the situation is different, in that more and more farmers are using it as a green manure (Figure 7.1).

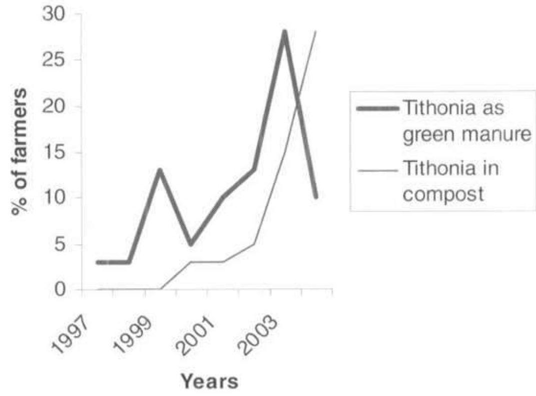


Figure 7.2. Trend in the use of *Tithonia* for SFM in pilot villages of Vihiga district

The explanation for this is that farmers in Siaya have double the size of land on average as farmers in Vihiga (average 1.0 ha, compared to 0.47 in Vihiga) and therefore Siaya farmers have enough space to plant some *Tithonia* on their farms unlike their counterparts in Vihiga who have no land to spare. As a matter of fact, 58% of farmers in Siaya have planted *Tithonia* on their farms compared to 13% in Vihiga. Planting *Tithonia* on farms saves on the time and labour associated with harvesting and transportation. Initially farmers used to get the plant from road sides quite a distance from their homes but as more and more farmers came to realise the economic benefits of *Tithonia*, it became very scarce and at the same time, farmers who had it on their land, would not allow their neighbours to harvest, unlike before. This prompted farmers in Siaya to grow it on their farms. But for those in Vihiga who have no option of planting it on their farms, they prefer to compost it in order to reduce on the labour requirements associated with chopping the leaves into small pieces before incorporating in a planting hole.

Classification of farmers into various adoption categories

Classifying farmers into various adoption categories provides information on perceptions and motivations of different farmers and therefore enables development practitioners to target their research to constraints experienced by different categories of farmers. As of 2004, the majority of farmers (52%) in Siaya district were considered to be adopters in comparison to a paltry 8% in Vihiga district. In contrast, Vihiga district had more non-adopters (60%) compared to 20% in Siaya district. Details of the other categories are presented in Table 7.1. It important to note, though, that these categories are only relevant at a specific point in time, as adoption is a continuous process with farmers falling into different categories on the adoption continuum over time (Kiptot et al., 2007). A farmer who is an adopter today may dis-adopt tomorrow for a range of reasons, and may then re-adopt the technology when the circumstances are favourable.

Table 7.1. Farmers' adoption status for *Tithonia* as of 12/2004

Status	Siaya n=60	Vihiga n=60
	% of farmers	
Non adopters	20	60
Adopters	52	8
Dis-adopters	3	5
Testers/rejecters	17	16
Re-adopters	8	11

Factors likely to influence adoption of *Tithonia* for soil fertility management

In order to assess factors likely to influence adoption of T*ithonia* for soil fertility, a logit regression model (Table 7.2) was developed.

Table 7.2. A logistic regression model of factors likely to influence adoption of *Tithonia* for SFM

Variables	Coefficient	Standard error
Gender	-1.047	0.877
District	1.847**	0.818
Age	0.008	0.027
No of years of schooling	0.231*	0.126
Farm size	-0.016	0.262
Access to hired labour	1.532**	0.769
Ownership of livestock	-2.186***	0.850
No of people working on farm	0.120	0.396
Whether planted *Tithonia* on farm	3.719***	0.809
Farmers status in group	0.252	0.703
No. of improved cows	0.312	0.387
Householp type	1.069	1.044
Constant	-4.185	2.041
Nagelkerke R^2	0.66	

Dependant variable=Adoption of biomass transfer 0=No, 1=Yes; Independent variables
Gender (Male=0, Female=1), District (Vihiga=0, Siaya=1), Access to hired labor (0=No, 1=Yes); Whether farmer has planted tithonia (No=0, 1=Yes); Farmers status in group (official=1, non-official=0), Livestock ownership (No=0, Yes=1); Household type (female headed=0, male headed=1

*, **, *** Significant at 10%, 5%, 1% level of probability

Ownership of livestock and planting of *Tithonia* on farms was found to strongly influence adoption of *Tithonia* (P<0.01). The influence of livestock ownership, however, was negative, which implies that the greater the number of livestock on farms the less the likelihood that a farmer will adopt *Tithonia*. Farmers who have more livestock have more manure, which reduces the need for *Tithonia*. Past research has shown that application of the optimum amount of 5t/ha of *Tithonia* requires 370 workdays/ha while application of animal manure takes only 1-7 workdays/ha (Jama et al., 1997) and therefore it is quite logical that farmers with manure will opt to use it instead of *Tithonia*. In contrast, increasing the planting of *Tithonia* on farms increases the likelihood of adoption. The farmer's district, and whether he/she had access to hired labour also influenced adoption ($P<0.05$). This coincides with the finding that 52% of farmers in Siaya district are considered adopters in comparison to a paltry 8% in Vihiga district (Table 7.1). The use of *Tithonia* biomass is a labour intensive technology and this explains why it is more likely to be adopted where farmers have access to hired labour to cut and transport *Tithonia* for them, thereby avoiding a situation in which household labour meant for other farm activities is diverted to *Tithonia*. During the survey, it was found that even farmers with meagre resources occasionally hired casual labourers to assist them. A casual labourer charges KSh.50 (US$0.70) per day, which according to farmers, is small in comparison with the economic returns gained if *Tithonia* is used on high value crops. More research on the cost benefit analysis of hiring labour is therefore needed. The number of years of schooling had a moderate influence over adoption probability ($P<0.10$). This is perhaps a weaker relationship than found in much of the adoption literature, where adopters of agricultural technologies have been found to have significantly more years of schooling than non-adopters (Feder et al. 1985; Moser and Barrett 2003; Obonyo and Franzel, 2004). Other factors such as gender, age, farm size, household type, number of people working on farm, ownership of improved cows did not show any influence over adoption of *Tithonia* in the regression, although the study found that adopters had slightly larger than average land holdings and were slightly younger (average age 50) than those who never adopted (average age 56) (Table 7.3).

Table 7.3. Farm and household characteristics of various categories of adopters

Variables	Non adopters n=48	Testers/ Rejecters n=20	Adopters n=36	Dis-adopters n=5	Re-adopters N=11
Farm size (ha)	0.6 (0.6)	0.5 (07)	0.7 (0.09)	0.5 (0.04)	0.3 (0.04)
No of years of education	6.5 (0.4)	6.5 (0.7)	7.8 (0.5)	6.7 (1.1)	6.5 (2.6)
Age of farmer in years	55.6 (1.6)	51.0 (1.0)	50.3 (2.2)	48.8 (3.6)	48 (6.6)
No of adults working on farm	1.8 (0.1)	1.2 (0.26)	1.8 (0.1)	1.9 (0.28)	2.3 (0.27)

Note: Figures in parenthesis are standard errors of mean

Main reasons for non-adoption, rejection and dis-adoption of Tithonia

During the formal survey, those farmers who were non adopters, testers/rejecters and dis-adopters were asked why they were not using *Tithonia*, even though they were aware of its benefits. Various reasons are presented in Table 7.4, as mentioned by farmers. It is clear that the main reason is labour intensiveness; this was mentioned by 30 farmers (Table 7.4). The same observation has been made by several other researchers (Jama et al. 2000, Place et al. 2005 and Obonyo and Franzel, 2004). According to Jama et al. (1997), a farmer needs about 5 tons of *Tithonia*/ha and this would require about 370 workdays/ha, which under normal circumstances is simply not practical.

Table 7.4. Main reasons various categories of farmers gave for not using *Tithonia* for soil fertility management

Reasons	Non-adopters n=48	Testers/rejecters n=20 No. of farmers	Dis-adopters n=5
Labour intensive	30	1	0
Size of farm too small to plant	5	4	0
Not available in the vicinity	10	3	0
No improvement in crop yield	0	10	0
No germination after using *Tithonia*	0	2	0
No reason stated	3	0	0
Sickness	0	0	2
Husband got job away from home	0	0	1
Spouse died	0	0	1
Old age	0	0	1

Transporting *Tithonia* which is heavy when fresh, and then cutting and chopping it into small pieces is a highly labour intensive venture. Previous research has shown that because of its high labour requirements it is not cost effective to use it on a low value crop like maize, but is only profitable when used on high value crops such as tomatoes, kale, cabbages etc. (ICRAF, 1997). This is the reason why many farmers apply it on very small portions and on high value crops. Farmers therefore need to be encouraged to use it on high value crops.

The main reason cited by farmers who experimented and rejected the technology was the fact they did not notice any improvement in crop yields after using *Tithonia*. This was mentioned by 10 farmers out of 20. This could be attributed to the fact that some farmers applied very small quantities of *Tithonia* which in essence led to no noticeable effect on crop yield. Two farmers found that their crops did not germinate after using *Tithonia*. This might be attributable to the fact that the affected farmers applied seed directly over *Tithonia* without cover. Applying the *Tithonia* with a thin layer of soil first, before planting a crop is the recommended practice. This suggests the need for researchers and extension officers to get farmers fully to understand agronomic practices concerning how and when to use *Tithonia*.

As regards to farmers who dis-adopted the technology after using it for several seasons, a main reason cited was sickness. Malaria is endemic to the region and also has very high rates of mortality due to HIV/AIDS. This has impacted negatively on technologies that are labour intensive, such as use of *Tithonia*. Death of spouse was also reported as having led to one farmer abandoning the use of *Tithonia* as she could not cope with the extra work involved. Old age was also mentioned by one farmer. He indicated that he was simply too old to engage in such a technology, since it is so labour intensive. Although age was not found to be statistically associated with the adoption of *Tithonia*, the results in Table 7.3 suggest that the adopters are somewhat younger than the other farmers in the sample.

Farmers' reasons for adopting Tithonia

All farmers who had adopted *Tithonia* in the pilot villages indicated that when it is used, crops germinate with vigour, and that crop yield increases (Table 7.5). Other reasons mentioned were the fact that it is a simple technology to use and it reduces infestation of termites & *Striga* weed on crop fields.

Table 7.5. Farmers' reasons for adopting *Tithonia*

Reasons	No. of farmers n=36 % of farmers
Crops germinate with vigour	100
Increase in crop yields	100
Simple to use	70
Reduction in *Striga* weed	56
Reduction of termites in the cropland	42

NB: There were multiple responses hence the total is more than 100

Farmer adaptations

Although the technology was initially promoted as a green manure to be used when planting maize, farmers have come up with a number of adaptations. The survey revealed that farmers used *Tithonia* for growing a variety of crops. Frequently mentioned were kale (45%), cabbages (20%), tomatoes (45%) and bananas (60%). A minority of farmers (15%) used it on maize. In addition they also used *Tithonia* for mulching their kale, tomatoes and cabbages. Furthermore, instead of only using it directly as a green manure, farmers are opting to compost it. As was shown in Figure 7.1 and 7.2, more and more farmers, especially in Vihiga district, prefer this composting option to direct application as a green manure. Other adaptations are the use of *Tithonia* for top-dressing maize and as a pesticide. Another major adaptation is the fact that farmers now plant it on farms instead of relying on *Tithonia* found along road sides and farm boundaries. The common planting practice used by farmers is to have the plant grow along contours in the cropland to serve a duel purpose of controlling soil erosion while providing leafy biomass for soil fertility replenishment.

Constraints experienced by farmers using Tithonia

Various constraints experienced by farmers using *Tithonia* are scarcity, mentioned by 45% of farmers; bad smell (40%), and labour intensiveness (45%), while a majority (80%) mentioned that they did not know how much *Tithonia* to use in a planting hole. The normal practice is for farmers to chop *Tithonia* leaves into small pieces, and then incorporate a handful of fragments in the planting hole. Farmers who use it to make compost incorporate as much as they can in the compost pit. The quantities applied are usually not measured and in most cases it is trial and error. The incidence of crops not germinating after using *Tithonia* is high and this could be attributed to insufficient knowledge on how much is needed. More research should be directed to this aspect, so that farmers know the required quantities for different crops. Although 45% of farmers using *Tithonia* mentioned labour intensiveness as a constraint, it did not necessarily prevent them from using *Tithonia*, but posed a major limitation to the area over which the farmer applies *Tithonia* biomass.

Although the bad smell of *Tithonia* was mentioned, this is probably not a major issue when compared to the economic returns associated with its use on high value crops. Most farmers have learnt to deal with it. Scarcity is another constraint that was mentioned by some, and was a factor also noted by Jama et al. (2000). Those who plant it argue that since many farmers in the pilot villages now know the economic importance of *Tithonia*, it is becoming more and more privatised. People can no longer simply go to anybody's farm to harvest it; now they have to ask for permission. Having a farm-based supply is the solution adopted by some, and others need to be encouraged to do likewise. Even for those with small farm sizes, they can be encouraged to plant along terraces and on internal and external farm boundaries.

Conclusions

This study has shown that the use of *Tithonia* biomass for SFM is a promising option for farmers willing to plant it on their farms and able to invest necessary labour. Farm planting is a reasonable thing to do, since it reduces labour requirements associated with transportation, in addition to solving a scarcity problem. When planted along contours, it also serves the additional purpose of controlling soil erosion. Farmers can periodically lop these hedges and use the biomass for soil fertility. But a problem pointed out by Jama et al. (2000) is that *Tithonia* is a nutrient miner; it effectively retrieves nutrients deep in the soil. As farmers continue to lop the hedges planted on farm, it is more likely that in the long term the positive effects of *Tithonia* on crop yield will diminish, since on-farm Tithonia may eventually pump out nutrients rather than supply them, unless farmers are encouraged to manure/fertilise their hedges, an unlikely prospect. It is therefore important that more research is undertaken to determine the longer term effects of using *Tithonia* hedges for on-farm for soil fertility management. This information will be invaluable in helping development agents and researchers devise agronomic options to be undertaken by farmers without compromising nutrient budgets on farms. For those farmers who are limited by the size of their farms, alternative niches that do not compromise land for cropping should be explored, i.e. use of contours and internal & external boundaries.

Chapter 8

Beyond the pilot villages: diffusion of agroforestry technologies in western Kenya

CHAPTER 8

Beyond the pilot villages: diffusion of agroforestry technologies in western Kenya

Abstract

This chapter looks at the diffusion of improved tree fallows and biomass transfer technologies in villages neighbouring the pilot sites. Pilot sites refer to those villages where an agroforestry programme based in western Kenya engaged with farmers to test and disseminate agroforestry-based soil fertility management technologies. One hundred and three farmers from two villages in Vihiga district and two in Siaya district were sampled and interviewed to assess the extent of diffusion of these two agroforestry technologies from 1998-2004. Results obtained are disappointing: 43% of farmers interviewed indicated that they had heard about improved fallows but only 14% had ever seen them. As for biomass transfer, only 33% of farmers had heard about this particular technology. Sources of information were mostly through relatives, friends, neighbours and group members. Although a substantial number of farmers had heard about the technologies, very few had practised them. For instance only one farmer had improved fallows and 10 had used *Tithonia* in compost, in 2004. Although this low uptake is attributed to a number of reasons, such as lack of awareness about the technologies, insufficient knowledge, and lack of sufficient resources such as land and labour, the chapter also points to one underlying mechanism – the need to deal with poverty with extremely limited means. In this regard, the technologies are 'simply not good enough'; in the eyes of the farmer they do not provide tangible economic benefits, e.g. food. The chapter concludes by pointing out that researchers need to rethink their strategy, paying closer attention to the context under which technological development takes place. In the present case a context of extreme poverty means that every farm process is scrutinised in terms of its immediate tangible contribution to food security.

Keywords: diffusion, non pilot villages, improved tree fallows, biomass transfer

Introduction

In 1928, hybrid corn was released to farmers by the Iowa State Agricultural Experiment station in the United States. Despite its superior yields over the traditional corn and intensive promotion by the extension service and seed companies, hybrid seed initially had a slow rate of adoption, but was eventually taken up widely by Iowan farmers. The events that followed thereafter, culminating in a study by Ryan and Gross (1943) in which they investigated the diffusion of hybrid corn among farmers in Iowa, has influenced the methodology, theoretical framework and interpretation of research on diffusion and adoption of technologies all over the world. The study revealed two key points: i) that the adoption process began with a few farmers, and only later did the innovation spread to other farmers, and ii) the most influential source of information on this innovation was neighbours. It implied that if a few farmers would adopt innovations, other farmers would follow. This work, followed by that of Rogers (1958), has provided the basis for diffusion of innovation theory that has influenced how agricultural extension has been conducted all over the world. According to this theory – based on a linear transfer of technology model - innovation and their attributes are given, and potential users are expected to adopt the technology. For those who did not adopt, change agents were supposed to pursue them to change attitudes, with the hope the laggards would one day adopt. Apart from corn in America, hybrid maize in Kenya is said to have followed the same trend (Ascroft et al., 1973).

The extension system in most countries, Kenya included was modelled around diffusion of innovation theory. Innovative technologies developed by researchers in research stations are then transferred to contact farmers expected to serve as model farmers so that other farmers in the community can learn from them with the output of widespread adoption. But the analytical climate has changed since then. Change occurred after it was realised that the model did not take into account farmer innovations. Furthermore, non-adopters were not recognised. The approach was biased towards wealthier farmers, who in most cases did not interact much with other community members (Yapa and Mayfield, 1978). These criticisms led to a radical shift in research and development, which has seen the extension system transform from the linear model of Technology Transfer (ToT) to a current focus on participatory approaches. These are more interactive and iterative, encourage farmer innovations, and above all consider farmers as key stakeholders in the whole process of technology development and dissemination. There has also been a change in extension policy in many developing countries from material delivery and incentive package provision to demand driven extension. Furthermore, the role of extension has also changed from providing blue prints to offering facilitation.

Although the extension system in Kenya has changed its mode of operation, from top-down to bottom-up, this change has not had much impact on small-scale farmers. This is due to structural adjustments programmes imposed by International Monetary Fund (IMF) in the early 1990s which led to financial constraints stretching staff and services very thinly. Because the number of extension officers has been reduced considerably, the few on the ground are not able to reach the many farmers who need extension service (Gautam, 2000). According to participatory poverty assessments conducted in ten districts of Kenya in 2000, it was found that lack of extension services are partially to blame for poverty (Republic of Kenya, 2001c). In order to address this problem, more attention is being given to new approaches, which are seen as a more feasible method of technology development, dissemination and up-scaling. These approaches, which are participatory in nature, promote farmers as the principal agents of change in their communities and focus on enhancing their learning processes and capacity building. But they still work on the assumption that if one farmer adopts a technology successfully, others may learn from him/her, thereby increasing the spread of technology.

One such approach is used in western Kenya by the agroforestry programme in Maseno to disseminate information on agroforestry. It is described as the village committee approach. Details of how it works have been provided in Chapter 3. The village committee approach is a strategy to involve farmers fully in the technology development and dissemination process so as to arrive at better adoption by farmers. The assumption of the village committee approach is that technologies developed jointly between farmers and researchers, and taken up by participating farmers, will indeed diffuse spontaneously to other community members in other villages not directly involved in the participatory process, thereby making the process sustainable. The approach was tested on a pilot basis in 17 villages in western Kenya and it was assumed that technologies will diffuse from these villages to neighbouring ones. But agroforestry technologies are quite complex and require a lot of understanding before implementation. Furthermore, in the cases of hybrid corn there was strong promotion by the extension service at the grassroots. The same cannot be said of agroforestry. This is because the extension service is virtually non-existent and therefore agroforestry technologies are expected to diffuse spontaneously to farmers in non-pilot villages. There are a number of issues that further complicate the diffusion process, viz. i) agroforestry technologies for soil fertility replenishment such as improved tree fallows as developed in western Kenya do not have immediate benefits and farmers have to wait before they see returns, ii) the technologies are knowledge-intensive and therefore involve knowledge transfer and much learning before implementation. So the main question is "can complex technologies diffuse spontaneously without the distortion of knowledge?" Is there indeed diffusion and to what extent? Should relevant formal institutions intervene or can other approaches be used to speed up the diffusion process? Does diffusion of the technology reflect the adoption process? If not, what is the problem? What diffuses to the community? In other words, what aspects of the technology diffuse widely to the community and why? What are the diffusion channels of a technology in the community? Which ones are more popular and why?

This study sought to examine these issues by conducting a survey in four villages neighbouring the pilot villages, but not in any way involved in the participatory process of agroforestry technology development The study was undertaken in order to i) understand whether knowledge intensive technologies diffuse from participating farmers to the whole community at large, ii) identify factors that influence the spontaneous diffusion of technologies, iii) identify communication channels for the diffusion of the technology and, iv) offer recommendations on ways to facilitate the rapid spread of agroforestry technologies.

Methods of data collection and study villages

This study was undertaken in four villages of Siaya and Vihiga districts. The four villages are Jina and Ulumbi in Siaya and Murumbi and Ekamanji in Vihiga. Like many other villages in the region, crop productivity is constrained by low levels of soil fertility and diminishing land holdings. The household was used as the sampling unit of inquiry, and villages were the primary units selected at the first stage of sampling. The villages were selected randomly from a list of villages in Jina sub-location (3) and Ebusiralo sub-locations (5). Jina sub-location neighbours Sauri sub-location which was used as a site for the pilot project in Siaya district. Ebusiralo sub-location neighbours Ebukanga, also a pilot site in Vihiga district. A list of households in the villages in the study area was constructed with the assistance of local leaders, i.e. village headmen, because there was no official record of households in the Divisional offices at Yala and Luanda, and in any case, the number of households keeps on changing due to migration, marriage and death. The list may not have been exhaustive, but nonetheless it gives an estimate of the number of households in the villages. Each village was sampled independently to ensure equal representation. A 10% sample of households was then randomly selected from this list, and as a result a total of 103 farmers were drawn for the interviews and the resulting samples in each village are shown in Table 8.1.

Table 8.1. Sample size of households drawn for the interview

District	Location	Sub-location	Village	No. of households	Sample size for the survey
Siaya	Yala Township	Jina	Jina	371	37
			Ulumbi	379	38
Vihiga	West Bunyore	Ebusiralo	Ekamanji	149	15
			Murumbi	132	13
Total				1031	103

Since the purpose of this study was to determine the diffusion of agroforestry technologies, in particular biomass transfer and improved fallows, various methods were used in order to capture the diffusion process. These were; a formal survey using a pre-designed questionnaire, observation and, where necessary, informal in-depth interviews were followed up with a few informants. This was necessary as farmers perceptions could not be readily captured in the questionnaires. The purpose of the survey was to capture the diffusion process from 1998-2004 and therefore it meant that recall data had to be used, a process which as mentioned in Chapter 6 had its shortcomings. Nonetheless, farmers used events that had occurred in the village to remember when they had seen/heard of the technology. For instance, one farmer indicated that he saw improved fallows one time he had gone to his sister's home in Sauri village for a funeral of his brother in-law. He asked his son who was present at the time of the interview when that was, and was told the year.

In order to avoid confusion in the use of terminology, various key terms used in this chapter are hereby defined. Diffusion as used in this study is the process by which a new idea or technology spreads among members of a social system over time (Rogers and Shoemaker, 1971; CIMMYT, 1993). Diffusion could either be spontaneous unplanned spread of new ideas or planned. This chapter is more concerned with the spontaneous, unplanned diffusion because the selected villages have not had any sort of intervention from any external organisation. Adoption, as used in this chapter, is defined as a decision to make full use of a new idea or technology on a continuous basis.

Results

Whether farmer has ever heard of improved fallows and biomass transfer technologies

Out of 103 farmers who were interviewed from the two districts, Siaya and Vihiga, 43% indicated that they had heard of improved fallow technology. Although 43% of farmers indicated that they had heard about the technology, the number of those who had ever seen improved fallow technology was quite small. Only 14% indicated that they had ever seen an improved fallow and had an idea what it looked like. As regards to biomass transfer, only 33% of farmers indicated that they had heard of it.

Source of information about the two agroforestry technologies

Relatives (kin and affines) were the most popular source of information (Table 8.2). Other sources of information were public meetings (*baraza*), the Ministry of Agriculture, NGOs operating in the area, neighbours and the Maseno Agroforestry Programme.

Table 8.2: Source of information on improved fallow technology

Source of information	Agroforestry technology % of farmers (n=103)	
	Improved fallow	Biomass transfer
Neighbour	4.8	6.7
Agroforestry Programme	3.8	4.8
Relatives	28.1	24.2
Friend	7.7	9.7
Group	5.8	7.7
Baraza	6.7	1.9
Ministry of Agriculture	1.9	1.9
Non Governmental Organisations	2.9	3.8
Any other	2.9	5.8
None	57.2	66.9

NB: There were multiple responses

One farmer Mzee Omondi had this to say:

> *'My daughter is married in Sauri village (one of the pilot villages), one time I visited her, and I saw trees with yellow and purple flowers in her farm. I asked her what they were for; she told me that they were brought to the village by some wazungus (whites) who told them that the trees are really good for soil fertility improvement. They did not have seeds at the time and therefore I never picked any, in any case I was not keen about planting trees that do not provide food because my farm is small.'*

Farmers who indicated that they got information from the Agroforestry Programme said that they used to work as casual labourers in the on-station experimental plots. Another farmer, Joel from Ulumbi village, indicated that his neighbour who is an extension officer in the Ministry of Agriculture has been planting fertility enhancing shrubs since the late 1990s.

'My neighbour is the one who informed me one time about the soil fertility enhancing ability of the trees he had planted on his farm.'

Groups were also mentioned as a source of information. Some farmers from the sample villages belonged to groups that also had members from the pilot villages and therefore whenever they had meetings, they would meet at the homestead of one of the members, and since improved fallow technologies are easily observable, they got to know about them. In other instances, some of them found their relatives chopping *Tithonia* or incorporating it in their farms.

What knowledge about improved fallows did farmers have?

Those farmers who had heard of improved fallows (IF) were asked if they had any knowledge about the fallow technology. All 44 farmers who had heard of improved fallows indicated that they were told that IF are good for soil fertility management. But only two farmers had an idea of the kind of nutrients that are replenished by IF species. More - 13.5% - of farmers said that they knew various types of species used for improved fallows. It is also interesting to note that although improved fallows were mainly promoted for soil fertility management, a good proportion of farmers (19.4%) were told that IF are also good for repelling moles. Only 12.6% of farmers said that they had knowledge on how to plant an improved fallow, while 14.5% indicated that they were told that species used for fallows also provide fuel-wood. More than half of the respondents (57.2%) had no idea about IF (Table 8.3).

Table 8.3: What farmers knew about improved fallows

Aspect of improved fallow farmers knows	% of farmers n=103
Types of improved fallow species	13.5
When to plant an improved fallow	4.8
Main purpose of improved fallow (Soil fertility management)	42.7
How to plant an improved fallow	12.6
Nutrients replenished by an improved fallow	1.9
Repels moles	19.4
Good for fuel-wood	14.5
Have no knowledge	57.2

Figure 8.1. An improved fallow of *Tephrosia candida* on a farm in Sauri village, Siaya (2005).

NB: There were multiple responses

What aspects of biomass transfer did farmers know?

All farmers (33%) who had heard about biomass transfer indicated that *Tithonia* is the species most used. A substantial number (20%) knew various ways of using *Tithonia*. Some mentioned that it can be used to make compost or applied directly as a green manure, used as mulch and as a pesticide. Two thirds of farmers sampled had no idea whatsoever what biomass transfer was while very few farmers (5.8%) had an idea of the kind of nutrients that are replenishment when *Tithonia* is used for planting crops (Table 8.4)

Table 8.4. Aspects about biomass transfer farmers knew

Aspects about biomass transfer technology	Percentage of farmers n=103
Species used for biomass transfer	33.0
How to use biomass transfer	19.4
When to use biomass transfer	18.4
Crops that are planted using biomass transfer	30.0
Nutrients replenished by biomass transfer	5.8
None	66.9

Figure 8.2. *Tithonia* hedge planted along a terrace on a farm in Luero village, Siaya (2005).

Which technology has the farmer ever practiced?

Out of 103 farmers sampled, 19 farmers (18%) indicated that they have ever practiced the use of biomass transfer only (1998-2004), while 11 farmers indicated that they had practiced the use of both biomass transfer technology and improved fallow. Two farmers indicated that they had practiced the use of improved fallows only.

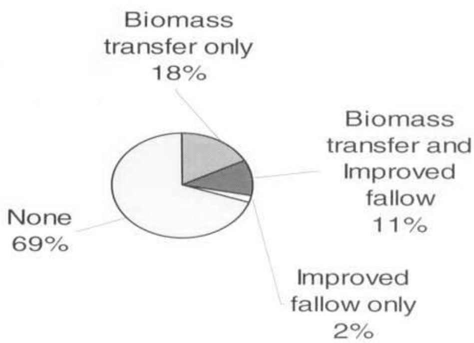


Figure 8.3. Percentage of farmers who had practiced either improved fallow or biomass transfer between 1998-2004.

There has been low use of both biomass transfer and improved fallow technologies in non-pilot villages. The findings in Figure 8.4 show that the use of improved fallow has been declining with more farmers opting to use *Tithonia* for soil fertility management, although the number of farmers is quite low. The use of *Tithonia* in compost seems to be preferred by farmers compared to direct application as green manure. This is due to the fact that using *Tithonia* in compost is less labour intensive compared to direct application as a green manure.

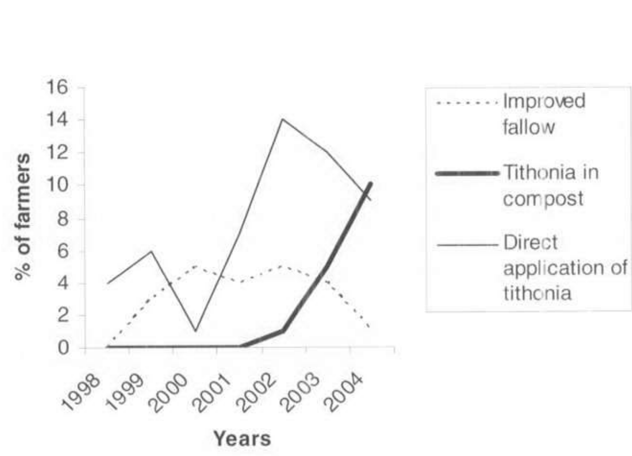


Figure 8.4. Proportion of farmers using agroforestry based soil fertility technologies in the non- pilot villages from 1998-2004.

Reasons why farmers who had heard of biomass transfer technology never practiced it

Out of 34 farmers indicating they had heard of biomass transfer, 31 tried it on their farmers between 1998 and 2004, but a majority later rejected the technology. Three farmers who never tried gave various reasons for not doing so. These were i) labour intensiveness, ii) lack of sufficient knowledge iii) scarcity of plants.

Mama Margaret Okuta is 68 years old and widowed. She lives on a half a hectare piece of land in Jina village of Siaya district which she shares with her two orphaned grandchildren, who go to school. She has two heads of cattle. When I visited her farm, I found her tethering her cattle behind her house. I had informed her earlier that I would visit so that we could talk about *aketch* (Luo name for *Tithonia*). So it was not really a surprise. This is an excerpt from the conversation I had with her.

> **Evelyne:** *The last time we talked, you told me that you had heard that Aketch is good for the soil, why haven't you tried it when planting your crops.*
> **Farmer:** *Ehh! my daughter, you don't see I am too old, I no longer have the strength to look for aketch and bring to my farm. I have livestock which I have to take care of, they are like children. My two grand children spent most of their time in school, rarely do they assist me. The free education that this new government brought is good, but it has taken away my grandchildren. I only see them at night. Since there is no one to assist me, I only use manure from my cattle to improve the fertility on my farm.*
> **Evelyne**: *If you ever get someone to assist you, try using aketch, it is really good.*
> **Farmer:** *Maybe when my grandson finishes school. He is in standard eight.*

Francis Were, on the other hand, is 35 years old, married with five children. He cultivates on one eighth of a hectare, has no job and therefore relies on casual labour for his source of livelihood.

Evelyne: *You told me that you had seen your friend in Ebukanga sub-location using maridadi* (Luyhia word for *Tithonia*) *for his crops, why haven't you tried?*
Farmer: *Yes, I saw my friend using it, he told me that he had learnt in a seminar that maridadi is really good, but I haven't tried it because I am always out working in other people's farms. My wife is also ever busy with household chores, we have no time, and besides, transporting and chopping maridadi into small pieces is a labour intensive activity, I don't have the time. It has also become very scarce and therefore one has to walk long distances to look for maridadi. We don't have the time to do that.*

Ceasar Onyango, a farmer in Ulumbi village, had a different perspective. He has never tried *Tithonia* because he does not have adequate knowledge on how to use it. His relative did not tell him the quantity that is required in a planting hole.

'I a*m hoping that ICRAF will also some day bring a seminar to our village so that they can show us how to use aketch.'*

Reasons why farmers who had heard about improved fallow technology never practiced it
A surprisingly high number of farmers who have heard about improved fallow never practiced it. During the survey, 43% of farmers indicated that they had heard of improved fallows, but only a paltry 13% had ever practised it between 1998 and 2004. I made a follow up with a few farmers and they gave varied reasons, such as i) lack of sufficient knowledge, ii) fallows were planted by researchers and therefore farmers in non-pilot villages are also expecting the same to be done in their villages, iii) small farm sizes, iv) fallows do not provide food.

Mzee Josephat Agula Odongo (55) lives in Jina village, Siaya district, is married with several children and cultivates a 0.5 ha piece of land. He has two local cows and uses cattle manure to fertilise his farm. He does not use mineral fertiliser because he cannot afford to.

Evelyne: *Why haven't you tried the use of improved fallows?*
Farmer*: I saw fallows one time I visited my friend in Sauri village, he told me the fallows were brought by ICRAF. I never took a keen interest because he said they had been planted by researchers. And in any case, I do not have enough knowledge about these fertility enhancing trees. We are hoping that someday ICRAF will come to our village so that they can show us how to plant fertiliser trees.*
Evelyne: *Didn't your friend tell you about the fallows?*
Farmer*: He told me that they are good for the soil and also for repelling moles, but I guess I was not so keen since he had mentioned that it was researchers who had planted and they occasionally went to his farm to assess their performance.*

Mzee Odera, another farmer from Ulumbi village, did not mince his words:

'My shamba (farm) is too small, if I plant fertiliser trees, what will my children eat?
Will they eat the trees?

John Owuor from Ulumbi village lives next to the Kisumu-Maseno-Busia highway and has one hectare of land. He had this to say about improved fallows.

'I heard about fallows in the late 1990s; they were brought by Wazungus (whites) from ICRAF. They planted them on farms in Sauri village and ICRAF has since been concentrating their research there. I used to see big vehicles going to Sauri to monitor the fallows, though I no longer see them these days. I have not planted because I am hoping that one day ICRAF will bring fallows to our village. I even hear that there's a big development project that ICRAF is bringing to Sauri again, no one thinks about our village, it has been completely neglected.'

Reasons why some farmers tried improved fallows on their farms but later rejected the technology

Various reasons were given.

i) The technology did not meet farmers' expectations

Elijah Oketch Madawo tried for one year, but has since abandoned planting of fallows.

'I was told that they are good for repelling moles and also improving the soil. I planted them to chase away moles but I did not see much difference. As for the soil, there was some improvement, but I discontinued because my family needs food which cannot be provided by the fertiliser trees. They are good for those farmers who have big pieces of land.'

Mama Hellen Waswani, from Vihiga district, planted *Crotolaria ochroleuca.*

'My sister who is married in Ebukanga gave me the seeds and told me that it is a good vegetable and also improves the soil. I planted it but I later found out that the leaves are not as tasty as our indigenous vegetable known as 'mitoo' *(Crotolaria brevidens) and furthermore I did not notice any improvement in soil fertility, so I abandoned planting it .'*

ii) Small farm sizes

This and other studies on improved fallows (Keil et al. 2005; Franzel, 1999), have established that farm size influences the adoption of improved fallows. Farmers who have small farms are not willing to sacrifice land that is meant for cropping to fertility enhancing trees/shrubs whose benefits are not immediate.

Mzee Indunse from Vihiga had this to say.

'I have been told that these trees are really good for the soil, but the farm I cultivate is ¼ an acre, I have 8 children, If I plant fertiliser trees, what will my family eat?'

Discussion

Why diffusion and adoption dynamics are disappointing beyond the pilot villages

Technologies unattractive to farmers as they do not solve farmers perceived immediate need, i.e. food

The findings of this study have shown that diffusion of both improved fallow and biomass transfer technologies is low. This could be attributed to the nature of the two technologies. Past research has established that attributes of a technology play a very important role in adoption. Fliegel and Kivlin (1966) present a detailed list of attributes of technologies as factors in diffusion. Many of these attributes are summarised by Rogers (1983) and are shown in Table 8.5. This list may not be exhaustive, but includes the most important as indicated by past research. Improved fallow technology's main purpose is soil fertility improvement, a benefit only achievable in the long term. Farmers in western Kenya are more interested in technologies that give tangible benefits in the short term, i.e. provide food. Because improved fallows cannot provide immediate benefits, 'they are simply not good enough' in the eyes of the farmers and hence the low rate of diffusion (outcome). Secondly, the technologies are knowledge intensive, and therefore require farmers to understand the technical aspects before implementation. Past research has shown that technologies that are known to have a high rate of diffusion are those that are simple, cheap and adaptable (IIRR, 2000).

Table 8.5. Characteristics of innovations which influence rate of adoption

Characteristic	Measurement	Notes
Relative advantage	The degree to which an innovation is perceived as better than the idea it supersedes	The new idea needs too provide gain in economics, prestige socially, convenience and satisfaction
Compatibility	The degree to which an innovation is perceived as being consistent with: Existing values Past experiences Needs of potential adopters	May require adoption of a new value system prior to adoption of an incompatible innovation
Complexity	The degree to which an innovation is perceived as difficult to understand and use	The simpler the idea to understand, usually the more easily adopted.
Trialability	The degree to which an innovation may be experimented with on a limited basis	Innovations which can be tried on an instalment plan are more quickly adopted
Observability	The degree to which the results of an innovation are visible to others.	The easier the results of an innovation are to see, the more likely it is to be adopted.

Source: Rogers (1983)

The findings of this study also show that most farmers who heard about these technologies did not have sufficient information (Table 8.3) required to implement complex technologies as required, although it is doubtful whether providing adequate information about the technologies would have made any difference to adoption. In terms of observability, the few farmers who saw these technologies may not have observed the associated benefits such as improvement in soil fertility and crop yield. Without this information, farmers seem unwilling to take the risk of investing in a technology about which they have unresolved doubts.

The technologies do not fit the socio-economic 'context' in which farmers are embedded

It is possible that farmers have enough basic knowledge to implement an innovation, but the context is such that knowledge-based mechanisms never become activated. Most farmers indicated that they had small pieces of land. The land-availability context was inappropriate for them to make use of the information they had about fallow techniques. Improved fallows involve a tree component, and at some point, farmers have to forego a season's crop in favour of trees/shrubs whose tangible benefits are not immediate. Farmers make rational decisions, and therefore when faced with this kind of scenario, the mechanism in play is a kind of cost-benefit calculation ('it is not worth foregoing a season's crop on a technology that does not provide tangible benefits'). To farmers, application is simply not an option, hence there knowledge remains dormant and there is no outcome. As for the case of biomass transfer, some farmers indicated that it is a labour intensive technology. As discussed in chapter 6, labour scarcity has been compounded by the fact that most children go to school due to the free primary education policy introduced by the Kenyan government in 2003. So here is a scenario where 'contextual circumstances' are again simply not conducive to adoption of the technology, as most farmers cannot simply divert scarce labour meant for cropping to the use of biomass transfer nor do they feel able to sacrifice cropping land for trees/shrubs whose benefits are not immediate.

The misconception farmers have about agroforestry soil based fertility technologies

As mentioned in the preceding chapters of this thesis, research on soil fertility technologies in western Kenya was a collaborative venture between ICRAF, KARI and KEFRI. Research was initially done on station, and later transferred on-farm (i.e. technologies were tested on farmers' fields). As an international organisation, ICRAF had an international staff, locally referred to as *Wazungus*, and in many instances there were a couple of students from abroad doing research on farmers fields. Wageningen University is one such institution that has had many of its students doing their PhD and MSc research in pilot villages. Monitoring of the on-farm trials was often conducted by scientists who moved around in big cars pasted with huge ICRAF logos, and hence farmers only noticed ICRAF and not their national partners, KEFRI and KARI. So farmers in neighbouring villages got the impression that the technologies were brought by ICRAF, and believed that some day the same technologies would be taken to their villages. This partly explains why a substantial number of farmers who were aware of the technologies never tested them on their farms. It was not yet time to do so. This misconception, which is widespread in the non-pilot villages, needs to be addressed. Farmers need to be made better aware of the rationale for carrying out participatory research and the fact that researchers are limited in terms of capacity and hence cannot work with all farmers. Nonetheless, farmers who are not involved in participatory research need to be provided with information on various technologies so that they can be in a position to make informed decisions on what options to adapt or reject.

Informal social networks alone may not be sufficient to enhance the spread of complex technologies

Participating farmers shared knowledge about biomass transfer and improved fallows mainly with their relatives, friends and group members. Relatives (kin and affines) proved to be the most important source of information. This is due to the fact that visiting relatives is a common social activity in Kenya. As indicated by Kiptot et al. (2006), farmers often visit when there is a social function (funeral, wedding, child naming etc) or just to pay a courtesy call - hence the high number of farmers who heard about the technologies from their relatives. Such sharing does not necessarily extend the technologies to farmers who have no close ties with the participating farmers. This may partly explain why a substantial number of farmers had never heard of improved fallows (57%) and biomass transfer (67%). The other possibility is that those farmers in non-pilot sites who have never heard of the technologies have friends and relatives in pilot villages who simply rejected the technologies and therefore had nothing to show or tell their kin from non-pilot sites. Judging by the results in chapter 6, this possibility cannot be ruled out. In addition, informal social networks had other shortcomings, for instance, insufficient knowledge about the two technologies was conveyed to farmers in non-pilot villages and as a result, some farmers may not have been able to test the technologies. What this means is that although informal social networks are important sources for disseminating technologies, as shown by Kiptot et al., (2006), Nathaniels (2005), Van Duuren (2003), Simpson and Owen (2002) and van der Mey (1999) they are not on their own fully sufficient. They need back up from institutions that have the expertise and extensive grassroots networks, although in this case it is doubtful whether having formal institutions in non-pilot villages would have made much positive difference, considering the fact that these technologies, as indicated earlier, are simply not 'attractive' to farmers.

Conclusions

There are four important conclusions that can be drawn from this chapter. First and foremost is that awareness of the existence of a technology and its associated knowledge are necessary conditions for adoption, but, obviously are not sufficient in themselves. There has to be a favourable attitude towards the technology. Furthermore, the technology should be able to meet farmers' expectations. Also, the farmer has to possess sufficient resources to be able to adopt the technology.

Secondly, the fact that a substantial number of farmers in the non-pilot sites had never heard of improved fallows or biomass transfer, that furthermore a substantial number of those farmers who had heard never made an attempt to test the technologies, and that even among those who tested many subsequently rejected raises questions about context and underlying mechanism for adoption of soil fertility enhancement in western Kenya. To a casual observer, one candidate mechanism could be lack of information due to the inefficient extension service, but it is doubtful whether providing information about the technologies would have made any difference considering that farmers (judging by their opportunism in regard to seed sales, for example) are realists who make rational decisions based on simple cost benefit analysis. The implication for this is that researchers need to go back to the drawing board to rethink their strategy. But one issue which needs to be given closer attention by researchers is the context under which technologies are developed. What we have seen here is that if the context is not conducive for the technology, diffusion and adoption simply cannot take place.

Thirdly, although agroforestry technologies were introduced in pilot villages and taken up by a few farmers, the same level of outcomes and degree of relevance in non-pilot villages cannot be expected. This is because there is variability in needs, opportunities and conditions among different farmers in different areas, which may influence the way the technologies are taken up. For instance, Kiptot et al. (2007) showed that most farmers in pilot villages only took up improved fallow technologies because of the anticipated benefits from projects, existence of a market for seed of improved fallows and availability of credit. But in the absence of such benefits in non-pilot villages, we obviously cannot expect the same level of enthusiasm. What this means is that when such technologies diffuse to other areas, there needs to be a careful re-examination of the way they are taken up and the outcomes that arise. Outcomes such as 'rejection' may require further research.

Last but not least, successful adoption and diffusion of a technology goes far beyond the characteristics of a technology per se. As Mango (2002) pointed out, the approach, context and set of relationships forged between researchers and farmers to develop and spread successful technologies are equally important determinants that may affect adoption. A case in point was the intensive monitoring that was undertaken by the agroforestry programme when undertaking participatory research. This created the wrong impression about the technologies and has since played a role in the non-adoption of technologies in non-pilot villages. Spontaneous spread of agroforestry soil-improving innovations remains a goal in western Kenya, but basic effort is still needed to specify a plausible scenario linking context (extreme poverty), mechanisms (technical knowledge) and favourable outcome (adoption of agroforestry innovation).

Chapter 9

Discussion and conclusions

CHAPTER 9

General discussion and conclusions

Introduction

This thesis has explored the processes of participatory learning, dissemination, adoption/adaptation and diffusion that took place when a community-based participatory approach was used by the agroforestry programme in western Kenya as a tool for ensuring technology adoption and dissemination. In presenting the chapters, various context-mechanism-outcome configurations have been described. The contestations and manoeuvres that took place between actors in their endeavour to practice agroforestry-based soil fertility technologies and how they influenced learning, adoption and diffusion have been explored in detail. Together the chapters constitute a technography (an account of the social processes through which farmers attempted to shape, adapt and implement a technological regime). But the purpose of such systematic description is not description for descriptions sake. What, at the end of the day, we seek, is some general understanding of what works for whom, why and when. In this concluding chapter an attempt is made to step back and discuss the bigger picture. The hope is that lessons learned can be used to improve current initiatives and future interventions. The discussion divides into seven sections.

The first section re-visits the context-mechanisms-outcome configurations identified in this thesis as the basic desideratum of a realist evaluation (Pawson and Tilley, 1997). The entry point in this thesis for grasping mechanisms has been to focus on links between participation and technology, and ask what works for whom, when and why. It has been made clear that participation must be seen as a political and dynamic process, as there are always tensions underlying issues concerning who participates and why. The discussion reiterates that although participation can be seen as a platform to challenge patterns of dominance it may also be a means through which existing power relations are reproduced and entrenched.

Sections two and three discuss what is at stake in both agroforestry adoption and in participation. Both agroforestry and participation have been promoted as alternative technologies/approaches that can make a difference in rural people's livelihoods. Agroforestry, has been widely seen as a more sustainable low-cost agricultural production system expected to contribute to the attainment of food security and poverty eradication. Do the findings of various studies presented in this thesis live up to this vision? Participation as reviewed in chapter 2, is a concept that has taken on the characteristics of a panacea; holding out the promise of inclusion, creating spaces for the marginalised and giving a voice to the voiceless. Various issues addressed in the thesis raise doubts about this claim, and these doubts are discussed in the third section. In a fourth section I look at the future of participatory research and discuss prevailing challenges for research organisations. A fifth section points out what needs to be done in order to achieve high adoption rates of agroforestry based soil fertility management technologies. The sixth section comments on farmers as important drivers of technological change. This leads to a seventh section - a general conclusion.

Context-mechanism-outcome configurations

In the introductory chapter, an important theoretical claim made was that a realist evaluation acknowledges the fact that interventions never work indefinitely in the same way and in all circumstances, and not for all people (Pawson & Tilley, 1997). Secondly, outcomes may vary depending on the context or mechanism; this is so because social programmes are often introduced in multiple contexts embedded in complex processes of human understanding and circumstances and they will work/not work depending on how the actors reason, negotiate, change or influence various interventions. Findings of this study have shown that uptake of soil fertility replenishing trees/shrubs varies, depending on the social contexts in which they are introduced. For instance, this study has shown that adoption of improved fallows in Vihiga district has generally been very low due to the fact that farmers in this district have very small farm sizes. Planting of improved fallows means foregoing a season's crop, which to many farmers is not a option. The implication for this is that introducing soil fertility shrubs in a context where farm sizes are small, will definitely lead to the rejection of the technology as an outcome, as was shown in chapter 6. Secondly, when there was a market for seed, many farmers planted soil fertility shrubs/trees in the hope of making money. This implies that for soil fertility management technologies to be 'attractive' they must be introduced in a context providing tangible economic benefits. In relation to biomass transfer technology involving the use of *Tithonia*, this study has shown that not many farmers are willing to practice it because of its labour intensiveness (Chapter 7). In addition, it was shown that this particular technology can only be taken up in contexts where farmers are faced with animal manure scarcity, and therefore have no other option rather than use *Tithonia* if they wish to improve crop productivity. And results in Chapter 7 further showed that because of its usefulness as a resource for soil fertility improvement, *Tithonia* has become very scarce in the wild, and therefore farmers wanting to use it must plant it on their farms to make it readily available. In summary, this particular technology is suitable in contexts where there is a manure scarcity, where farmers have big farm sizes and therefore can plant it and at the same time, in contexts where farmers are willing to hire casual labour specifically for that particular technology, to avoid a situation where scarce labour meant for cropping is diverted to the biomass transfer technology.

In relation to the use of the village committee approach by the agroforestry programme, as a means to reach many farmers, this study has shown that the rationale of using groups in technology dissemination was misplaced, as the approach assumed that groups are fully appropriate vehicles for technology dissemination. There is no doubt that groups are not only traditional and necessary for survival especially for the most vulnerable members of the population, but using them for technology development and dissemination without fully understanding their nature was not a good idea. First and foremost, the approach failed to realise that resources are required to join a group. This automatically prevented some farmers from joining groups and by extension benefiting from development interventions. Secondly it failed to acknowledge that these groups were formed with a specific agenda, and therefore bringing on board another activity which was not a priority for farmers was misplaced. In addition, the approach ended up reproducing community power structures controlled by village elites, which in essence ended up causing social tensions and excluding marginalised members of the community from participating in various agroforestry programmes. The mechanisms associated with group activities were not as envisaged by project designers, and perverse outputs (from their perspective) ensured. In essence, the village committee approach can only work effectively in a context where local people are empowered and able to stand up and challenge the domination of village elites, or where development practitioners work with groups specifically formed for a particular development task/activity. In short, the context was not thoroughly understood, and unanticipated mechanisms (associated with village power politics) kicked into play, resulting in outcomes that diverged from those intended by the agroforesters.

Agroforestry adoption and dissemination at stake?

Agroforestry has been proposed as a low cost option for mitigating problems such as declining soil fertility, shortages of fodder, fuel-wood and poles in small holder farms. Since its institutionalisation in Kenya in 1977 (Chapter 1), major technological advances have been made. In western Kenya, which has been the focus for this thesis, several promising agroforestry options for soil fertility management and conservation have been developed. Examples are improved tree fallows involving fast growing leguminous trees/shrubs, and biomass transfer technology using *Tithonia* which involves the cutting of leaves of trees/shrubs grown away from the farm (or on-farm, if land is available) and incorporating them on crop fields to improve soil fertility. Long term results undertaken in western Kenya have shown that these technologies have the potential to increase maize yields threefold (Niang, 1998b; Niang, 2002), especially when P additions are made to take care of P deficiencies. Efforts have also been made by researchers in western Kenya to involve the whole community in participatory technology development and dissemination at project sites (Chapter 3). In spite of all this effort, adoption of agroforestry based soil fertility technologies has been quite low, as shown in Chapters 6 and 7; some farmers are taking up the technologies for the "wrong" reasons (pseudo-adopters), while a majority of farmers in Vihiga simply never made an attempt to test the technologies. A few who did test them later rejected them. Furthermore, the findings in Chapter 8 have shown that the diffusion of these technologies to villages where the agroforestry programme has not been working is quite disappointing. What could be the problem?

First, it is important to note that farmers in sub-Saharan Africa are confronted with a number of problems, of which soil fertility is just one. Farmers in western Kenya have very small farm sizes. Farmers in Vihiga, which is quite densely populated, have an average farm size of less than 0.5 ha, while in Siaya farmers have an average of 1 ha. Maize is the staple food crop in both districts, and is grown twice a year, to provide food to the households. Farmers in this region lack reliable cash crops which they can fall back on in the event of shortage of the staple food, hence the practice of cropping maize continuously. This is attempted without the use of mineral fertilisers, as most households are too poor to afford them. Agroforestry technologies involve the planting of a tree component with agricultural crops, and in most cases, e.g. the case of improved fallows, farmers have to forego a season's crop, an option which not many farmers are willing to risk. This is because whatever increase in yield they get with agroforestry is not good enough to justify foregoing a season's crop. Agroforestry technologies such as improved tree fallows, in addition to supplying nutrients to crop fields, also provide fuel-wood, and reduce *Striga* and couch grass (hence less labour is required for weeding). Therefore, when the whole system is looked at in totality it has been shown to be marginally profitable (Swinkels et al., 1997). But what researchers need to understand is that farmers' number one priority is food and hence an introduction of any system that competes with food crops; such as improved tree/shrub fallows, is not an option for farmers where land size is limited, unless the agroforestry system can provide products which put cash in farmers' pockets to be later converted to food, as was the case when there was a market for tree seed (Chapter 6). One farmer even asked me whether his children will eat fertiliser trees.

One other agroforestry option for soil fertility improvement which can be used without farmers having to plant the trees/shrubs on their farms is biomass transfer technology (Chapter 7). However its adoption has also been quite low, especially in Vihiga district. Reasons given centred on its labour intensiveness, while others indicated that the raw material has become very scarce as a gatherable resource in the vicinity. Hence 58% of farmers in Siaya exposed to the technology have opted to plant the requisite plants for biomass transfer on their farmers so that material is readily available, and also to reduce the labour requirements associated with transportation. This defeats the objective where land is very scarce, but results discussed in chapter 7 show that the technology is promising in areas where farmers are able and willing to plant it on farms, have manure scarcity and can afford to hire casual labour. What this means is that the poorest farmers, with the smallest farm sizes, are unlikely to plant it on-farm as it will take up space meant for agricultural crops. Farmers are therefore being encouraged to plant along contours and terraces, although most farmers in Vihiga district who have livestock opt to plant napier grass on these terraces and then use livestock manure to fertilise their crop fields.

Thirdly diffusion of these two agroforestry technologies to non-pilot villages is worryingly low (Chapter 8). This is attributed to a number of issues such as the basic unattractiveness of the technologies and their complex nature. The technologies are not attractive to farmers since they do not address the number one problem in farmers' eyes – 'food security.' Secondly, these technologies are knowledge intensive; they require a lot of understanding before implementation. And therefore, informal social networks alone may not be sufficient to sustain spontaneous spread, because some farmers with the technologies are unable to explain the principles to other farmers. Therefore, some end up testing the technologies without following the right agronomic recommendations, thereby leading to low yields. The extension system on the other hand is dormant, and even readily available effective technologies are unable to reach farmers outside the limited number of sites in which researchers are working. But in the present case, it is doubtful whether having extension would have made any difference due to the fact that farmers consider the soil fertility technologies to be 'simply not good enough.' This sends a strong message to researchers that the marginal superiority of a complex technology is not good enough. It must either be so superior as to sell itself, or it must be sufficiently clear in terms of how the basic mechanism works in local context that pioneer farmers could indeed teach it to others if they wished. But then this raises some questions about whether the social mechanisms of community participation do indeed work as agroforestry researchers had hoped.

Participation at stake?

It is widely assumed in development discourse that community-based mechanisms of participatory research and extension offer a promising means to address the limitations of the linear model of technology transfer. However, it has become clear in recent decades that this populist approach, based on putting 'participation' at the centre stage, has not really lived up to expectations. This thesis confirms this suspicion, but the conclusion is that we need to pay closer attention to how participatory development engages hidden mechanisms of informal community governance, if perverse effects are to be avoided. Processes of participation, such as sharing knowledge of new practices, learning new techniques, and enabling farmers to make informed decisions about what agroforestry technologies to practice can be empowering. But whether they are or not, in practice, depends on addressing a range of issues that have come to light in this thesis. There is need to subject these issues to rigorous critical analysis if the approach is to deliver on its promise.

In theory, participatory rural development is intended to give local people a voice, but in reality, "voice" is elusive. This is because efforts to promote participation in development projects tend to articulate with local (and often hidden) mechanisms of power, thereby excluding the least powerful members of society. Reflecting on agroforestry studies carried out in western Kenya, this thesis has explored the complexities of the social processes that apparently underlie the straightforward concept of participation. The thesis has documented some of the manoeuvres, social tensions, structural contradictions, and issues of exclusion and inclusion that emerge once participatory projects are funded.

For instance, the use of 'research' farmers in on-farm trials discussed in Chapter 6 created social tensions in villages, since they marked out the high status of some farmers, while others felt left out (and perhaps not averse to a spot of sabotage). Another case in point is discussed in Chapter 3, where village committees were composed of representatives of various farmer groups in the hope of efficient dissemination of agroforestry technologies. The idea was based on a presumed mechanism of communicative efficiency – farmer representatives would hand on information to a majority of members quickly, while capacity was to be built through training a few farmers to train a majority. What was not fully understood is that farmer representatives (as in many parts of rural Africa) are not delegates but persons chosen in recognition of the power they already command. Such figures treated the attention they received from researchers as further proof of their high status, and not as an invitation to extend information to lower status farmers "for free."

By confusing a status mechanism with a communication mechanism, researcher participatory interventions reproduced local power relationships. Committees were mainly composed of village elites, who then tended not to spread messages but to exclude the poorer farmers from participating. The use of "representative farmers" in these committees often masked how representative these people were. A case in point is a discussion in Chapter 3 where one of the village committees was composed of people who had worked in the city, but are now retired or retrenched. This places them on a higher level of social status than the other farmers they are supposedly meant to represent. It seems unlikely that these people will readily understand the interests and concerns of the other farmers.

Participation as reviewed in Chapter 2 is about inclusiveness, giving the voiceless a voice, but having only a handful of dubiously mandated individuals represent others goes against the ideals of 'good participation.' In Chapter 4, I referred to this phenomenon as 'participation by proxy.' Is participation by proxy true participation? If all it does is reinforce status hierarchies at village level then it is not surprising that agroforestry technologies fail to spread (even assuming it to be problem free from a technical perspective) since the wrong mechanism for mass poverty alleviation has been triggered. This is not an argument against the ideals of participation, but an argument in favour of clarifying hidden social mechanisms in relation to specified social contexts. The current participatory modalities are probably not "fit for the purpose," and new pro-poor modalities need to be devised. A specific instance where participation clearly needs overhaul can be seen in evidence that the use of groups excluded the poorer members of society on the grounds of lacking resources to join. Participation in lengthy, discursive meetings, for example, requires time that many poorer farmers cannot afford. This is perhaps an argument in favour of a shift from deliberative participation towards what Richards (2007b) calls performative participation.

In the participatory learning processes discussed in Chapter 4, exclusion was either by choice or design. This is partly blamed on the fact that community structures have remained paternalistic, despite the change from top down to bottom up language in development circles. Power seems to have shifted from project officials to village (modernized) elites (such as return migrants, retired officials, etc) who control development initiatives in rural areas. They decide on who participates, but more often than not, only a few elites and their friends and family members get to participate in development initiatives. This is supported by Ramisch et al. (2006) who also observed that village elites often 'capture' the most lucrative activities, or are quickly confirmed as the appropriate 'leaders' in projects. A conclusion is that attention needs to be paid to the micro-politics of inclusion and exclusion if technological participation is to succeed (Richards, 2007b).

Specifically, this thesis argues that in order for participatory approaches to make a difference in society, issues of power relations, acknowledged but rarely discussed in rural western Kenya, have to be addressed, in order to develop more inclusive transformative practices. As argued earlier, power has shifted from development professionals to village (modernized) elites. The unequal power relationship between the elites in committees/groups and other farmers in the community makes it difficult to obtain genuine participation because the whole process of participation is subject to manipulation in favour of elites and their families, as was claimed by some farmers in chapters 3 and 4. For some of the elites, participation has very little to do with empowerment, but is seen as an opportunity to gain socially or materially from development initiatives. Genuine participation demands that all stakeholders participate in all stages of project development, but where there is a monopoly of power in the hands of a village elite this may not be achieved unless efforts are made, by development professionals, to require villagers to engage in sincere attempts at devolution of power to create spaces for the marginalised members of society. Another option is to design projects that directly address the less marginalised in society, empowering them so that they have the confidence to assert themselves and challenge elite manipulation. The Strengthening Folk Ecology (SFE) project implemented by TSBF in western Kenya tried to minimise the domination of village elites by allowing elites to feel 'important' via formal acknowledgement, while at the same time providing multiple alternative avenues for participants to interact with each other. The project, for instance, emphasized informal settings to get the input and feedback of the marginalised members of the community (Ramisch et al., 2006).

Which way on for research organisations committed to participation?

Despite these caveats about participation, participatory research – defined here as collaboration of farmers and scientists in technology generation and development – remains a promising approach, capable of taking into account farmers' own innovations, thereby leading to the development of technologies that are responsive to farmers needs. However, this thesis has demonstrated that participatory research faces a number of challenges, some of which are now briefly addressed.

First and foremost, participatory research as discussed in the first chapter of this thesis was undertaken in the earlier phases of the agroforestry programme in western Kenya with the sole purpose of testing technologies under farmers' conditions. It was called participatory not in a real sense of 'participation' as used in development circles, but in the literal sense that farmers took part in the process, either as landlords (leasing land to researchers for experimental purposes) and providing paid labour for weeding and guarding of on-farm experiments, or through benefiting from the crops harvested from the experimental plots (Chapter 6). The selection process for participating farmers was not participatory, it therefore, created some social tensions in villages, as selected farmers were seen to be benefiting socially or materially from projects that were undertaking participatory research. Because these farmers benefited initially from participatory research, it has since created a wrong impression about participatory research in the region. In 1997, when a community-based participatory approach was initiated to involve all farmers in a technology development and dissemination process, farmers still had the mentality that by participating in technology development they stood to benefit materially in the short term. There was little sense of "ownership" of a process that might eventually benefit the community as a whole. Some farmers even retained agroforestry trees/shrubs on their farms as a kind of display, signaling superior status and an expectation that they would continue to benefit socially and materially. It seems important to address these misconceptions. How can research organisations change the perceptions of farmers in western Kenya about participatory research?

It is important that right from the outset of project implementation, roles and expectations of parties involved be clearly defined and explained so as to avoid misunderstandings, and to have farmers learn to collaborate in participatory research for the right reasons and not for opportunistic ones, as reported in Chapter 6. It should be made clear right from the onset about who participates, where, how and on what terms. Ideally, participatory research should be a two way empowering process of knowledge generation and technology development of benefit to both parties. If knowledge and technologies are developed jointly, researchers would definitely get credit on their part from published reports and papers, while farmers will also benefit by having technologies that are responsive to their needs. In addition, participatory research has other advantages, especially if farmers involved are selected in a participatory manner. These include:

- Quicker and widespread diffusion of technologies
- Lower costs of technology development
- Better targeting of research and policy to address constraints in the system
- Empowerment of individual farmers and the community at large

Secondly, participatory research is, as mentioned, an approach to tap farmers' knowledge/innovations in technology development and also to test technologies under farmers' conditions. However, because of the complexities involved in terms of logistics and costs, only a few farmers are involved. What this means is that only a few farmers are empowered. Furthermore, research organizations mandates are to undertake research, not extension. How, then, can other farmers in the community benefit? The most effective way is for research institutions to link up with organisations whose mandate is development rather than research – preferably with those able to access an extensive grassroots network. These organisations may include state extension service, local NGOs and community organisations. They can then ensure that research results reach many farmers by using sites for participatory research as training grounds for other farmers in the community to visit and learn from their fellow farmers about various techniques. Kudadjie (2006) proposed a form of Research-NGO liaison in which researchers partner with local development agencies with the required scientific expertise to engage in and provide research support for farmers in order to facilitate local innovation. This therefore means that research organisations have to incorporate empowerment of development organisations in their agenda so that they can pass on the right information to as many farmers as possible at the grassroots.

Thirdly, participatory research often involves experimentation under controlled conditions in order to achieve uniformity in all experiments under farmer management. This is usually a great challenge, because of the heterogeneous conditions between farms. In order to minimise heterogeneity, researchers often supply inputs in the form of seed and fertiliser to the participating farmers to be used in experimental plots. This gesture, as discussed in Chapter 5, has often triggered jealousy and social tensions between the participating farmers and non-participating farmers in the villages. How then can participatory research succeed without causing social tensions? Research organisations should seek to sensitize communities, right from the outset, about the purpose of carrying out participatory research, and also then help the community to decide on who should represent them in project activities. This would be a good opportunity for the researchers to engage in proper discussions with villagers about inclusion and exclusion. Randomization (in any case a requirement for a good trials design) is often then acceptable to villagers as a means to include all classes of farmers without challenging political power structures head-on. It should also be made clear that inputs given are only for experimental purposes in order to allow meaningful comparisons between farms. If it does not already exist, participating farmers need to acquire a sense of what Richards (1985) termed "people's science".

How to achieve high adoption rates of fertiliser trees

Mercer (2004) asserted that no matter how elegant, efficient, productive, and/ or ecologically sustainable, agroforestry systems can only contribute to improved livelihoods and sustainable land use if they are adopted by smallholders. The results presented in Chapters 6, 7 and 8 have shown that despite the fact that soil fertility is a major problem in western Kenya, farmers' adoption rates for use of improved fallows and biomass transfer technology has been quite low. Several reasons were given by farmers for not adopting, or for discontinuing the use of, these technologies. These included factors such as farm size, labour, scarcity of material (in the case of *Tithonia*), lack of a market for seed and the fact that the technologies do not provide edible products. This is not surprising, as studies done elsewhere, as reviewed by Giller (2001), have shown that legumes grown specifically for soil fertility have not been widely adopted by farmers. In Chapter 6, many farmers took up the use of improved fallows because there was a market for seed and abandoned the fallows the moment the market disappeared. The implication of this is that in order for agroforestry based-soil fertility replenishment technologies to be widely adopted by farmers and therefore play a greater role in soil fertility management in smallholder farms, they must provide other tangible economic benefits such as seed, food or fodder.

Farmers as drivers of technological change

In the introductory chapter of this thesis, I addressed the concept of agency outlined in the actor oriented perspective of Long (2001), in which it is argued that farmers are capable of processing social experience and coming up with various strategies to suit their circumstances. This can also be applied to technology. Farmers reject or redesign technologies by evaluating the outcomes of previous actions and then come up with strategies to address issues that they are confronted with. For instance, this thesis has shown that in their endeavour to practice the use of biomass transfer technology, farmers in western Kenya found chopping *Tithonia* into small pieces for use as a green manure quite a laborious task. As a result, most of them are opting to use *Tithonia* biomass in compost, which saves a lot of labour. They claim that *Tithonia* has the ability to speed up the composting process. Other strategies that farmers have come up with is the use of species mixtures in improved fallows to repel caterpillars, to form dense canopies thus reducing the incidences of weeds, using *Tephrosia vogelii* for repelling moles, use of *Tithonia* as a pesticide, as a mulch and for top dressing. What this means is that researchers need to work closely with farmers to capture strategies that farmers come up with in their everyday practices. Such strategies can then be fed back into the R & D system. Such an approach if adopted can provide the opportunity for an intensive and sustained interaction between both farmers and scientists, which in the long run may lead to development of technologies that are feasible under farmers' conditions.

General conclusions

This thesis has shown that adoption of agroforestry technologies for soil fertility management in western Kenya is generally disappointingly low. The lack of a direct product that can be used as food or sold to generate income is the main disincentive. It can therefore be concluded that soil fertility management is a function of socio-economic processes within a community, and it is therefore imperative that researchers develop a realist awareness of the contexts, mechanisms and outcomes governing participatory technology development so that there is rapid correction when evaluation reveals evidence of negative or perverse outcomes. By establishing good feedback to R&D, there will be a better chance of avoiding a situation in which a lot of time and resource is wasted on promoting technologies that are 'not good enough' in the eyes of farmers. This thesis has further shown that adoption of agroforestry technologies is a long term process and therefore studying the adoption process requires a long time period in order to fully understand how and why farmers make certain land use decisions. In addition, classifying farmers into two categories (of adopters and non-adopters), as is often the case, is an unhelpful oversimplification, as farmers often go through various stages before they eventually adopt or reject technologies. In relation to participation, findings in this thesis have shown that achieving true participation has remained elusive, and may only be achievable if power is devolved from village elites while at the same time marginalised members of the community are empowered to stand up and challenge the status quo. This will in the end require political action favouring a more open society.

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Summary

This thesis is based on a collaborative agroforestry programme between the Kenya Forestry Research Institute (KEFRI), Kenya Agricultural Research Institute (KARI) and the World Agroforestry Centre (ICRAF) which has since 1988 been undertaking soil fertility research to address the problem of nutrient deficiency in smallholder farms within the western Kenya highlands. Over the years, approaches to technology development have evolved from the linear model of technology transfer (ToT) to the current participatory approach. In addition, various agroforestry technologies have been developed to address the problem of soil fertility. The core of the thesis explores and describes various processes that take place in the implementation of a community based participatory approach known as the village committee approach in technology adoption and dissemination. Issues that this thesis explores in detail are the processes of participatory learning, adoption/adaptation/non-adoption, dissemination and diffusion of the technologies. Overall, the thesis is guided by the technographic approach. Technography makes use of diverse observational and analytical methods and frameworks to arrive at hypotheses about likely mechanisms affecting the operation, transformation or adoption of technological processes. One such framework adapted to the needs of this thesis is the context-mechanism-outcomes configuration (CMOC). This framework rests upon realist assumptions. In order to understand the various mechanisms, this study drew upon the qualitative methods used by ethnographers. But some issues to do with learning and adoption were assessed from the perspective of a sampling approach, so it was also necessary to use the quantitative approach to social science. Attention was paid to the integration of quantitative and qualitative approaches. Multiple sources of data were used, including formal and informal surveys involving structured/semi-structured/unstructured interviews with farmers, in-depth interviews with key informants, case studies, participant observation and secondary data.

Findings presented show that the use of the village committee approach was misapplied as the approach assumed that groups are fully appropriate vehicles for technology development and dissemination. The groups did not play a major role in agroforestry dissemination, as was hoped by the programme. This may partly be attributed to the fact that agroforesty as a technology was not high on the agenda of most groups and therefore farmers did not give it much thought. The use of representative farmers to train others was also not effective, as some of the representative farmers never adopted the technologies and therefore had nothing to show to farmers within their groups. In addition, working with representative farmers from various groups created the opportunity for those farmers in leadership positions to use their social capital negatively, by monopolizing information on development initiatives. But looking at group cohesion in terms of CMOC the thesis cautions that we should remain aware of "hidden" candidate mechanisms only glimpsed in the case studies mentioned in chapter 3 or the discourse of participants. Group formation and success depended on being able to exclude some of the most needy persons through imposing membership requirements, such as fees, etc. This suggests the possibility that wealthier farmers benefit from cooperation only when they can exclude poor resource farmers. Second, agroforestry is apparently treated as a kind of ritual requirement helping groups access assets that really make sense – namely livestock distribution through the pass-on system. The possibility must be faced that agroforestry is valued more as a networking opportunity than as a mechanisms for transforming land management.

As regards to participatory learning addressed in chapter 4, this thesis shows that despite attempts by project officials to put locals in the driving seat on technology initiatives, achieving genuine participation has remained elusive. Some people were virtually excluded from the learning process. Exclusion was either by choice (self exclusion) or a product of village power politics. This is a major obstacle to participation, and unless it is tackled, efforts

being made to involve marginalized members of society through up-scaling of development initiatives will have disappointing results. As regards to farmer to farmer dissemination addressed in chapter 5, findings show that informal social networks were more effective for seed dissemination than for knowledge sharing. This calls for simplification of technical information by development professionals, in order to help support farmers' understanding and communication of complex principles. Also, it is important to recognise that as farmer-to-farmer dissemination takes place the message and uptake changes and therefore technology is re-shaped in the process of transfer. More studies are therefore needed at different sites to see if the mechanisms of trustworthy transfer (such as kinship) are found across different social contexts. More understanding is also needed on spread of knowledge and artefacts (such as seeds) across barriers between different socioeconomic groups, and whether mechanisms of transfer are the same among men and women.

In relation to agroforestry adoption, the results show that the process of adoption is highly variable and dynamic, with farmers taking up or discontinuing the use of soil fertility management technologies due to a whole range of factors of which soil fertility management is just one. Mechanisms of adoption are complex, and switched on and off by contextual factors. For this reason adoption research needs to probe beyond categorization and correlation, and frame its analytical questions in terms of the context-mechanism-outcome configurations advocated as the basis of a realistic evaluation methodology, as assessed in various chapters of the thesis. Adoption and diffusion of these technologies has been generally very low. The thesis points to the fact that for agroforestry-based soil fertility replenishing technologies to be attractive to farmers, they must provide other tangible economic benefits besides soil fertility improvement. Chapter 8 discusses diffusion of agroforestry technologies which is generally very low. This is attributed to a number of reasons. To a casual observer, one candidate mechanism could be lack of information due to the inefficient extension service, but it is doubtful whether providing information about the technologies would have made any difference considering that farmers (judging by their opportunism in regard to seed sales as is discussed in chapter 6 for example) are realists who make rational decisions based on simple cost benefit analysis. The implication for this is that researchers in western Kenya need to go back to the drawing board to rethink their strategy. But one issue which needs to be given closer attention by researchers is the context under which technologies are developed. What this thesis shows is that if the context is not conducive for the technology, diffusion and adoption simply can not take place. All in all the thesis concludes in the final chapter, that soil fertility management is a function of socio-economic processes within a community, and it is therefore imperative that researchers develop a realist awareness of the contexts, mechanisms and outcomes governing participatory technology development so that there is rapid correction when evaluation reveals evidence of negative or perverse outcomes. By establishing good feedback to R&D, there will be a better chance of avoiding a situation in which a lot of time and resource is wasted on promoting technologies that are 'not good enough' in the eyes of farmers. In relation to participation, findings in this thesis have shown that achieving true participation has remained elusive, and may only be achievable if power is devolved from village elites while at the same time marginalised members of the community are empowered to stand up and challenge the status quo.

Samenvatting

Het onderzoek voor dit proefschrift vond plaats in het kader van een samenwerkingsverband tussen het *Kenya Forest Research Institute* (KEFRI), het *Kenya Agricultural Institute* (KARI) en het *World Agroforestry Research Centre* (ICRAF). Dit samenwerkingsverb and was opgericht in 1988 om aandacht te schenken aan het probleem van de bodemvruchtbaarheid in met name de kleine boeren sector in de West Keniaanse hooglanden. De methode en benadering van technologie ontwikkeling evolueerde door de jaren heen van een typische overdracht van technologie naar een met aandacht voor participatie. Ook werden tal van technologieën ontwikkeld om het probleem van de bodemvruchtbaarheid probleem werkelijk aan te pakken. De kern van dit proefschrift exploreert en beschrijft de verschillende processen die zich afspelen gedurende de implementatie van de zogenaamde dorpsgerichte benadering van technologieontwikkeling. Er is bijzondere aandacht voor aspecten zoals participatief leren, adoptie/adaptie/non-adoptie, verspreiding en diffusie van technologieën.

Het onderzoek naar dergelijke processen en aspecten is geïnformeerd door technografie. Deze benadering combineert observaties en een analyse kader om hypothesen te formuleren over de mogelijke mechanismen die van invloed zijn op de werking, transformatie of adoptie van technologie. Een dergelijke analyse kader verbind context met mechanismen en uitkomsten en bouwt voort op zogenaamde realistische aannames. Ten einde grip te krijgen op de verschillend mechanismen en processen is vooral gebruikt van kwalitatieve onderzoekstechnieken zoals die worden gehanteerd door etnografen. Meer specifieke dimensies van het leer proces zijn geëvalueerd middels kwantitatieve methodes en met behulp van steekproeven. De integratie van kwantitatieve en kwalitatieve benaderingen behoefde daarom extra aandacht. Dit streven werd mede mogelijk gemaakt door gebruik te maken van verschillende soorten data: een vragenlijst met gesloten en open vragen; gestructureerde en meer open interviews met boeren, diepte interviews, gevalstudies van bijvoorbeeld dorpsvergaderingen, participerende observatie; tevens werd ook secondair bronnenmateriaal geraadpleegd.

De bevindingen van de studie wijzen erop dat de dorpsgerichte benadering misplaatst was. Deze benadering veronderstеld immers dat groepen een geschikt instrument is om technologie te ontwikkeling en de toepassing ervan te verspreiden onder bredere lagen van de boerenbevolking. De groepen speelden echter geen belangrijke rol in de verspreiding van *agroforestry* technologieën. Een verklaring die in dit proefschrift wordt aangedragen is dat *agroforestry* geen hoge prioriteit heeft voor de leden van de groepen. Boeren schonken er dus niet of nauwelijks aandacht aan. Gebruikmaking van voorbeeld boeren die anderen op hun beurt trainden, werkte ook niet. Sommige van deze voorbeeld boeren namen zelf de technologie niet in gebruik en konden anderen dus niets laten zien. Het inschakelen van voorbeeld boeren schiep veelvuldig mogelijkheden voor hen door het sociaal kapitaal dat een dergelijke positie met zich mee brengt voor zichzelf aan te wenden. Zo werd er nog al eens belangrijke informatie over nieuwe initiatieven aan andere groepsleden onthouden. De analyse van de cohesie binnen groepen vanuit een context-mechanismen-uitkomsten perspectief wijst ook op verborgen en mogelijke mechanismen zoals groepsprocessen. Hier wordt met name in hoofdstuk 3 en de daar gepresenteerde geval studies op in gegaan. Groepsvorming bleek afhankelijk te zijn van het uitsluiten van anderen doordat hoge eisen (zoals het heffen van contributie) werden gesteld aan het lidmaatschap. Dit wijst op de mogelijkheid dat rijkere boeren meer profijt hebben van samenwerking in groepen door armere boeren uit te sluiten. Een tweede kandidaat mechanisme is mogelijkerwijs dat *agroforestry* onderdeel is van een ritueel dat de toegang tot belangrijke hulpbronnen vergemakkelijkt. We moeten dus wel degelijk rekening houden met de mogelijkheid dat *agroforestry* meer gewaardeerd wordt als een mogelijkheid voor netwerken dan als een mechanisme voor het veranderen van landgebruik.

De analyse van het participatieve leren in hoofdstuk 4 laat zien dat ondanks pogingen van project medewerkers om participatie werkelijk na te streven een illusie is gebleken. Sommige mensen werden letterlijk buiten beschouwing gelaten. Dit was ofwel eigen keus (*self exclusion*) of de uitwerking van dorpspolitiek. Dit vormt een belangrijk obstakel voor echte participatie en als dit niet serieus wordt genomen zijn de talloze gingen om mensen die aan de zijlijn staan van het ontwikkelingsproces te laten profiteren van interventies voor niets. De analyse van de verspreiding van technologieën waarbij boeren anderen trainen en informeren, laat zien dat informele netwerken en relaties veel effectiever zijn daar waar het gaat om uitwisseling zaden dan wanneer het delen van kennis betreft. Dit wijst duidelijk op de noodzaak om informatie te versimpelen en hier ligt een duidelijke taak voor ontwikkelingsexperts teneinde boeren te helpen de technologieën te begrijpen en het communiceren van complexe principes. Het is ook van belang te onderkennen dat als boeren boeren trainen de boodschap en ook de toepassing van technologie veranderd en hiermee dus ook de technologie. Er moeten meer studies worden gedaan op verschillende plekken en dorpen om te onderzoeken of de mechanismen voor een betrouwbare overdracht (zoals verwantschapsrelaties) zich ook andere sociale contexten voor doen. Een beter begrip is nodig van de verspreiding en uitwisseling van kennis en artefacten (zoals zaad) tussen verschillende sociaal-economische groepen alsmede van de mechanismen van overdracht hetzelfde zijn voor mannen als vrouwen.

Wat de adoptie van *agroforstry* betreft, de resultaten van het onderzoek wijzen op grote verschillen alsmede op dynamieken waarbij boeren naar verloop van tijden weer stoppen met het toepassen van bepaalde bodemvruchtbaarheidsverbeterende technieken. Een hele reeks factoren is hier verantwoordelijke voor waarbij bodem beheer er maar een is. Mechanismen van adoptie zijn uiterst complex en worden als het ware als een knop aan en uitgezet door contextuele factoren. Adoptie onderzoek moet daarom ook verder gaan dan alleen maar nadruk leggen op sociale categorieën of op statistische verbanden zoals uitgedrukt in correlatie coëfficiënten. In dit proefschrift geef ik de voorkeur aan een analyse van de context-mechanisme-uitkomst configuraties zoals wordt gepropageerd door een realistische evaluatie methodologie. De adoptie en verspreiding van *agroforestry* technologieën is betrekkelijk gering. Dit proefschrift beargumenteerd dat als deze technologieën attractief willen zijn voor boeren dan moeten ze behalve een bodemvruchtbaarheidsverbetering perspectief ook een duidelijk en tastbaar economisch profijt bieden.

Hoofdstuk 8 handelt over de verspreiding van a.groforestry technologieën. Ook dit is betrekkelijk gering en heeft een aantal verklaringen. Voor een toevallige observeerder, zou een kandidaat mechanisme gebrek aan informatie kunnen zijn. Dit vanwege de inefficiënties van het voorlichtingsapparaat. Het valt echter te betwijfelen dat als de informatie voor handen was dit een dramatisch verbetering zou hebben opgeleverd. Boeren zijn realisten zoals hoofdstuk 6 ook al heeft laten zien; boeren nemen rationele besluiten gebaseerd op vergelijking van kosten en baten. Dit betekent op zijn beurt dat onderzoekers in West Kenia weer terug moeten naar de tekentafel om hun strategie te herzien. Een aspect dat hierbij veel aandacht verdiend is de context waarin technologieën worden onderworpen. Dit proefschrift wijst er immers nadrukkelijk op dat als de context niet mee werkt, het treurig gesteld zal zijn met de adoptie en verspreiding van technologie. De leidraad gevolgd in dit proefschrift is dat bodemvruchtbaarheid en het beheer ervan een functie is van socio-economische processen in gemeenschappen. Het is dus noodzakelijk dat onderzoekers zich een realistische opvatting aanmeten van de contexten, mechanismen en uikomsten die van invloed zijn op participatieve technologie ontwikkelingsprocessen. Alleen dan kan men tijdig corrigeren om niet wenselijke uitkomsten te voorkomen. Dit kan allen dan indien duidelijke communicatie mechanismen en relaties tussen onderzoek en ontwikkeling tot stand is gebracht. Dan kan ook worden voorkomen dat er technologieën worden gepromoot die in de ogen van boeren tijdverspilling is. Participatie, zo is de teneur van dit proefschrift, is een illusie en is slechts binnen bereik indien machtsrelaties binnen gemeenschappen aandacht ook daadwerkelijk verschuiven.

Curriculum vitae

Evelyne Kiptot was born in Kenya on the 3rd November, 1968. She did her primary education at Misikhu Girls Boarding Primary School; thereafter she joined Lugulu Girls High School in 1981 for her O-level and Bunyore Girls High School in 1985 for her A-level education which she completed in 1986. She enrolled at Moi University (Eldoret) in 1987 for a BSc. degree in Forestry which she obtained in 1990, thereafter she was employed by the Kenya Forestry Research Institute (KEFRI) as an Assistant Research Officer. She was seconded to a collaborative dryland agroforestry research project based at KARI's Katumani Research Station in Machakos district where she worked till 1994. In 1995, she was awarded a Ford Foundation Scholarship to study for a Masters degree at the School of Agricultural and Forest Sciences, University of Wales-Bangor (UK) graduating in 1997 with an MPhil degree in Agroforestry. Upon completing her Masters programme, she went to work at KEFRI's Muguga Regional Research Centre as a Reseach Officer where she has been ever since. In September 2003, she received a Rockefeller Foundation Scholarship through Wageningen University's Technology and Agrarian Development Group under the Participatory Approaches and Up-scaling Programme as part of the third cohort.

She currently works as a Senior Research Officer and her research interests include indigenous knowledge systems pertaining to the management and use of tree resources in pastoral areas, adoption research, participatory approaches and upscaling of innovations. She has published in several refereed journals and participated in many international conferences on forestry/agroforestry related issues.

CERES PhD Education Statement Form

Completed Training and Supervision Plan Evelyne Kiptot

Description	Department/Institute	Month/year	Credits
I. Orientation			
CERES Introductory Courses	CERES Utrecht University	April-May 2004	6
II. Research Methods and Techniques			
Techniques for writing and presenting scientific papers	Wageningen Language Centa	March –April 2004	2
PAU workshop on Peer Learning	Baarlo, Netherlands	December 1st-4th 2003	
Sharing experiences on PhD research and discussion of findings	PAU workshop in Malindi, Kenya	13-18 June 2004	1
Learning in PAU: Support to Analysis and PhD thesis write up	PAU workshop in Jinja, Uganda	24th-28 January 2006	1
Socio-cultural Field Research methods	Masholt/ CERES	March 2004	3
III Seminar Presentations			
PhD Research Proposal	CERES	May 2004	4
Farmer to farmer dissemination of agroforestry technologies in western Kenya	Kenya Forestry Research Institute Bi-annual Conference	6th-9th November 2006	4
Advanced Research Seminars	TAO and RDS (Wageningen University Chair groups)	Sept 2003-June 2004 Feb 2007-July 2007	1
IV. Academic skills			
Introduction to the Sociology of Knowledge and Rural Development	MSc Course RDS 20804	Rural Development Sociology group, Wageningen	6
Technography, researching, technology and development	MSc Course TAD 30804	Technology and Agrarian Development	6
Total			**34**

Funding

The main financial support for this PhD thesis was received from the Rockefeller Foundation through the Participatory Approaches and Up-Scaling (PAU) programme of the Technology and Agrarian Development (TAD) Chair group, Wageningen University, The Netherlands. Additional support was also received from the Kenya Forestry Research Institute through the Farm Forestry Programme. The author is grateful to these institutions for the generous support.

Cover design by Author and Dr. Conny Almekinders