PARTICIPATORY RESEARCH FOR IMPROVED AGROECOSYSTEM MANAGEMENT: PROCEEDINGS OF A SYNTHESIS WORKSHOP

Nazreth, Ethiopia
17-21 August, 1998

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PREFACE

Many publications distributed through the Network on Bean Research in Africa have reported results from working with farmers, either as clients or as participants in research and development. Participatory research is not particularly new, and an increasing number of non-governmental organizations and other development agencies base their activities on participatory approaches that may include an adaptive research element. The workshop reported here, however, was designed to draw out the recent experiences of a committed group of researchers involved in linking the formal and informal research sectors through an innovative set of community-based activities across Eastern Africa. These workshop proceedings, from the Participatory Research for Improved Agroecosystem Management (PRIAM) Project, address the process of participatory research, and the lessons, successes and problems still being faced.

CIAT is committed to continuing to undertake and support research on processes that offer prospects of enhancing the relevance and the cost-effectiveness of formal sector research under conditions of dwindling resources for research in Africa, and to fostering its institutionalization. Involvement in similar work in Latin America has already produced valuable lessons, but we realize that African situations need African solutions.

The Network on Bean Research in Africa serves to stimulate, focus and coordinate research efforts on common bean, the systems within which it is produced and the people who consume it. The network is organized by CIAT in collaboration with two interdependent sub-regional networks of national programs: the Eastern and Central Africa Bean Research Network (ECABREN) and the SADC Bean Research Network (SABRN) for southern Africa. As an outcome of this workshop, a working group on participatory research was formed within ECABREN, which now provides coordination and financial support for ongoing PRIAM activities.

Financial support for regional bean projects comes from the Canadian International Development Agency (CIDA), the Swiss Agency for Development and Cooperation (SDC) and the United States Agency for International Development (USAID).

Two other publications series complement this Workshop Proceedings series: Occasional Publications and Reprints. Further information on bean research in Africa is available from:

Pan-Africa Coordinator, CIAT, P.O.Box 6247, Kampala, Uganda.

Regional Coordinator, Eastern and Central Africa Bean Research Network, P.O. Box 2704, Arusha, Tanzania.

Regional Coordinator, SADC Bean Network, P.O.Box 2704, Arusha, Tanzania.

Roger Kirkby
Pan-Africa Coordinator

ACKNOWLEDGMENTS

We would like to gratefully acknowledge Dr. Seyfu Ketema, Director General of the Ethiopian Agricultural Research Organization (EARO), for authorizing and opening the PRIAM workshop; Dr. Aberra Deressa, Center Manager of Nazreth Agricultural Research Center (NARC), for hosting and facilitating the successful completion of the workshop; Dr. Habtu Assefa and colleagues at NARC for assisting to organize the workshop, and for providing administrative and logistical support throughout the workshop; Ato Sisay and the farmers of Wulenchiti for generously hosting workshop participants during the field day; the many researchers, NGO and extension staff, and farmers, who have worked so diligently in the various PRIAM sub-projects over the last three years; and Dr. Charles Wortmann for initiating the development of the PRIAM Project.

Additionally, special thanks are due to Stacey Young for the technical editing, and to Mabel Tibalikwana for the general editing, formatting and final layout, of this document.

Finally, gracious thanks are due to the Rockefeller Foundation for funding the PRIAM Project, the PRIAM Synthesis Workshop, and the publication of this document.

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OPENING SESSION

WELCOME ADDRESS

Dr. Aberra Deressa
Center Manager, Nazreth Agricultral Research Center, EARO[1]

Distinguished Participants, Invited Guests, Ladies and Gentlemen:

It is with pleasure that I welcome you all, on behalf of Melkassa Research Center and on my own behalf, to this synthesis workshop on participatory research for improved agroecosystem management, organized by EARO and CIAT. This workshop will provide an important opportunity for selected agricultural scientists from around East Africa to meet and share their experiences of participatory research.

Technology assessment is not complete until it is proven that farmers have adopted or will adopt the technology in question. So agricultural research should be carried out in such a way that these conditions are satisfied.

The conventional approach to agricultural research, development and transfer of technology involves technologies based on knowledge generated mostly through a top-down approach, or knowledge generated elsewhere altogether. Believing their knowledge to be superior to that of farmers, scientists who employ this approach decide what changes are needed and try them out under controlled conditions, passing the results on to farmers through extension services.

Some of the innovations resulting from this conventional approach to agricultural research have been applied by resource-rich farmers and by government or parastatal enterprises, but resource-poor farmers have adopted few.

Most introduced technologies depend on favorable and reliable climatic conditions and require a high level of external inputs, which may be suitable for resource-rich farmers. However, the vast majority of farmers in developing countries practice rainfed-farming, often on poor soil and in areas of high climatic variability, and therefore face high production risks.

In recent years it has become clear that few resource-poor farmers have gained much from the top-down technological advances that have been made so far. For them, production increases in the future will derive more from evolutionary than from revolutionary processes.

Against this background there has emerged a growing concern to understand the diverse and complex environments in which resource-poor farmers operate, in order that technology developments could be geared to suit these circumstances, and that farmers' indigenous technical knowledge could be fed into technology development.

It is from these areas of concern that the concept of farmer participation in research (FPR) has arisen. Participation in this context is seen as the involvement of farmers in research activities as clients, colleagues, partners and evaluators in the research processes.

[1] Ethiopian Agricultural Research Organisation.

The idea of resource-rich farmers participating in research is not new. Commercial farmers have participated actively in research on some colonial export crops and in some green revolution situations. They took their problems directly to scientists, they conducted trials and demonstrations on their farms, they visited research stations and selected the best new technologies for use on their own farms. But resource-poor farmers have had limited access to the information generated through formal science.

So participatory approaches in agricultural research for resource-poor farmers appear to be new, and they have evolved from the Farming System Research and Extension approach. The approaches have been strengthened by the development of Participatory Rural Appraisal tools and Action-Learning methods that seek to involve the farmers more fully in research and development programs. Farmer participation has evolved from scientists' contact with individual farmers to their collaboration with farmers' groups, while the researcher-farmer relationship has changed from a contractual to a collegial one. Farmers' involvement in the research process will help:

1. to develop appropriate technology which is productive and sustainable
2. to ensure that funds are used effectively
3. to increase resource-poor farmers' capacity to engage in self-sustaining development
4. to enhance the process of technology adoption.

In recent years, research and development programs have adopted participatory technology development approaches whereby farmers are also involved in the process. The participatory approaches have evolved as a result of perceived weaknesses in the traditional top-down research and development process. Often the technologies developed through this approach have resulted in low adoption rates and in some cases outright rejection by the intended users. When knowledge and technology are poorly presented, are not cost-effective or are irrelevant to farmers' concerns, they are likely to be rejected. Consequently, many researchers and development agencies have attempted to develop a research approach which involves small-scale farmers, utilizes local and indigenous technical knowledge and provides farmers with a permanent voice in the research and development process.

At the Nazareth Research Center, researchers and other actors have made considerable efforts to improve farmer participation. The Melkassa Research Center has been conducting Farmer Participatory Research in the localities of Wulinchity and Bofa over the past three years. Farmers were selected from the two districts and were given training in undertaking trials using new technologies generated by the center. They worked with researchers to carry out experiments on improved varieties of beans, maize and teff and with improved farm implements. Testing the technologies with farmers' participation has enabled the researchers to develop appropriate technologies. Farmers were even able to identify additional uses of the improved implements. Researchers were able to communicate with farmers better than ever, which resulted in the improvement and adoption of several types of farm implements and crop varieties. Moreover, women farmers from the two areas were able to improve utilization of a bean variety known as Roba in the preparation of different types of food. In general, participatory research provides the researchers with a better understanding of farmers' systems, their indigenous technical knowledge, their preference in crop varieties and their other concerns. The Melkassa Research Center appreciates and has gained from the advantages of participatory research and plans to further strengthen the program and try to apply it to all commodity programs in the future. However, the costs of participatory approaches have not been quantified, even though its potential benefits are high. Also, more work is needed to improve the knowledge of the main actors in the zone on participatory approaches so as to facilitate farmer-oriented research in our mandated areas.

The ultimate goal of FPR should be to develop demand-driven research and development programs. This can be achieved only by empowering the intended beneficiaries of those programs. Research and extension are well equipped for stimulating technical empowerment, while financial empowerment can be tackled better by other organizations like cooperatives, community development organizations and NGOs. A joint effort in the form of collaboration among the main actors is the best way to attain this goal. In view of those actors' diverse interests and objectives, the first step to effective collaboration might take the form of an agreed memorandum of understanding between Wulinchity and Bofa farmers and the zonal and district MoA offices. This process has started in Eastern Shoa zone.

The participants of this workshop will evaluate the achievements and failures of participatory research in eastern Africa and produce workable recommendations for how future research in agriculture should address farmers' priority problems.

I would like to extend my sincere thanks to the organizing committee members, CIAT and Melkassa Research Center Staff who have contributed their time and energy to organize this workshop. I wish you all success in your deliberations and hope your discussions will be enjoyable and fruitful.

Thank you.

OPENING REMARKS

Dr. Seyfu Ketema
Director General, Ethiopian Agricultural Research Organization (EARO)

Distinguished Participants, Invited Guests, Ladies and Gentlemen:

I am honored to be here during the opening of this Workshop on Participatory Research for Improved Agroecosystem Management.

Ethiopian farmers have been practicing a settled form of agriculture for several millennia; consequently, they possess tremendous knowledge of traditional agriculture and agro-ecosystem management. Little of this knowledge, however, has been documented in a systematic way to enhance its use in agricultural research and development.

Agricultural research that involves farmers as active participants features problem orientation, acknowledgment of people's capacity to produce and analyze knowledge, the researchers' commitment to and involvement with the community, the rejection of self-centered practices and the recognition of research as a partnership process for researchers and farmers.

The underlying purpose of the participatory research approach is the empowerment of farmers and the enhancement of interaction between farmers and researchers. By implication, this workshop could yield the same.

Our approach to date with respect to participatory research is less than satisfactory. The standard, token concession involves asking farmers to articulate their problems merely for the benefit of researchers' doubt. An improvement on this scenario involves researchers who incorporate farmers' problems into their research agendas for the purpose of subsequently generating technology. Ultimately, research results will be taken to farmers for verification.

Learning from farmers is a piecemeal process requiring ongoing interaction between researchers and farmers over an extended period. Well-designed research programs and curious, open-minded researchers will generate confidence among farmers and encourage them to react frankly to what they see. The researcher may stand to gain an understanding of the technology for improved agroecosystems management within complex farming situations, and an insight into which of their proposed options for ecosystems management might draw a positive reaction from farmers. Farmers will benefit from the proposed options, as long as those options are adequately tailored to their circumstances.

The design of an experiment is principally the responsibility of the researcher, as is the management of those variables being examined in the experiment. The farmer is responsible for the remaining operations, but it should be ensured that the farmers' practices correspond with the norm for the target group.

In the context of Ethiopia's agricultural research system, there are a number of proposals that seek to secure the involvement of farmers at all stages of research, from initiation through execution to the technology transfer process. Nevertheless, the proposals may require certain standard formats, which will permit the identification of farmers' strategies or coping mechanisms at times of crisis in agroecosystems. Research proposals should take this requirement into account. Doing so could yield that additional benefit of encouraging farmers' participation.

Their participation would be reflected in the execution of proposals, the evaluation of new technologies based on their own criteria, and the modification of technologies introduced into their farming systems. It is only in this way that the indigenous knowledge of farmers will be easily and simply combined with new technologies effectively to solve agricultural productivity constraints. I presume that this is the sole idea of participatory research.

Participatory research is not and cannot be limited to involving farmers. All relevant stakeholders in technology and information generation, transfer and application should be taken into consideration.

This workshop is intended to provide an opportunity to share researchers' views on their experiences gained through pilot projects using the Participatory Research Approach in and around Melkassa Research Center over the last few years. You will be expected to evaluate the achievements and failures, the advantages and disadvantages of the approach. Subsequently, you will have the opportunity to formulate a working strategy for incorporating the approach into the agricultural research system.

I wish you all the best in your deliberations and declare the workshop officially opened.

Thank you.

THE PRIAM PROJECT: AN OVERVIEW

Cary Farley[1]

PRIAM PROJECT AND THE PRESENT

Project Title

Participatory Research for Improved Agroecosystem Management (PRIAM): A Community Based Project in Eastern Africa.[2]

Project Duration

January 1, 1996 -- December 31, 1998

Donor Organization

The Rockefeller Foundation, (Dr. John Lynam - Nairobi, Kenya)

Coordinating institution

CIAT (International Center for Tropical Agriculture)

Project Coordinator

Cary Farley, Visiting Research Fellow, (Social Science Research Fellowship in Agriculture, The Rockefeller Foundation)

Project Officers

Soniia David, Cary Farley, Roger Kirkby and Charles Wortmann

Project Rationale

The formal agricultural research and development sector has achieved notable successes in recent decades, (e.g., high-yielding wheat, maize and rice varieties characteristic of the Green Revolution), but increasingly concerns have arisen about sustainability, social equitability and the ecological risks associated with many of the "successful" technologies. Building on conventional On-Farm Trials and Farming Systems Research methods, a variety of participatory research and agroecological approaches are evolving to address these perceived shortcomings.

Agroecosystems that are productive and sustainable require a relatively well-endowed and well-managed resource base. Basic and strategic technical research programs attempt to better understand the processes involved in agricultural production and resource degradation, and to develop prototype technologies that better utilize available resources and help to improve

[1] Formerly: PRIAM Project Coordinator, CIAT, Kawanda ARI, P.O. Box 6247, Kampala, Uganda. Currently: Director, Community Conservation Program, African Wildlife Foundation, P.O. Box 2453, Arusha, Tanzania. Email: CFarley@awf-tz.org

[2] This project was initially titled and funded as: Advancement of Farmer Participatory Research for Improved Soil, Crop and Pest Management in Eastern Africa.

agroecosystem management. Applied and adaptive research programs are also needed to ensure that the proposed solutions are field-tested and appropriate to farmers' situations. Efficient and effective applied and adaptive research requires an in-depth understanding of the agroecosystem from both farmers' and researchers' perspectives. While researchers can provide technical expertise and experience, farmers' indigenous technical knowledge and local research experiences are also important in applied and adaptive research efforts. Additionally, an in-depth understanding of the complexities of agroecosystems requires not only an understanding of the bio-physical aspects of farming systems, but also the socio-cultural, economic and political aspects of farmers' conditions. This diverse and dynamically interrelated information can only be obtained, and fully appreciated, while working closely with farmers in a community over an extended period of time. A combination of participatory research and agroecological approaches can help to better understand and address the socio-cultural and bio-physical heterogeneity of rural communities, involve a diversity of farmers in decision-making throughout the research and development process, and emphasize the importance of developing products, (i.e., improving the adoption of new technologies), as well as facilitating process, (i.e., improving problem-solving capacities.) In total, a community-based, participatory agroecosystem management program can help to improve our understanding of agroecosystems, and thus to improve their management.

Project Purpose

The purpose of the project is to develop and promote participatory research methodologies and community-based projects in collaboration with national agricultural research institutes, government ministries, and non-governmental organizations for common use in improving soil, crop, tree and disease and pest management in five countries in Eastern Africa (i.e., Ethiopia, Kenya, Madagascar, Uganda, and the Democratic Republic of the Congo, (formerly Zaire). The project is expected to work in collaboration with the Eastern and Central African Bean Research Network (ECABREN) and the African Highlands Eco-Regional Program (AHI).

Project Objectives

1. To implement community-based participatory research projects in collaboration with National Agricultural Research Institutes (NARIs), Ministries of Agriculture (MoAs) and Departments of Extension (Extension), and Non-Governmental Organizations (NGOs).

2. To facilitate the institutionalization of participatory research approaches within collaborating NARIs, MoAs, Extension and NGOs.

3. To refine and develop methods for different stages of the participatory research process, including: 1. Characterization and Diagnosis, 2. Planning and Experimentation, 3. Monitoring and Evaluation, 4. Information and Technology Dissemination, and 5. Analysis of Experience.

Project Partners

Details of the various PRIAM Sub-Projects, including host institutions and the major collaborating partners participating in the Sub-Projects, are detailed in Table 1. The general location of the PRIAM Sub-project research sites, as well as the locations of the partner projects' research sites, are presented in Figure 1.

PRIAM PROJECT AND THE FUTURE

Project Funding

The initial phase (1996--1998) of the PRIAM Project was funded by The Rockefeller Foundation. Subsequent funding will be provided by primarily by the Eastern and Central African Bean Research Network (ECABREN)[1], while other donors such as The Rockefeller Foundation, (e.g., for the PRIAM sub-projects at Kisii and Kitale), will also continue to provide some support.

Project Coordination

During the next phase of the PRIAM Project, project coordination will be undertaken primarily by the PRIAM Working Group/ECABREN and ECABREN, with secondary support provided by CIAT-Africa. The PRIAM Project Coordinator will be heretofore a researcher affiliated with one of the PRIAM sub-projects and ECABREN.[2]

Project Objectives

1. To strengthen existing and develop new partnerships between NARIs, MoAs, NGOs and local communities by supporting research that is prioritized by farmers, and also implemented by farmers in collaboration with other partners.

2. To intensify production systems in sustainable ways through linking farmer's research interests with prototype outputs from the "formal" research, development and extension sector, and initiating a shift of research operational costs from the public domain to the beneficiaries.

3. To accelerate technology transfer through rapid and low-cost dissemination approaches, including farmer-to-farmer and community-to-community approaches, and developing farmer- and community-level capabilities to produce and supply quality seed and other technologies.

PRIAM Monitoring Tour

Tour dates

4-10 July, 1999

Tour location

Western Kenya

[1] ECABREN Contacts: 1) Dr. Pynji Mukishi, Coordinator, ECABREN, Selian Agricultural Research Institute, P.O. Box 2704, Arusha, Tanzania. Email: CIAT-ECABREN@CGIAR.ORG 2) Dr. Roger Kirkby, Coordinator, CIAT-Africa, Kawanda ARI, P.O. Box 6247, Kampala, Uganda. Email: CIAT-AFRICA@CGIAR.ORG

[2] Coordinator, PRIAM Working Group, ECABREN: Bodo Rabary, FOFIFA-Antsirabe, B.P. 230, Antsirabe 110, Madagascar. Email: fofifa-abe@dts.mg

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[1] ECABREN Contacts: 1) Dr. Pynji Mukishi, Coordinator, ECABREN, Selian Agricultural Research Institute, P.O. Box 2704, Arusha, Tanzania. Email: CIAT-ECABREN@CGIAR.ORG 2) Dr. Roger Kirkby, Coordinator, CIAT-Africa, Kawanda ARI, P.O. Box 6247, Kampala, Uganda. Email: CIAT-AFRICA@CGIAR.ORG

[2] Coordinator, PRIAM Working Group, ECABREN: Bodo Rabary, FOFIFA-Antsirabe, B.P. 230, Antsirabe 110, Madagascar. Email: fofifa-abe@dts.mg

Tour objectives

1. To visit a diversity of organizations (e.g., PRIAM Sub-Projects, AHI Sub-Projects, NGOs, and NARIs) in Western Kenya involved in participatory research and related community-based activities.

2. To share experiences, ideas and useful tools and techniques, among tour participants, host organizations staff, and farmers and other community members.

3. To compare and contrast the various skills/techniques, participatory research methods and community-based approaches employed in the different research projects and organizations..

4. To identify "new" technologies, (including crop, forage and tree varieties), and methods and approaches that might be adopted, or prove to be otherwise useful, in the participant's project.

5. To meet fellow researchers, extension agents and development practitioners of participatory research and related approaches, and develop an informal or formal information network.

Expected tour outputs

1. Improved understanding of the diversity of farming systems in Western Kenya.

2. Improved understanding and appreciation of a wider array of participatory research methods and community development approaches.

3. Increased awareness of new agricultural technologies, (including crop, forage and tree varieties), and their various sources.

4. Networking amongst tour participants, host-oganization staff, farmers and other community members, and organizations.

5. PRIAM Monitoring Tour Synthesis Report.

PRIAM SYNTHESIS WORKSHOP

Workshop Dates

16-22 August, 1998

Workshop Venue

Nazreth Agricultural Research Center (Melkassa), Nazreth, Ethiopia

Workshop Hosts

Nazreth Agricultural Research Center and Ethiopian Agricultural Research Organization

Workshop Participants

See Addendum II for a list of participants and their addresses.

Workshop Rationale

The PRIAM Project, supported by The Rockefeller Foundation and coordinated by CIAT-Africa, will complete its initial phase in December, 1998. The PRIAM Synthesis Workshop provides a forum for researchers participating in the PRIAM Project, as well as researchers from partner research projects in the region, to share experiences and ideas, and exchange information, methods and various material resources, prior to the end of the first phase. It also provides participants an opportunity to develop new strategies for further funding and the further development of participatory research programs and activities in the region.

Workshop Objectives

1. To visit the PRIAM Sub-Project/Nazreth at Wulenchiti community, meet participating researchers, development agents and farmers, and visit field-based activities.

2. To exchange participatory research and related community development experiences between participants from PRIAM Project, and other participatory research and community-based projects in the region.

3. To share and exhange information, material resources, skills/techniques and methodological tools amongst participants.

4. Within Working Groups, to: a) draw methodological and institutional lessons from the projects, b) identify opportunities and challenges to further develop and/or scale-up existing participatory research activities at the community-level, and c) identify opportunities and means to strengthen participatory research programs within research, extension and development institutions.

Expected Outputs

1. Information sharing and networking amongst all participants.

2. Sharing of participatory research experiences, and related techniques and methodological tools, amongst workshop participants.

3. Methodological and institutional successes, constraints and challenges are identified and analyzed; future research agendas are developed from these lessons.

4. PRIAM Synthesis Workshop Proceedings are published.

PROCEEDINGS OF THE PRIAM SYNTHESIS WORKSHOP

Proceedings

The papers presented in this document depict the experiences of a diversity of partners, communities and organizations, and the related triumphs, trials and tribulations of participating researchers, extension agents, NGO staff, development practitioners, farmers community members as they work to implement participatory research projects and related activities across Eastern Africa. They also candidly reveal the variety of obstacles various the partners face as people of different backgrounds and types of experience strive to find alternative and innovative ways to work together, and they realistically portray the considerable time and commitment required of partners to collectively identify and evaluate feasible solutions to new and recurrent agricultural and natural resource management problems. While this document does not attempt to provide a "blueprint" detailing how to implement particpatory research projects, we hope that it will provide readers with many useful ideas and valuable insights that they might draw on to make their own research and development efforts more effective.

"If one advances confidently in the direction of their dreams and endeavors to lead a life which they have imagined, they will meet with a success unexpected in common hours".

Henry David Thoreau.

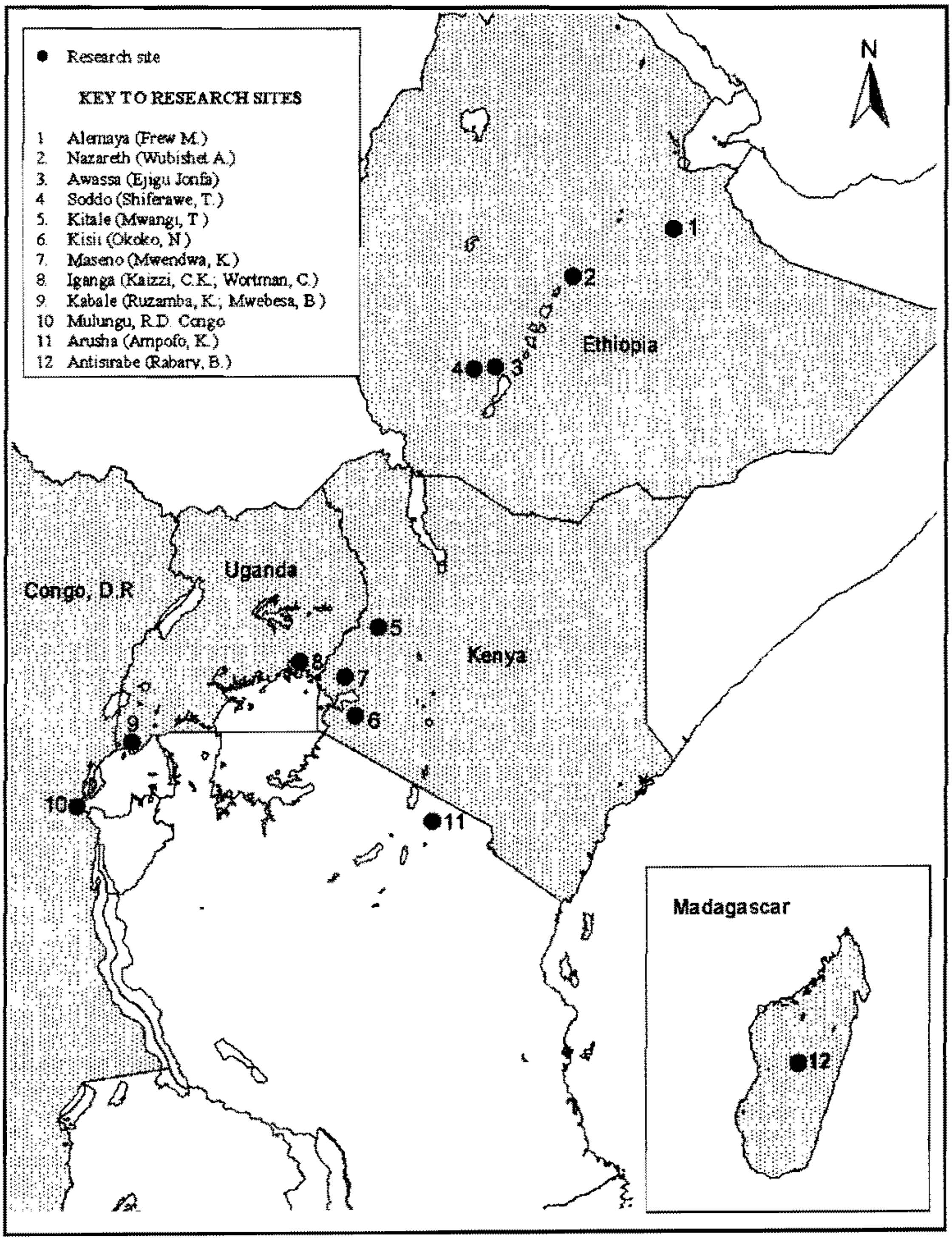
Table 1. PRIAM Sub-Projects

Country	Research Site	Initiated	Collaborators	Financial & Technical Support
A. Ethiopia	1. Nazreth (Wulenchiti)	1996	Nazreth Agricultural Research Center, EARO, MoA/Extension	ECABREN, PRIAM
	2. Soddo (Sura Koyo)	1996	Awassa Research Center, MoA/Extension, FARM AFRICA	PRIAM, FARM AFRICA
	3. Alemaya (Ararso)	1997	Alemaya University of Agriculture, MoA/Extension	PRIAM
B. Kenya	4. Kitale (Weonia Farm)	1997	Kitale National Agricultural Research Center, KARI, MoA/Extension, EAT	The Rockefeller Foundation, PRIAM
	5. Kisii (Nyatieko)	1997	Kisii Regional Research Center, KARI, MoA/Extension	The Rockefeller Foundation, PRIAM
C. Uganda	6. Iganga (Ikulwe)	1996[1]	Ikulwe District Farm Institute, MoA/Extension	PRIAM
	7. Kabale (Nyarurambi)	1997	District Agricultural Office, DTC-CARE	PRIAM
D. Madagascar	8. Antsirabe (Antanetibe)	1997	FOFIFA, MoA/Extension	PRIAM
E. R.D. Congo	9. Mulungu (Buchumba)	1998	Centre de Recherche du Mulungu, INERA	PRIAM

Collaborators:

EARO - Ethiopian Agricultural Research Organization
FOFIFA - Centre National de la Recherche Appliquee' au Developpement Rural
INERA - Institut National Pour l'Etude et al Recherche Agronomique
KARI - Kenyan Agricultural Research Institute
NARO - National Agricultural Research Organization (Uganda)
CARE - NGO
DTC - Development Through Conservation (CARE)
EAT - Environmental Action team (NGO)
FARM AFRICA - NGO
MoA/Extension - Minstry of Agriculture, Department of Extension

Figure 1. Research sites



SECTION II
PRIAM SUB-PROJECTS

PARTICIPATORY RESEARCH FOR IMPROVED AGROECOSYSTEM MANAGEMENT, ANTANETIBE, BETAFO, MADAGASCAR

Bodovololona Rabary[1] and Razakamiaramanana[1]

ABSTRACT

FOFIFA[2], a National Applied Research Center for Rural Development, has initiated Participatory Research for Improved Agroecosystem Management (PRIAM), a community-based approach, in Antanetibe Betafo Antsirabe. Although the research team in Antsirabe has already conducted Farmer Participatory Research (FPR) work, they found that PRIAM improved the FPR process. It made the participation of farmers more effective in characterizing their agroecosystem and in analyzing their problems. Farmers drew up a research plan and elected a Farmer Research Committee (FRC). As it is a new approach for farmers and for researchers and their collaborating institutions, some problems have arisen, but some successes were achieved as well. The farmers and the research team have learned a lot from their first year of collaboration and are able to define the forthcoming challenges.

INTRODUCTION

FOFIFA, as a National Applied Research Center for Rural Development housed in the Ministry of Scientific Research, has always worked together with farmers and many other partners, primarily the extension services. Within FOFIFA, the Department of Research-Development was the main interface with the extension services and farmers. However, FOFIFA recognized that, in order to be more efficient, the research team should be working more closely with farmers to understand their circumstances. Researchers held many discussions about the methods of Farming Systems Research and the techniques of system characterization and problem diagnosis. IRRI supported FOFIFA in this effort to improve its working relationship with farmers, and FOFIFA's regional centers experimented with different approaches in which farmers participated and made decisions.

Since 1991, ECABREN[3]/CIAT has assisted FOFIFA in training its researchers and partners and in implementing FPR. Antsirabe was one of the most dynamic regions in experimenting with collaboration with farmers and NGOs. Good results were obtained in Ambohibary (Tsarahonenana and Anosy), the first site of FPR work. Encouraged by this success, the team extended the site to Betafo. After much discussion with the extension service, a site was chosen in Antanetibe. The FPR team and the farmers at this new site were satisfied by the collaboration during almost two years of work. Then the PRIAM program was implemented with the community in February 1997 after a Participatory Rural Appraisal in the village. This paper presents relevant information about the PRIAM project in Antanetibe Betafo, discusses research results, and analyzes the approach.

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[2] Centre National de la Recherche Appliquée au Developpement Rural, (FOFIFA).
[3] Eastern and Central Africa Bean Research Network.

INSTITUTIONAL ARRANGEMENTS

National Research Institute

The PRIAM project in Antsirabe is under FOFIFA's leadership. FOFIFA deals with a wide range of crops and research subjects except for the following: potatoes, wheat, barley, tobacco and malt. FOFIFA has six supporting scientific departments and eight regional research centers spread across eight agroecological regions. Antsirabe is one of the research stations located in the central plateau. This region has the highest concentration of NGOs, projects and associations working in rural areas. Each has its own approach and its own means of motivation to obtain results from farmers. Consequently, working with farmers is particularly difficult in Antsirabe.

Collaborating Institutions

In order to improve collaboration with other institutions and to broaden the skills of the actors involved, FOFIFA invited a few institutions to experiment with PRIAM in Antanetibe:

- CIRAGRI Antsirabe: Agricultural District of Antsirabe for the Ministry of Agriculture, which is the extension service.

- CIREF Antsirabe: Forest and Water District of Antsirabe in the Ministry of Forests and Water.

- FAFIALA: NGO working on agroforestry and soil erosion problems in the high plateaux; based near Antananarivo.

- CARE International Madagascar: working for rural development, including assistance when natural calamities occur, and providing some social facilities for poor people.

Participatory Research Team

There were 11 members of the PR team at the outset. This number was reduced to nine after a few months. The members included:

- 2 agronomists from FOFIFA Antsirabe: 1 in rice and 1 in legumes
- 1 entomologist from FOFIFA Antsirabe
- 1 agronomist from FOFIFA/DRA Antananarivo in vegetables
- 1 phytopathologist from FOFIFA/DRA Antananarivo
- 1 soil scientist from FOFIFA/DRR Antananarivo
- 1 technician from CIRAGRI Antsirabe specializing on farmers' associations
- 1 supervisor from CIRAGRI Antsirabe for Betafo zone
- 1 forestry technician, CIREF Antsirabe in charge of Betafo

Research Site Selection

The site was selected since the previous FPR work. As work with Antanetibe's farmers was interesting for both the villagers and the researchers, the team found it logical to choose Antanetibe as the site for the PRIAM program. The main selection criteria the team employed in choosing the site were:

- to collaborate closely and efficiently with extensionists, as they are the principal facilitators in rural areas (Werner, 1996), and as researchers do not have time to reach as many farmers/villages as is necessary for good monitoring and diffusion of results
- to find a site where there was a minimum of intervention being done by other organizations, in order to facilitate the implementation of the FPR process and the initiation of the collaboration with different partners in a participatory way
- to select a site where the three major topographical units were commonly planted by the community: the mountain which was the woodland but most of the time deforested , the *tanety*[1] which is on ferralitic acid soils, and the *bas-fonds*[2] for rice, the staple food, and also for some cash crops during off-seasons
- to work at a site where farmers are interested in the FPR process in order to ensure a good experience with the community, as the team is still learning the process and the way to interact with farmers and the other institutions.

Consequently, the site at Antanetibe, Betafo was selected with the collaboration of the extensionist in charge of Betafo zone. The community is composed of farmers from a cluster of four hamlets, each with about ten households. Only one farmers' association exists at the site: "the water users' association." Antanetibe is located in the highlands villages, and it has the advantage of having irrigation all year long. The village is 30 km from Antsirabe town and 8 km from Betafo district. It is near a main road.

AGROECOSYSTEM CHARACTERIZATION

Methods

The agroecosystem of the village was characterized with the effective participation of the community during four days of meetings. This was a fabulous experience for both researchers and farmers. More than 100 farmers participated each day. Everybody was interested in the process and discussion: women, men and young people all took part. Different tools were used to elicit information:

- A transect walk was taken to survey farmers' circumstances: soils, vegetation, cropping systems, problems and opportunities. Farmers and researchers split into four groups, each taking a different direction. Each group had to draw their resource map and their transect walk.
- A theme was assigned to each group to work out. There were four themes: soil, cropping systems, livestock and socioeconomic issues. Researchers and the farmers' group leader animated sessions in order to collect information about their theme and to analyze problems and opportunities.
- Diagramming (rainfall patterns, labor calendar, cultural calendar, etc.) was used to present information and facilitate farmers' understanding. Tools such as pairwise ranking and voting with defined criteria were used to make decisions during prioritization (Pretty et al., 1995). Diagramming causes and problems (Tripp and Woolley, 1989) aided in identifying the causes of the priority problems. Results were presented in table form. Farmers did all the work: drawing maps, transect, diagrams, tables, and so on. Researchers acted only as facilitators.

[1] The hillside where most of the upland crops are found.

[2] The valley or alluvial/colluvial plain for irrigated rice fields.

AGROECOSYSTEM DATA

Altitude

Antanetibe is at an altitude of 1200 m asl. The landscape showed a cluster of mountains that are seriously eroded and have formed big ravines. The valleys were all transformed into rice fields. As the site had access to irrigation, slopes at the bottom and the middle of the mountain were terraced. There were very few trees and almost all the mountain was cultivated.

Soil Types

The soils in *tanety* were Ferralsols, typical of the high plateaux of Madagascar, which have fragile topsoils. Soil pH values range from 5.0 to 6.0 on slopes. Soil colors are generally reddish to yellowish-red. In rice fields, soils are gleysols and slightly acidic. Farmers classified seven categories of soils according to their color and texture (Table 2).

Labor Calendar and Gender Roles

The labor calendar is influenced mainly by rice crop activities. The labor shortage occurs during November-December, which corresponds to the time for preparing rice fields until weeding (see Table 3), and during March-April, which is the harvest time for rice and some other crops (e.g., second season beans, maize, groundnuts, etc.). Farmers are very busy during rainy seasons and the lack of cash is critical.

Table 2. Soil classification by farmers in Antanetibe Betafo

Soil name	Properties	Crops
Tanimena lohavalala (granular red soil)	Good soil for all kinds of crops; easily eroded; requires fertilizer	Groundnut, bambara nut, soya bean, maize, bean, chives, cassava
Tanimena (red soil)	Easily depleted and eroded, only for one season crop; requires fertilizer and organic matter	Tomato, cassava, upland rice
Tanimavo (yellowish soil)	Easy to work, deep; requires organic matter; easily eroded	Cassava, bean, groundnut, taro, soya bean
Tany dilatra (silt)	Infertile; used to paint walls	
Tanifotsy (white soil)	Infertile; used to paint walls	
Tanimanga (clay)	Type of soil in rice fields; requires large amounts of fertilizer; cold and sticky	Rice, taro, vegetables during off-season
Tanimainty (black soil)	Hard to work during dry season	Rice
Tany esoka/Baiboho (low soil)	Good soil, appropriate for all kinds of crops; requires deep tillage; easily covered by weeds	Beans, groundnut, taro, sugarcane, rice

Table 3. Labor calendar and gender roles for rice crop and upland crops in general

IRRIGATED RICE

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
W/T		Harvest & Post-Harvest				Seed bed preparation					
						Soil preparation & puddling					
								Sowing			
									Transplanting		
										Weeding	

W/T = Weeding & Transplanting

UPLAND CROPS

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
	Harvest & Post-Harvest							Soil preparation			
S/W										Sowing & Weeding	

S/W = Sowing and weeding

Men and Women | Men | Women

Indigenous Technical Knowledge (ITK)

Farmers have great deal of knowledge about their environment, their complex cropping systems and their cultural practices (Rabary, 1998). Some of this indigenous knowledge proved to be particularly well adapted to the rural environment while conserving biodiversity. This empirical knowledge should be analyzed and included in the process of identifying possible solutions and in the search for sustainable agriculture models (Altieri, 1996). As Butler (1991) has noted, ITK is the heart of Farmer Participatory Research. In Antanetibe, as in the other rural communities, ITK is used in everyday life (e.g., soil classification, seed storage, insect repellent, irrigation management, etc.). However, the majority of farmers do not realize the value of this knowledge.

Socioeconomic Profile

The community in Antanetibe is mainly comprised of people with family ties to each other. On the surface, their standards of living appear to be similar. However, stratification exists and can be ascertained by noting whether a household owns livestock, the number of livestock it owns, and the land area of its farm. The PRIAM team will study these factors. The village has easy access to the market; even so, farmers find the transport cost too high and the price of produce too low. In addition, a long-standing conflict exists within the community, which prevents effective organization.

Cropping Systems

As a staple food, rice is the main crop. In the *bas-fonds*, after rice, potatoes and tomatoes are commonly planted as off-season crops. On the *tanety*, there are two major cropping systems: an intercropping of maize-bean and a sole crop, mainly during the second season. Upland rice is a new crop under experimentation. Cassava occupies about 50% of the plots. Cassava, maize and potato provide farmers with complementary foods and feeds for animals. Beans, bambara nut and groundnut are sources of protein. Cash crops are mainly chives, onion, tomato and hot pepper (Table 4).

PROBLEM DIAGNOSIS

Farmers raised about ten problems in each sub-system. Prioritization was necessary because neither the farmers nor researchers will be able to address all these problems at the same time. Farmers used various methods of problem ranking. As each crop had many problems, farmers summarized them into seven broad problems, prioritized them, and selected the three most important problems: disease, lack of seeds and poor manure quality.

Similarly, prioritization was done for the other sub-systems. Table 7 summarizes the prioritized problems, their causes and the solutions that farmers selected as feasible.

Community Research Program

After having analyzed their problems and found suitable solutions, farmers drew up their participatory research planning, outlining the types of activities to be undertaken and the period for carrying them out (Table 6). It was then necessary to determine who would be in charge of the program. Although the whole community (about one hundred people) was implicated during the PRA phase, it was agreed that a small group should be elected to manage the activities, and so the farmers named a Farmers' Research Committee (FRC).

The FRC is composed of six members, all men as women were not willing to be members. During the characterization and diagnosis phase, women participated a lot and could share their ideas, make decisions and lead discussions. Despite their capacity, women felt that they were too busy to be good members of the FRC. The duties of the FRC are:

--to be a contact group for researchers and visitors
--to organize FPR within the community (meetings, trials, monitoring, etc.)
--to represent the community when necessary.

However, since the implementation of the PRIAM project (in February 1997), the FRC members were changed twice due to their inefficiency. The president was in charge of too many other tasks in the village and he could not organize PRIAM activities with the community. Without his leadership, the FRC members did not know how to work because they could not meet to discuss their roles and organization. All this disorder delayed the implementation of the farmers' program. The researchers' team was discouraged in the face of farmers' disorganization as they lost time and money. Consequently, researchers asked farmers to come to a decision. As the community recognized the weakness of their FRC, they elected a new president and members. The new president is a retired professional who has returned to his "home" village. As Odour-Noah et al. (1992) point out, such community members have considerable potential to contribute to these groups.

Table 4. The varieties, seasons and problems of the major crops found in Antanetibe Betafo in 1997

Crop	**Variety**	**Season**	**Problems**
Irrigated rice	5 traditional varieties: *tsiràka, telovolana, botramavo, botrakely, alikombo*	September	insects
Upland rice	*mavokely, mampierika*	November	cutworms
Cassava	5 varieties: *mandrindrano lahy, mandrindrano vavy, tsilavom-bositra, keta-potsy, gasy*	October to May	virus
Maize	*katsapotsy* = for poor soil *afokely* = for good soil	1. Nov. - Dec. 2. Jan. - Feb.	disease cutworm lack of inputs
Beans	*soafianarana, rotra, menakely*	1. November (1^{st} -15^{th}) 2. February	insects
Bambara nut	5 different colors (from FOFIFA)	Late Oct. - Nov.	lack of seeds insects powdery disease
Groundnut	4 varieties (3 from FOFIFA)	Late Oct. - Nov.	empty pods yellowish
Potato	*garana, pota, marakely*	1. November 2. May - July (off season)	gall bacteria
Onion	white and red	1. May (main season) 2. February	powdery disease yellowish
Chives	*maitsokely, baka, andangy*	all year long	dry leaves powdery disease
Hot pepper	*maitso, sakaibe, tsilanindimilahy*	November	poor seedlings insect larvae in fruit
Tomato	*long, kaki type, gasy*	all year long	gall bacteria
Soya bean	not precise (for soil fertility management)	November	lack of seeds

Table 5. Pairwise ranking matrix method in prioritization of the major problems in cropping systems

	In-efficiency of cultural practices	Lack of seeds	Poor storage techniques	Disease	Poor manure quality	Theft of crops	Lack of knowledge in product trans-formation
Inefficiency of cultural practices							
Lack of seeds	seeds						
Poor storage techniques	Techniques	seeds					
Disease	disease	disease	disease				
Poor manure quality	manure	seeds	manure	disease			
Theft of crops	Techniques	seeds	storage	disease	manure		
Product trans-formation	Techniques	seeds	Trans-formation	disease	manure	theft	
SCORE	3	5	1	6	4	1	1
RANK	4th	2nd	5th	1st	3rd	5th	5th

Table 6. The Antanetibe Community Research Program for 1997-98

Activities	**Period**
A. Crops	
- demonstration and trial on manuring and composting	- dry season
- seminar on environmental protection (against fire and erosion)	- before dry season
- information and trial on diverse vegetable crops	- dry season
- trial on improved varieties	- rainy season
- training and trial on crop protection	- off-season and rainy season
B. Soil	
- trial on hedgerows for multiple uses	- rainy season
- tree plantation	- rainy season
- trial on mulching and cover crops	- rainy season
C. Livestock	
- cross visits to farmers' model and mechanized farms	- dry season
- training on livestock techniques improvement	- dry season
- training on livestock feeding	- end of dry season
- trial on fodder crops	- rainy season
D. Social	
- constitute farmers' association	- in one month after PRIAM training workshop
- spraying houses with insecticides, training on hygiene	- dry season

Table 7. Farmers' priority problems, their causes and feasible solutions

Priority problems	Causes	Solutions
A. Crops		
insects and diseases	- bad quality of organic fertilizer - contaminated seeds - *tanety* fire	- training on manuring & composting - seminar on environmental protection (against fire & erosion)
lack of good seeds	- lack of information on seed production techniques - bad seed storage techniques	- demonstration on seed production & seed storage
low quality of manure	- bad processing methods for farm manure and compost - lack of cattle	- training on composting - trial on fertilizer dose according to type of soil and crop
B. Soil		
inadequacy of water in rice field	- drying up of the spring - *tanety* fire	- farmers' association - restoration or construction of dams
soil erosion	- lack of soil protection - inadequacy of tree plantation	- canals maintenance - tree plantation - agroforestry
scarcity of land	- increase in population - poor access to land	- improving cropping systems
C. Livestock		
lack of improved breeds	- absence of information - lack of cash	- initiation of new breeding techniques (cross visits, training) - improving poultry farming
lack of fodder	- lack of fodder production - environmental degradation	- trial on improved pasture - fodder plantation - plantation of hedge rows fodder
D. Social		
low selling price of products	- lack of production policy within the community - problem of storage	- diversifying cash crops and cropping seasons - training on local storage techniques
insufficient food products	- low production	- use high yielding varieties, tolerant varieties - double rice cropping
presence of domestic insects	- animals living in the same house as farmers	- spray insecticides in the house

RESULTS

Crop Variety Trials

Diversification of crops was a priority solution for two major problems: low price of products and insufficient food production. Farmers conducted different variety trials:

- potato variety *miova,* from FIFAMANOR, which is supposed to be a high-yielding variety tolerant of bacteria. This new variety was compared with a local variety. Ten farmers conducted the trial. All of them found the variety *miova* to be a non-performer.

- soybeans, two varieties: UFV 1 and BR 16, from FIFAMANOR. Sixteen farmers conducted the trial. Most of them said that they planted too late (January 1998) and the yield was very low. Two farmers planted in December 1998, and one farmer out of the two was satisfied with his trial. He got about 600 kg/ha of soybeans. He kept seeds for the next season, sold about 4-5 kg of soybeans at the market and ate the rest of the product. The second farmer took the initiative in mulching his soybean trial and found that he got the best yield among all the farmers in the village, about 800 kg/ha. He explained that he did the mulching for soil humidity and fertility management.

- rice bean variety *tsiasisa mena.* This is a new crop for the community. As soon as farmers saw the seeds, everybody wanted some. Unfortunately, there was only 0.45kg of seeds, which were distributed among nine farmers. Each of them got 0.05 kg of *tsiasisa mena.* As the quantity of seeds was small, some of the farmers intercropped it with maize, some planted it at the edge of a chives crop and some planted it as a sole crop. Most of the farmers did not take care of the crop. One of them harvested about 0.25 kg of seeds. He harvested too late and lost a lot of seeds. Only one farmer gave good feedback. He was the one who planted the *tsiasisa mena* at the edge of his chives crop. He harvested about 1kg of seeds although the crop could not stand the wind. He made a cooking test and found the *tsiasisa mena* very palatable and easy to cook. He plans for the next season to plant it in sole crop and choose a better plot.

- vegetables: - zucchini (courgette), variety *caserta/laniera*
  - snap beans, variety *monel*
  - *pe tsaï*, variety *maitso laniera*
  - green garlic
  - *pak choï* variety *white*

  No results were obtained in vegetable trials due to damage caused by frequent passing of grasshoppers. However, farmers are very interested in vegetable crops and found them to be good cash crops.

- rice: - irrigated rice: variety *Kalila* (473) and *Mailaka* (X 265) compared with a local variety, *Tsiràka.* The two new varieties were very promising despite the delay of the planting date and farmers were interested to try again.
  - upland rice: variety FOFIFA 133, 134, 152 and 154. The locusts wiped out the trials. Only one farmer could get yield, but the community found it interesting.

Soil Fertility Management

Mulching

After much discussion with the community about soil fertility management techniques, the FRC organized farmers' meeting to decide which trial to begin with. Researchers wanted the farmers themselves to design the trial. As the FRC was inefficient, there was no meeting and no suggestion from farmers. However, one farmer decided himself to try mulching and directly mulch his soybean trial; as reported previously, he realized the benefits of his management.

Hedgerows

At the same time, agroforestry seeds were distributed to farmers to be planted as hedgerows. The objectives were multiple: getting enough biomass for composting or mulching, protecting plots against erosion, improving soil fertility, getting firewood or stakes for climbing beans, etc. Few species were planted (*Tephrosia vogelii, Crotolaria grahamiana, Cajanus cajan, Flemingia congesta*), and only Tephrosia and Crotolaria established well.

Composting

Farmers were trained twice on compost techniques. About 12 farmers are now testing the techniques and have applied compost to their plots. Some of them got good results with chives.

Plant Protection

As it was surveyed that cutworms are the main enemy of *tanety* crops (maize, rice and beans), and since farmers cannot afford the use of chemical insecticides, the use of *Melia azedarach* (voandelaka) was proposed to the community, as the village has the advantage of having many *M. azedarach* trees. The trial consists of collecting voandelaka seeds and grinding them in order to get an insecticidal powder with which to coat seeds (0.05 kg for 1 kg of seeds) and make a liquid spray insecticide (0.05 kg of powder per liter of water). Farmers were trained in the techniques of the powder preparation. After the training, only one farmer decided to conduct the trial on the use of *Melia azedarach* as an insecticide. He discovered on his own the easiest way to grind the seeds to get the insecticide powder. He made all necessary observations, such as counting the insect larvae and adults, seedlings and plant stand. After the trial, he returned his results to the community and offered suggestions for how to improve the technique. As result, farmers found that it was a very efficient pesticide.

Environmental Protection

The forestry technician organized a seminar on protecting against *tanety* fire. It was attended by the whole community as this is a common problem. Farmers established a community law. The same technician also trained the community in the techniques of spring protection. He provided seedling trees to be planted for that purpose.

These are long-term activities and require time before results can be seen. However, a follow-up training on sound environmental management practices is planned.

Protection Against Domestic Insects

As household insects (flea, bug, mosquito, etc.) are a source of human disease, farmers requested the assistance of a health agent. The PRIAM extensionist helped them to find the health agent and all community houses were sprayed. Moreover, farmers were trained in hygiene practices.

Livestock Techniques Improvement

Very few of the farmers in the community have cows. However, most of the families have pigs and poultry. As the problems identified by farmers were insufficient animal feed and lack of improved breeds, the first activities conducted by the livestock technician were to prepare farmers for the introduction of new breeds and to train them in improved livestock farming. Hence, to give farmers some idea of good management of livestock and poultry farming, representatives were sent by the community to visit some improved farms (cattle, pigs, poultry and dairy cows) led by two PRIAM researchers. Three different farms with different levels of technical capacity were visited (FIFAMANOR, TOMBOTSOA, RAMILAMINA). Farmers had the opportunity to see and ask questions about the breeds, their feeding, housing and management, and the benefits gained from the improved management practices they observed there. After the visit, the representatives organized a meeting to pass on what they had learned to the community. Visits to smaller improved farms were planned for a second tour, but in the meantime the livestock technician left FOFIFA.

Trainings on the feeding, housing and health of livestock and poultry were also given to interested farmers.

DISCUSSION

The results obtained during this first year were generally qualitative rather than quantitative because the researchers and the farmers were just learning how to work together.

For most of the researchers, this approach was new and they were not sure how to interact with farmers. It wasn't clear to them whether they needed to wait for farmers' decisions before taking action or whether they could decide themselves how to do things and choose farmers to be collaborators.

For farmers, in spite of the explanations given by researchers about the objectives of the process and the principles of the approach, many of them still expected to get something for free: inputs, implements and even money. Hence, many farmers offered to conduct trials but then failed to maintain them. Very few made observations and got results. This means that they did not understand the importance of their participation and the need to conduct experiments. Fortunately, there are some experimenters/innovative farmers who got good results. Those experimenters attracted the other farmers' attention and aroused their curiosity. Many farmers asked to participate again.

Consequently, this first year was very promising and very constructive. The research team and the farmers thought about how to improve their relationship and the work. Researchers think that it is necessary to conduct more specific diagnosis to define more precisely the problems related to disease and pests, and to compile data on social organizations.

ACHIEVEMENTS

Farmers were very proud to be able to conduct all the PRA phases on their own and establish the PRIAM activities planning. They recognized the importance of the approach, which enabled them to discuss their problems together and articulate their knowledge. This empowerment gave them the confidence to look for new technologies in order to improve their productivity.

The FPR team and the FRC are operational at Antanetibe Betafo despite the problem of FRC organization. Some partners identified as potential collaborators were contacted and became involved in the FPR program. They are contributing to carrying out the activities using the same approach.

Despite the researchers' discouragement at the project's outset, due to the non-functioning of the FRC, the team still engaged in discussions with the FRC and advised them. Some activities were conducted during the first year and some good results were obtained.

Farmers and researchers became aware of the value of the farmers' Indigenous Technical Knowledge. It was then used as a benchmark for any treatment being tested.

Farmers realized the benefits of FPR and became anxious to have new technologies at their disposal.

LESSONS LEARNED

The major constraint is that most of the villagers are still afraid of being involved in the project, due in large part to a bad experience they had with a bank concerning rural credit. They are afraid that they will lose their land or will be forced to reimburse money if they fail in the trial.

An internal conflict exists within the community, which made it difficult for the farmers to commit to the FPR. As this conflict is related to a family tie, it is necessary that farmers themselves find a solution that is acceptable to everybody. This is a big challenge because farmers need to be well-organized to be able to tackle with success problems related to erosion control, market and production strategies, social organization and so on. Farmers themselves felt the need to form an association in order to make a collective effort on behalf of the development of their villages.

Among researchers, there is a need to improve the use of FPR methodologies: farmer-designed and farmer-managed trials, researcher-designed and farmer-managed trials, recording of observation and results, monitoring, evaluation and data analysis (Tripp and Woolley, 1989; Stroud, 1993; Farrington and Nelson, 1997). It is easier to fall back on conventional on-farm trials. It is also a challenge to find technologies adapted to farmer circumstances.

PRIAM team organization and coordination is difficult as half of the members are based in Antananarivo, at 170 km from Antsirabe. There are no communication facilities (telephone, e-mail, vehicle) and meetings are often postponed. The team needs to meet periodically and discuss problems and the progress of their work, and should try to find a better solution.

Although the Malagasy government has decided to make use of the participatory approach for any rural development project, relationships with the other collaborators and coordination of various efforts involving the PRIAM approach still represent a big challenge. Each actor has his own motivation in the process (e.g., for some farmers, to get inputs free of charge; for NGOs, to reach farmers to pass on messages and technologies) which can compromise true collaboration and participation.

CONCLUSION

The team's experience with FPR demonstrates how complex rural agroecosystems are and even how complicated the farmers' thinking about their farm management can be. FOFIFA and the PRIAM team are convinced of the adequacy of the PRIAM approach in doing Farmer Participatory Research. A community approach is very important in considering aspects of farmers' environments that condition their decisions and their strategies for development. Moreover, an association of farmers has a better chance of solving a common problem than examples imported from some other area. This project's most important achievement is that it has convinced farmers that they are able to make decisions to solve their problems and improve their circumstances and environment themselves, although they have problems in realizing this approach. Hence, there are many challenges and the team has already planned to define a strategic method to improve the work with the community.

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DISCUSSION SESSION

Question 1.
What about FRC election and womens' involvement?
Response
Women were very active during PRIAM workshop in the village and they know more about cropping systems, but they did not want to be members of the FRC. It may be because men are always the leaders of the family.

Question 2.
In the soybean mulching trial initiated by the farmer, have you involved researchers of relevant disciplines such as pathologists, weed scientists etc so that they can comment on the trial?
Response
During the field visit, multidisciplinary team was present but it was mainly the farmer who explained the relationship between his good yield and the control of weed, the improvement of soil humidity and less disease with mulching.

Question 3.
Why were women not selected in the FRC in the PRIAM site?
Response
Sociological setup leading roles of men in the household. Despite this, women are very strong participants in the community.

DEVELOPMENT OF PARTICIPATORY METHODS TO SUSTAIN FARMER PARTICIPATION IN THE RESEARCH PROCESS

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ABSTRACT

Adoption of existing and newly generated technologies continues to be low despite attempts by researchers to promote them. The lack of appropriate methodologies in trial designs, implementation, evaluation and dissemination suitable for different regions has aggravated the problem. Studies are underway of participatory research methods that involve farmers significantly in research processes and are designed to bring about their empowerment. Farmers' involvement can take the form of farmer research committees and farmers' group evaluation panels, and it can be enhanced through the institution of such practices as good record keeping by individual farmers and free farmer-to-farmer exchange of information and research findings. The Farmer Participatory Research (FPR) methodologies employed during the problem diagnosis and research planning stages sufficiently empowered the farmers to take the lead in identifying and prioritizing their problems. Farmers also formulated tangible interventions to address their agricultural constraints. The FPR approach has so far enabled farmers to think through the experimentation processes and sort out plot sizes, treatments, plant density, data to be collected, replications and management practices for the different trials. Farmers have been empowered to lay out, monitor and evaluate trials on their own. Therefore, research has been simplified and made more meaningful to farmers, thus creating an in-built mechanism for dissemination and adoption of existing and newly generated technologies, a situation that can be exploited to boost agricultural production.

INTRODUCTION

Adoption of existing and newly generated technologies continues to be low despite the time and resources committed by researchers in an effort to alleviate this problem (Chambers et al., 1989). This has been attributed in part to lower farmer involvement in the whole process of technology development.

A review of farmer involvement two years after the implementation of the Soil Management Project (SMP) revealed that farmers participated actively in the initial diagnostic stage of information gathering, problem identification and prioritization. Beyond this, their participation in the process of design, implementation, monitoring and evaluation was minimal (Mbugua et al., 1997; Njue et al., 1997).

Because the research teams in the SMP had a strong desire from the project's outset to involve farmers in the whole research process, the lack of farmer involvement beyond the diagnostic stage was very disappointing. Researchers felt they lacked appropriate methodologies to involve farmers effectively in the whole technology development process. This view is supported by Okali et al. (1994), who reported that these methodologies are either lacking or not well developed.

Participatory approaches are increasingly being used as part of the general trend toward involving target groups in development and research activities (Mellis at al 1996). This strategy enhances the sustainability of technologies after the initial stages by encouraging farmers to share results with other farmers, which leads to the extension of ideas and approaches to other villages and ultimately enables the withdrawal of outside support.

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ghtfoot and Ocado (1998) reported success in using participatory methods in jointly developing new ways to control a crucial weed problem in the Philippines. Attempts to involve farmers have been successful and farmers have increased their capacity and skills and their willingness to work together. The Dryland Applied Research and Agricultural Project (DAREP) working with farmers in the semi-arid lands of eastern Kenya has attempted to use participatory methods to introduce new tools including animal power options. That process is ongoing (Mellis et al., 1995). The "Kuturaya" approach in Zimbabwe tested during the early 1980s has also used participatory methods to increase farmer participation (Chuma et al., 1996).

Despite these attempts to involve farmers in all aspects of technology development, farmers' interest has not been sustained as anticipated. A recent tour by Kitale and Kisii scientists to CIAT-Uganda's Farmer Participatory Research (FPR) clusters indicated that there is no blueprint of FPR methodologies (NARC-Kitale, 1998). Even if there were one, it is very unlikely that such an approach could be extrapolated outside the context in which it was initially developed (Triomphe, 1998). Therefore, every region needs to develop its own FPR methodologies tailored to the prevailing circumstances facing farmers. Hence Weonia farm in Trans Nzoia district was included in the SMP at the beginning of 1997 with the following objectives:

- to develop new participatory methods and strengthen existing ones
- to strengthen farmers' own research and problem-solving capacity
- to implement more efficient research through expanded stakeholder collaboration
- to include farmers' indigenous technical knowledge (ITK) in the research process
- to increase adoption of existing and newly-developed technologies
- to strengthen institutions at different levels by using participatory methods.

This paper presents the methodologies used in the Farmer Participatory Research process and also highlights the results and experiences thus far.

METHODOLOGY

Description of Site and Farming Systems

Weonia Farm is in Trans-Nzoia District, located at 1°N 35° E, 1800 m asl and covers an area of 246,800 ha of which approximately 80% is arable land. The region is a high-potential area that enjoys an equatorial highland climate. It falls within the upper midland 4 (UM_4) agroecological zone, which normally receives between 900 mm and 1200 mm of rainfall per annum, 60% reliable (Jaetzold and Schmidt, 1983; Kiminini Agricultural Extension Office), with the highest precipitation occurring in April-May and July-August. The dry spell occurs in December-February. Most of Trans-Nzoia District is covered by Humic Ferralsols (FAO-UNESCO, 1974). These are very deep soils that are dark red to dark reddish-brown in color with a sandy clay to clay texture and moderately acid humic topsoil (Strobel et al., 1987). They are characterized by a weak to moderate sub-angular blocky structure and are well drained with a high moisture storage capacity. Ferralsols in general are quite widespread in Trans-Nzoia as they occupy most of the UM_4, UM_3 and LH_3 agroecological zones of the district (Mwangi, et al., 1997). Other soil types found in Trans-Nzoia include Nitisols (UH_0, UH_2 and UH_3), Andosols (UH_0 and UH_2), Acrisols (LH_2), Cambisols (LH_1), Luvisols (LH_1) and Vertisols (UM_4) (Mwangi et al., 1997).

Most small-scale farmers engage in subsistence farming, with maize and dairy production as the most important enterprises. Maize is grown almost always as an intercrop with one row of maize and beans on the same hill or (less commonly) on different hills. The population of dairy cattle (excluding those in ADC farms) remained almost constant at 105,000 between 1989 and 1992, but milk production decreased by 25% over the same period. During this same period the population of Zebu cattle decreased from 25,000 to 20,000 and beef cattle remained the same at 20,000. The number of sheep increased from 49,000 to 61,000 while the population of goats decreased from 25,000 to 20,000. Chicken increased from 98,000 to 265,000, of which more than 90% were indigenous breeds (Nkonge et al., 1997).

Weonia Farm is situated 26 km northwest of Kitale town along the Kitale-Webuye road. It is comprised of eight villages--Kabuyefwe, Matisi, Sango, Sirisia, Mayanja, Webuye, Shibembe and Lukhafwa--for ease of administrative purposes. The farm is characterized by gently sloping topography. According to farmers, the soils in this area have a generally sandy clay loam texture with occasional patches of waterlogged portions. The farm consists of about 700 households; farm sizes range from 0.1 to 6 acres, with the average being about 3 acres. The major annual crops grown are maize, beans, finger millet, sweet potatoes, cassava and horticultural crops. Perennial crops grown include coffee, banana and some fruit trees. Agroforestry is also practiced due to the influence of a local a non-governmental organization (NGO) known as Vi Tree Planting Project. The NGO personnel have been promoting tree planting for the past ten years. The livestock consists of indigenous cattle, poultry and a few sheep and goats.

The site was chosen taking into consideration the small scale of the farms, the farmers' resource base, and accessibility from the main road and research center.

Problem Diagnosis and Formulation of Action Plan

This exercise took seven days. The first two days consisted of a training exercise on Farmer Participatory Research (FPR) methodologies for an FPR team consisting of researchers, extension workers and NGO personnel at the National Agricultural Research Center (NARC) Kitale. The training started on a high note with most FPR team members expecting to acquire skills for sustaining farmers' interest in research beyond the diagnostic stage. There was an introduction to ongoing FPR activities in the East and Central Africa region and to basic FPR principles, concepts and procedures. Five days were then spent out in the community. The program consisted of the following general exercises: diagnosis and characterization of the area, problem identification and prioritization, problem cause analysis, identification and prioritization of solutions, formulation of a research plan, and formation of a Farmer Research Committee (FRC) and an FPR core team made up of researchers from different disciplines, extension workers and NGO personnel.

The first day in the community began with an introduction of the research team to the community. The team's objectives were explained to the community. Farmers' attendance over the five days varied in number and in gender composition, and the number of farmers participating rose from 34 on the first day to 98 on the fifth day. Four groups were formed from the FPR team and the community; each of these groups carried out different exercises. At the end of each exercise a farmer chosen from each group presented the findings to the whole assembly, after which discussions were held and a consensus was reached. One group drew a resource map showing the area's natural and socioeconomic features, i.e., the network of major roads, schools, dips, brothels, streams and rivers. Three groups carried out transect walks.

the second day, the respective groups met to discuss cropping and livestock production systems and seasonal calendars. The groups identified problems affecting their sub-system in Weonia farm. Each group dealt with different problems: Group 1 dealt with livestock, Group 2 with crops, Group 3 with soils and Group 4 discussed any other problems affecting the community.

During the third day the groups prioritized the 12 identified problems using the pairwise ranking and counter methods. The results (Table 9) were presented to the whole assembly. The researchable problems were charted and analyzed to increase participants' understanding of the problems and to identify potential solutions. Farmers rested on the next day but researchers met on the station to continue the discussion of problems, their causes and potential solutions. The various interventions suggested by the farmers and FPR team, in the form of trials, demonstrations, seminars and farmers' tours, were revisited and grouped according to whether they might be implemented immediately, mid- season or later in the season (Table 10, 11, and 12). This decision was communicated to the community the following week, during the fifth day in the community, for additional input.

After the presentation, farmers were requested to select from among themselves those who could carry out the trials. They decided to do this according to villages. There are eight villages; six farmers were selected from each village for a total of 48 farmers. These farmers were asked to elect a Farmers' Research Committee (FRC) from amongst themselves that would assist the FPR team in harmonizing its duties with the farmers' duties. Eight farmers were selected, one from each of the eight villages, to belong to the committee. The members of the FRC then appointed a chairman, secretary and treasurer from amongst themselves. The duties of the committee included: visiting farmers regularly and checking on the progress of trials; convening meetings with farmers whenever necessary; and meeting with researchers to discuss the progress of the trials.

Planning and Implementation of On-Farm Activities

The FPR team consolidated all the possible interventions into nine trials: five demonstrations, three seminars (workshops) and one farmer tour. In doing so, the team considered the availability of resources (sustainability), the time needed to implement findings, existing technologies and farmers' technical knowledge. Only technologies that could retard environmental degradation were considered for testing.

The next task--to decide on the best ways to involve farmers in designing the on-farm trials--was a tough one for FPR team. The team met on the station and brainstormed about all possible avenues of involving farmers in trial design and implementation. Consultations were also held over possible treatments for each of the nine trials in an attempt to empower researchers to assist farmers in thinking through the treatments. All the necessary materials needed for the exercise were gathered and possible procedures to follow with the farmers were agreed upon. The FPR team went back to the community on the following day to discuss the nine trials. The team felt that the trials were too many to handle immediately because the farmers had never been exposed to experimentation procedures before. After thorough discussions the farmers prioritized the nine trials and identified four to begin during the first season. The farmers split into two groups, each of which dealt with two trials. The groups discussed the experimentation procedures which included experimental layout treatments, plot sizes, plant density, data to be collected, number of farmers per trial and management of trials. The FPR team members facilitated the process in guiding farmers while thinking through the experimental design, layout and management using simple, farmer-friendly language. The farmers then presented the results of their discussions to the full group, after which they discussed ways to harmonize their ideas. The whole process t two days, at the end of which the roles of the farmers, FRC, frontline extension staff and FP team were clearly defined. During the whole FPR exercise three languages were used: English, Kiswahili and Kibukusu (local dialect). At the end of the initial FPR exercise farmers requested certificates. These were issued to them.

RESULTS AND DISCUSSION

The initial FPR process went quite smoothly, as most members of the research team were aware of the procedures and tools to be used. In collaboration with research teams, farmers developed soil and resource maps calendars and historical profiles and identified different types of land use. Detailed information was also gathered regarding labor/cash availability, farming systems diversity, causes of feed shortage and low yields. Causes of waterlogging and poor nutrition as well as community institutional linkages were documented. Thus this was a good entry point for getting information about the community as the general topics discussed aroused the farmers' interest, stimulated dialogue and led easily into farmers talking about their problems. Holding group meetings was useful because it was easy to get a consensus on priority problems. The problems were identified and prioritized as shown in Table 8.

Table 8. Production constraints of Weonia, ranked by % of farmers

PROBLEMS	RANKING	PERCENT (%)
Low soil fertility	1	14
Lack of fertilizer	2	13
Plant diseases and pests	3	12
Low yields	4	11
Animal diseases and parasites	5	10
Waterlogging	6	9
Swampy areas	7	8
Soil erosion	8	7
Inadequate feeds	9	6
Lack of clean water	10	5
Fencing	11	3
Expensive building materials	12	2

From among the above twelve problems the researchable ones were identified and prioritized. The solutions identified were prioritized and from further discussions among researchers, the following interventions were identified:

Trials

1. verification trials on improved forages
2. verification trials on fertilizer combinations in maize and vegetables
3. evaluations of important varieties
4. introduction of new crops, e.g., rice, cocoyams, Babari nuts, other leguminous crops
5. timing trials for planting waterlogged soils

6. trials on use of ash (ITK) and chemicals to control stalk borer
7. trials on chemical control of bean fly
8. screening of finger millet varieties tolerant to blast
9. trials on control of aphids in kales, indigenous vegetables and beans.

Demonstrations

1. compost making and FYM management
2. utilization of rabbits
3. planting water-tolerant crops
4. control of blight in tomatoes
5. mulching

Workshops

1. disease control in livestock
2. fish farming
3. bee keeping
4. farm planning
5. agroforestry
6. crop husbandry
7. clean planting materials for bananas and systemic control of banana weevil

Tours

1. mixed farming
2. zero grazing

In season one, researchers made most decisions pertaining to experimental design. Although 48 farmers agreed to conduct trials, only 25 of them participated. Before carrying out the activities farmers had to prepare the land and demarcate an area that they felt was suitable. However, due to different expectations, some were not able to prepare land on time. Others thought researchers would prepare land or provide labor for the same. This happened despite having reached an agreement with the farmers regarding roles. Others had already planted so the area left was not enough for the trials selected. Some land was not suitable: it was either rocky, shaded or sloping. These problems resulted in the reduction of participating farmers to 25. Those remaining actively participated in determining plot locations and demarcation with guidance from researchers, who set the number of treatments within an acceptable range. Plot layout and planting was performed by both researchers and farmers. Researchers provided inputs. The parameters to be measured were decided on by researchers and farmers. Farmers were encouraged to keep their own records and observations; researchers also kept records on biological data and monitored farmers' assessments.

At the end of the year the farmers conducted an evaluation of the whole season. They were happy with most of what had been done during the year but they expressed dissatisfaction with some aspects. This resulted in some changes in the procedure for the following season. Negative aspects the farmers identified were mainly the result of the team's (mainly the researchers') lateness in implementing some of the activities and of logistical problems, particularly regarding transport. To avoid repeating these mistakes, pre-planting workshops and demonstrations on plot layout, spacing, plant populations and applying treatments were held prior to planting during the second season. Then the researchers supplied the experimental materials they had agreed to provide to individual farmers. It was hoped that with assistance from extension staff, farmers would continue with activities without waiting for the researchers. A follow-up of the exercise showed that most of the farmers were able to effectively lay out the plots and plant without the researcher being present. This showed that farmers were gaining confidence in themselves and building up their capacity to carry out activities without fear of making mistakes.

Researchers continued to provide inputs but it was agreed that this would not be done in the third season. Farmers would be encouraged to acquire inputs.

Two more activities were added at the beginning of the second season: on-farm evaluations of farmers' indigenous technical knowledge for controlling pests and diseases, and mulching trials on kales. The number of participating farmers increased to 65.

MONITORING AND EVALUATION

Initially, researchers took the lead in this project, making research visits to check on conventional data collection, e.g., germination checks, weeding at the appropriate time and topdressing. Although efforts were made to ensure that there was farmer participation at all stages of technology development, they were not always successful. A farmer participatory research review workshop held at Nanyuki during the middle of the first season (in June 1997) revealed that farmers were not being involved sufficiently in monitoring and evaluating the activities. Researchers were still performing these tasks in their conventional way, through normal research visits. A two-fold solution was suggested that included holding a workshop to make farmers aware not only of the importance of record keeping but also how to keep meaningful records. The importance of making joint work plans involving all farm household members was stressed.

In July 1997, a planning workshop was held during which participatory monitoring and evaluation (M&E) was discussed. Farmers agreed that continuous M&E was important. After the objectives were explained to the 28 farmers present (7 female and 21 male), farmers split into four groups: Group 1 discussed maize and kales, Group 2 discussed forages, Group 3 discussed wheat, rice and finger millet, and Group 4 discussed legumes, groundnuts, pigeon peas, simsim and green grams.

Together with researchers, the groups developed checklists/criteria regarding what they considered important when collecting data and how the information would be recorded. Each group elected a leader to coordinate M&E and set dates for evaluation. They also decided that visits would take place on a weekly basis.

The end-of-year evaluation indicated that only a few farmers actually participated fully in the M&E exercise. This was mainly due to the large area being covered which led to fatigue and hunger for those participating. The exercise was also time-consuming and farmers requested some form of facilitation. The FPR team would not consider any form of facilitation whether monetary or in kind because they wanted the whole community and not a few individuals to feel that the trials belonged to them. The farmers were asked to suggest an easy way of monitoring the trials during the second season. Farmers suggested that for the following season they would be chosen to monitor each experiment on a village basis, then all farmers would meet once a month to discuss the situation at the whole-farm level. After discussions it was agreed that the idea was good and farmers decided to monitor the trials accordingly.

Together with the FPR team the farmers came up with the following list of criteria to be monitored in each trial during the July 1997 monitoring and evaluation workshop:

Group 1. Maize and Kales

1. date of emergence
2. number of suckers per plant
3. leaf color (score 1-5, where 1 is green and 5 is yellow)
4. pests and diseases
5. plant height
6. leaf size (kales)
7. date of planting
8. size of maize cob and number of ears per plant
9. yield per plot using "gorogoro" (2 kg tin)
10. number of leaves per plot leaving four leaves per plant after plucking (Kales)
11. weekly plucking of kale leaves
12. harvest by every farmer of his or her produce

Group 2. Forages

1. herbage - calibrate a gunny bag to get standard measure.
2. resistance to drought (how long leaves maintain leaf color during dry season)
3. regrowth ability after cutting
4. preference/palatability (score 1-3)
5. milk yield using Treetop bottles
6. diseases and pests
7. yield

Group 3. Finger millet

1. plant height (score 1-5 where 1 is tallest and 5 is shortest)
2. leaf color (score 1-5 where 1 is green and 5 is yellow)
3. composite head open/closed
4. susceptibility to bird damage (score 1-5 where 1 is none attacked and 5 is most attacked)
5. days to head and flower
6. color of grain
7. yield
8. days to maturity
9. diseases, types and severity (scored 1-5 where 1 is high and 5 is low)
10. pests, type and severity (scored 1-5 where 1 is many and 5 is none)

Rice and wheat

1. date of emergence/stand count
2. plant height
3. leaf color
4. days to flower
5. diseases (score 1-5 where 1 is high and 5 is least)
6. pests (score 1-5 where 1 is high and 5 is least)
7. yield using "gorogoro" (2 kg tin)
8. palatability

Group 4. Groundnuts, pigeon peas, green grams and simsim

1. date of emergence/stand count
2. diseases/pests (score 1-5)
3. leaf color (score 1-3)
4. vigor
5. premature shedding
6. maturity date
7. yield (when dried, use a "gorogoro" (2 kg tin) as standard measure, count broken seeds, count diseased seeds)

After developing these criteria there was a lot of enthusiasm initially, but later on some group members got tired and stopped participating in the monthly M&E visits. There were sentiments raised that some form of payment should be provided as motivation. This was discouraged because it was felt that encouraging payment would take away that sense of belonging and responsibility. Some farmers however were very keen and continued with M&E and very good records were obtained.

The records were used during planning of the second season activities with farmers. Some trials were modified depending on the outcomes of the farmers' M&E exercises. Some treatments were replaced by others and planting dates of some crops were rescheduled. In the second season M&E frameworks were developed to assist the farmers to carry out the exercise more effectively. This was done on a village basis and leaders were chosen for each trial in each village. The exercise is ongoing and has not been evaluated. However, it has been noted with pleasure that some farmers are recording important information on cards displayed on plots in order to share information with others.

DISSEMINATION AND ADOPTION

Since the interventions are still being evaluated, this process has not been initiated. However, there were two field days held in the farmers' fields. With the guidance and assistance of the FPR team, some contact farmers took the lead in explaining to others the activities they were carrying out. The attendance was very high on both days, with more than 100 farmers in attendance each day. A lot of interest was shown, judging from the numerous questions asked. The high enrollment of farmers in the second season may also have been the result of these dissemination activities. The FPR team has not had the opportunity to visit non-participating farmers to gauge whether they adopted anything from the field days. However, some participating farmers have their own separate plots planted with the best crop varieties from last seasons' trials.

FARMER RESEARCH COMMITTEE (FRC)

The members of FRC played a major role in bridging the gap between the research team and the farmers. They took the lead in organizing the M&E exercises in addition to participating actively in compiling M&E results. In some instances the frontline extension staff member joined them while monitoring and evaluating the activities, but his presence was optional. The committee members arranged the farmers' field days almost single-handedly as they were the ones who selected the farms for staging the field days. They assigned other farmers duties for explaining various activities. The FPR team remained in the background and assisted only if the need arose. The FRC was always at the forefront in making arrangements during the farmers' planning meetings and workshops. In a few instances, they called for farmers' meetings without the knowledge of the research team and sorted out their differences. They kept the research team informed about research progress and farmers' opinions, requests and expectations through the frontline extension staff.

LESSONS LEARNED

Capturing farmers' interest was not easy and based a lot on the type of trials one started with. Activities involved with food crops were accepted very easily. The researcher was assured of quick results if the farmer could easily understand her or his role. Once the farmer was well acquainted with the research process, it was easier to introduce other activities. The number of farmers one started with was also important: a small number was optimal, as this made monitoring easy and also made it possible to know all of the participating farmers and keep abreast of their activities.

Farmers' expectations also played an important role in the success of the activities. Some farmers had very high expectations, e.g., regarding loans and inputs, and if these were not delivered they quickly lost interest.

The process required a high initial input in terms of "personpower" and other resources which, if not available or not planned for, might have resulted in the failure of the FPR. Each group involved may also have a specific interest, e.g., the researcher may only be interested in experimental data in order to justify his or her work, extensionists in big demonstration plots for teaching purposes, while the farmer may be interested in quick food crops or livestock feed. Conflicts between these varying interests can have negative consequences.

CHALLENGES AHEAD

1. Grouping farmers according to wealth was not considered initially. It would be useful to do this in order to target specific technologies to specific wealth groups.
2. The level of involvement by women farmers was still quite low. Efforts should be made to carry out detailed gender analysis at the project's outset so as to ensure higher involvement of women farmers.
3. After the end of this season more efforts should be made to encourage farmers to initiate their own experiments. Farmers should be empowered to build their experimental capacities.
4. For the sake of the sustainability of introduced technologies, the issue of provision of inputs for experiments should be well articulated before implementation of trials. Any input to be given should be carefully specified, and every effort should be made to ensure that farmers understand at what point they will cease to receive free inputs.

CONCLUSION

Farmer participatory research is a very useful approach because the emphasis is on working as partners where everybody is equal. The process of sharing information and learning from each other generates a lot of useful information and contributes to the development of the communities involved. Participation empowers the farmers to solve their own problems instead of looking for ready answers. Participating farmers also increase their capacity and skills and their willingness to work together. However, FPR requires a high initial resource input, in both human and financial terms. More institutional support is also required in order for this approach to be sustainable.

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Table 9. Ranking problems

Problems

1. Lack of fertilizer
2. Low yield
3. Plant diseases and pests
4. Soil Erosion
5. Water logging
6. Low soil fertility
7. Animal diseases and pests
8. Lack of fencing
9. Lack of animal feeds
10. Swampy land
11. Lack of clean water
12. Expensive building materials

Pair-wise ranking

Soil Erosion
Swampy land
Lack of clean water
Animal diseases and pests
Low soil fertility
Waterlogging
Plant diseases and pests
Lack of fertilizer
Low yield
Expensive building materials
Lack of animal feeds
Lack of fencing

Problem	1	2	3	4	5	6	7	8	9	10	11	12	SCORE	RANK
1		1	3	4	5	6	7	1	1	10	11	1	4	8
2			3	4	5	6	7	2	2	10	11	2	3	9
3				4	5	6	7	3	3	10	11	3	5	7
4					4	4	7	4	4	4	4	4	10	1
5						5	7	5	5	10	11	5	7	6
6							6	6	6	10	6	6	8	5
7								7	7	10	11	7	8	4
8									9	10	11	12	0	12
9										10	11	12	1	11
10											11	10	9	2
11												11	9	3
12													2	10

Table 10. Livestock problems, solutions and interventions

Problem	Solution	F/S Trial	Demo	Seminar	Others Specify
1. Diseases and parasites	1a. Technical skills on control measures e.g., ticks E.g., - Tick control - De-worming - Vaccination (p)	-	-	-	-
	1b. Dip Management	-	-	2	Community to renovate dip Coordinate with vet
2. Inadequate livestock feeds	2a. Verification trial on improved forages 2b. Feeding trial - 2 2c. Workshop on feed conservation - ration form - - feeding management 2d. Zero grazing	F-1 - - -	1 - - 3	 - 2	- - - -
3. Lack of technical knowledge of - bee keeping - fish farming - rabbits - ducks	3a. Training on:- - Use of K.T.B.H. - Construction of fish pods and management 3b. Utilization of Rabbits	- -	*1 1	1 -	To coordinate with DLPO -
4. Poor poultry housing	4a. Training on - Construction of poultry housing - Poultry management - Chicken brooding				•
5. Poor breeds (Zebus)	5a. Upgrading of Zebus through - Private artificial insemination (A.I). - Bull scheme	-	-	-	Community to identify source of good bulls through MALDM (DLPO)
6. Lack of fencing	6a. Use of locally-available materials - Live fences - Wiring	-	-	-	Community to plant hedges, trees Individuals to fence

1=Immediate 2=Mid-season 3=Later

Table 11. Crop-related problems, solutions and interventions

Problem	Solution	F/S Trial	Demo (Field Day)	Seminar
Land preparation	Form self-help groups	-	-	1
Non-use of inorganic fertilizers and organic fertilizers	- Conduct verification trials on use of fertilizer combinations - Teach farmers compost making and management of FYM - Appoint a stockist with assistance of the MOALDM staff	1	1	1
Use of non-certified seed	same as above			1
Low yielding varieties (maize, sweet potatoes cassava, sorghum)	- Conduct variety trials: evaluate improved varieties against local varieties - Hold demonstrations on recommended crop production packages	1	1	1
Poor weed control/poor tillage	- Form self-help group to assist each other in weeding and plowing - Teach farmers how to weed using draught animals - Conduct verification trials of weeding methods	3 1		1
Lack of technical knowledge	- Organize seminars to teach farmers various aspects of crop husbandry - Hold farmer tours/field days - Teach farmers farm planning		2	1 2 2
Continuous cropping	- Introduce alternative crops, e.g., rice, horticultural crops and other leguminous crops - Introduce other cropping systems (rotations, relays)	1 1	1	2
Markets	- Form self-help groups			2

Table 12. Soil problems, solutions and interventions

Problem	Solution	Trial	Demonstrations	Seminar
1. Soil erosion	1. Terraces			
	(a) Grass strips		1	
	(b) Trashlines		3	
	(c) Fanya juu		3	
	(d) Fanya chini		3	
	2. Agroforestry			
	3. (a) Proper tillage			1
	(b) Cover crops		1	1
2. Waterlogging	(a) Drainage channels			3
	(b) Water-tolerant crops		1	
	(c) Early planting	3		
3. Low soil fertility	(a) Crop rotation	1		
	(b) Intercropping		1	
	(c) Use of compost/farmyard	1		
	manure	1	1	
	- fertilizer	1	1	
	- crop residues	1	1	
	(d) Low input costs			
4. Leaching	(a) Mulching	1	1	
	(b) Plant deep-rooted crops			1
	(c) Use of organic manures/compost	1	1	
5. Soil compaction	(a) Use of organic manure		1	
	(b) Early plowing		3	
	(c) Deep plowing		3	
	(d) Relay cropping		3	

DISCUSSION SESSION

Question 4.
Did you try modifying the trial designs when farmers found the trials difficult to understand?
Response
Farmer experimentation is still a challenge we still need to find ways of how the farmers way of doing this but our intention is to ensure that from the following season this will be considered.

Question 5.
Did you try modifying the trial designs when farmers found the trials difficult to understand?
Response
Not yet, but that was what I meant by saying that the challenge is to incorporate farmer experimentation into the program.

Question 6.
Why is low soil fertility the farmer problem no.1 particularly given the good maize crop in the slides and the soil is humic?
Response
Farmers practice 'monoculture' technique, which makes the soil easily exhausted.

Question 7.
Why did you pick-up solutions that could not be adopted -- for example the use of chemical fertilizers which farmers are unable to buy.
Response
Because we want to go to farmers with baskets of options among which they choose.

FARMER PARTICIPATORY RESEARCH IN NYATIEKO, CENTRAL KISII DISTRICT, WESTERN KENYA

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INTRODUCTION

In the recent past, it has been observed that available agricultural technologies have not had a noticeable impact on small-scale farming (Hilderbrand, 1984). This was attributed to non-adoption of these technologies because they had mainly failed to address the real problems affecting small-scale farmers. The researchers and extensionists used top-down approaches to generate and disseminate those technologies. Little effort was made to understand the sociocultural and economic status of the farming community, yet these conditions are important in determining the success or failure of introduced technologies (Chambers, 1992). Farmers did not participate actively in the research process and were not seen as equal partners in it (Okali et al., 1994), and this may have led to the development of inappropriate technologies (Werner, 1993). The Farmer Participatory Research (FPR) approach is a recent effort which aims to enable farmers to exercise greater influence over research priorities and decisions and to encourage them to participate actively in the implementation of such research (Okali et al., 1994). Farmer participatory research was initiated in July 1997 in Nyatieko location of Kisii district under the PRIAM (Participatory Research in Agroecosystems Management) project based at CIAT-Uganda. This paper reviews the application of the FPR approach at Nyatieko and highlights lessons learned.

SITE CHARACTERIZATION

Nyatieko is situated in Mosocho division, Central Kisii District in southwest Kenya. It is located in the upper midland UM_1 agroecological zone at an altitude of 1700 m asl (Jaetzold and Schmidt, 1982). The rainfall is bimodal with an annual average of 1750 mm. The first rainy season starts in February and peaks in April, and the second season begins in August and peaks in October. Temperatures range between 20°C to 28°C whereas the relative humidity ranges between 45% and 65%.

The soils in the area are classified as Nitisols and are well drained. The natural vegetation in this area consists of shrubs and bushes; false sunflower and *Lantana camara* are predominant. There are planted trees that include blue gum, black wattle, grevillea and fruit trees (e.g. avocados, guavas, papaws and loquats).

Farming is the major income-generating activity in this village where farmers practice mixed farming of crops and livestock. The major crops grown are tea, maize, finger millet, sweet potatoes, coffee, beans and vegetables (tomatoes, cabbages, onions and cowpea). Livestock kept are cattle, sheep, goats and poultry. Farmers practice several cropping systems which include: mixed cropping of coffee, bananas, maize, beans and vegetables; relay cropping, e.g., maize/maize, maize/sweet potato; intercropping, e.g., maize and beans. Monocropping is also practiced, especially for tea. The area is densely populated with about 500 people per square kilometer (Kenya census, 1994). Land tenure is individual ownership with title deeds.

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Landholding ranges between 0.5-2.0 acres per household. The majority of the villagers are small-scale, resource-poor farmers.

Roles of household members are well defined. Male children and adults are responsible for land preparation, input acquisition, planting, harvesting and herding livestock. Female children and adults are responsible for planting, weeding, harvesting, shelling and threshing, in addition to domestic chores like child care, cooking and milking. Peak labor is usually in the months of March-April for the long rainy season and September-October for the short rainy season, due to high labor requirements for planting, weeding (twice) and thinning of maize. In Nyatieko, both men and women are involved in farm work although women do more than men.

METHODOLOGY

The farmer participatory research at Nyatieko was carried out by a multi-disciplinary team of scientists of KARI's (Kenya Agricultural Research Institute) Regional Research Center at Kisii. Agronomists, pathologists, soil scientists, an animal nutritionist, a social economist and a biometrician participated in all stages of the research process. They were involved in site selection, problem diagnosis and prioritization, problem causal analysis, trial design and implementation, and monitoring and evaluation. Extension officers of the Ministry of Agriculture (MoA) also participated in the research.

Site Selection

Nyatieko site was selected in liaison with the MoA extension staff and local provincial administration. The major criteria used were low soil fertility, representativeness of the predominant agricultural farming systems and proximity to the Research Center.

Problem Diagnosis

This was the initial stage of farmer participatory research. It was carried out through participatory rural appraisal (PRA) exercises. Participants were first exposed to the PRA tools and methods in a workshop held before the research was initiated. During the PRA exercises, various methodological tools were used to gather information. These included transect walks, resource maps, historical trends, matrix ranking, pair-wise ranking, counter methods, seasonal calendars, etc. Problem causal analysis for crops, livestock, soil management and socioeconomic subsystems was carried out (Table 13). Indigenous technical knowledge (ITK) was documented and used in the identification of possible solutions. The PRA team together with the farmers identified and prioritized researchable activities (Table 14).

Research Trials and Demonstrations

All the ongoing trials and demonstrations are designed by researchers and farmers but they are managed wholly by farmers. Seven trials and two demonstrations are being implemented:

1. Evaluation of maize varieties (18 farmers).

2. Evaluation of cultural practices to manage sweet potato weevil (4 farmers).

3. Finger millet variety evaluation for tolerance to blast disease (8 farmers).

4. Evaluation of the effects of fertilizers on napier grass production (9 farmers).

5. Assessment of the effect of intercropping maize with legumes and incorporating crop residue for soil fertility improvement (18 farmers).

6. Assessment of the effect of organic and inorganic fertilizers in improving soil fertility and crop yield (5 farmers).

7. Evaluation of alternative phosphorus (P) sources for the restoration of P in low-fertility soils (18 farmers).

8. a. Demonstration of different agronomic packages for annual crops (2 farmers).

   b. Soil erosion control trial using recommended grass strips (Makarikari and Vetiver) and stone lines arrangement (7 farmers).

Implementation

There are 60 participating farmers to date, 40 of whom were selected by the community during a workshop held to train farmers in the basic principles of agricultural research. The criteria used to select farmers were ownership of land, willingness to work hard and interest in the research activity. The original 40 farmers selected a Farmer Research Committee (FRC) consisting of eight farmers (five women and three men). The FRC has a chairman, vice chairman and secretary. The responsibilities of the committee are to assist in overseeing the implementation, monitoring and evaluation of trials and to serve as a link between scientists and participating farmers. So far, the committee has been actively involved in monitoring the trials through farm visits. A field day and a planning workshop have been held and some selected farmers have participated in two cross site visits.

Preliminary Research Results

Results of two experiments carried out during the short rainy season in 1997 follow.

Maize varieties evaluation trial

Farmers in Nyatieko have been planting various maize varieties in the short and long rainy seasons but they have been getting low yields. During this project's diagnostic stage farmers identified lack of a suitable maize variety as one of the major constraints affecting maize production in the area. An on-farm trial was conducted in the short rainy season in 1997 to evaluate maize varieties suitable for the area. The varieties evaluated were H513, Pioneer, H614, H625 and Muragori (a local variety). Eighteen farmers participated in this trial and functioned as replications. Plot sizes were 10 x 5 m and maize was planted at a spacing of 75 x 30 cm. The randomized complete block design method was used. The first season results (Table 15) revealed that H513 and Pioneer flowered earlier (64 days for both varieties) than Muragori, H614 and H625 (67, 76 and 78 days respectively). The varieties H513 and Pioneer had a higher percentage of rotting ears although they were not significantly different ($P>0.05$) from the others. The varieties that took long to mature (H625 and 614) had higher grain yields, although the yields were not significantly different from the other varieties due to high coefficient of variation (Table 15). Maize streak virus and stalk borer pest did not affect maize performance severely. Farmers' evaluation workshop was held at the end of the season and varieties H625 and H614 were ranked the best in overall performance (Table 16). It was agreed that the trial should be continued and the following should be included: collection of socioeconomic data and variety H627 as additional treatment.

Maize legume intercrop and crop residue incorporation

This trial was begun in the short rains of 1997 with the objective of incorporating legume crop residues to improve soil fertility. The trial was planted on 18 farms, which functioned as replications. The treatments included (i) maize as a sole crop; (ii) maize/soya bean; (iii) maize/beans; and (iv) maize/green gram. The plot size was 10 x 5 m and maize was planted at a spacing of 75 x 30 cm while legumes were planted between maize rows at a spacing of 10 cm within the row. The one season's results showed no significant differences in yields between the treatments (Table 17).

ACHIEVEMENTS

Through the PRA exercise, problems affecting farmers at Nyatieko were diagnosed and potential solutions were identified. The FPR approach has boosted farmers' confidence in conducting experiments and evaluating the results. The FRC formed at the initiation of the trials is very active in overseeing and monitoring the implementation of the trials. It provides very useful feedback between farmers and researchers. Also, the use of a multi-institutional and multi-disciplinary team has led to a holistic approach to solving farmers' agricultural problems. The approach has resulted in a change of attitude between farmers and scientists as they see each other as equal partners.

Farmers in Nyatieko have already started utilizing useful technologies that are being tested. For instance, some participating and non-participating farmers have adopted the practice of planting legumes between rows of maize instead of planting the legumes and maize in the same hill; they have also adopted the recommended maize spacing. Moreover, some participating farmers have already started planting the promising maize variety (H614 D) on their farms. There is also increased demand for introduced CIAT bean varieties that are resistant to bean fly infestation. Farmers' interest in the trials has greatly increased. They know the objectives and can explain treatments of the trials being carried out. They actively participate in the evaluation of the trial results. This has impressed the participating team of scientists and extensionists who now appreciate the ability of farmers to do their own problem analysis and research.

LESSONS LEARNED

A major shortcoming at the initiation of the research activities concerned the community's high expectations since the PRA exercises identified all problems affecting farming in the area. Even after researchers explained the objectives of the project, some farmers still asked to be assisted with such facilities like a maize mill and a tea factory!

The resources required to implement successful FPR are high. To maintain frequent contact with farmers requires a lot of time and transport. The approach requires committed and devoted scientists and farmers as it takes time before research yields conclusive results. The sustainability of the FRC is questionable as members expect token payment to do their work. Provision of free inputs (fertilizers, pesticides, farm equipment, seeds, etc.) does not support sustainability of the project.

Because farms are spread out across a large region that is hilly and in many cases far away from accessible feeder roads, effective monitoring of the trials is difficult. Theft, mixing of trial materials by farmers and destruction of the trials by livestock and wild animals (porcupines and mole rats) are other problems affecting the FPR work. Timely farm operations are not carried out by all farmers. This creates large variations in the trial data.

CHALLENGES AHEAD

FPR faces several challenges such as avoiding raising farmers' expectations, ensuring that research results have an impact beyond the participating farms and sustaining farmers' motivation in conducting their own experiments even after researchers leave. Empowering farmers so that they can exert pressure on public research and extension organizations to provide the desired services is another important future challenge.

CONCLUSION

The farmer participatory research approach is effective in encouraging farmers' involvement in the research process. It fosters multi-disciplinary and multi-institutional collaboration and also widens the knowledge base of all stakeholders. However, this approach is time-consuming and requires a lot of resources in the initial stages; in the long run, however, it is likely to be cost-effective.

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Table 13. Crop and livestock problems: causes and suggested solutions

Problems	Causes	Possible Solutions
1a. Inadequate/inappropriate use of inorganic fertilizers b. Lack of organic fertilizer	a. Lack of knowledge of fertilizer use b. Use of expired fertilizer c. Lack of livestock to produce FYM due to reduced land size d. Lack of knowledge to make and use compost manure e. High cost of inorganic fertilizer	a. Workshop/demonstration to teach farmers about use of inorganic and organic fertilizers b. Credit facilities for farm inputs c. GoK price subsidies d. Enforcement of requirement that stockists sell only non-expired fertilizers e. Compost making and utilization workshops f. Encouragement to keep small ruminants for FYM
2a. Lack of suitable maize variety for the area b. Lack of adequate seed for suitable bean variety (red haricot) for farmers c. Mixed tomato varieties	a. Unknowing purchase of mixed tomato seed b. Failure to identify suitable bean variety	a. Maize variety adoption trial b. Encourage farmers to produce adequate amount of suitable bean seed c. Seed companies to be informed of mixed seed complaint by farmers
3. Crop pests and diseases: maize stalk borer, maize smut, finger millet blast, bean fly, sweet potato weevil	a. Late planting b. Unexpected drought c. Lack of resistant varieties	a. Demonstrations conveying various management technologies, e.g., early planting, resistant varieties, etc.

Table 16. Pair-wise ranking of maize varieties by forty Nyatieko farmers (short rainy season 1997)

Variety	Population stand/Ha	Days to flower	Lodged plants(%)	Rotten cobs(%)	1000 seed Weight (%)	Yields (kg ha^{-1})	Stalk Borer Attack	Maize streak virus (%)
Pioneer	5	1	1	5	5	5	1	1
H 513	3	2	2	4	4	4	4	5
Muragori	4	3	3	3	3	3	2	4
H 614 D	1	4	4	2	2	2	3	2
H 625	2	5	5	1	1	1	5	3

Key: 1=Best 5=worst

Table 17. Mean maize yields in maize/legume intercrop and crop residue incorporation (short rains 1997)

Treatments	Mean yields (kg ha^{-1})
Pure maize with crop residue incorporation	3941
Maize/soybean with residue incorporation	3830
Maize/common beans intercrop with residue incorporation	3603
Maize/green gram intercrop with crop residue incorporation	3728
Mean	3775.5
S.E."	845.8
L.S.D.	854.4
C.V.%	22.4
F-Test	N.S.

DISCUSSION SESSION

Question 8.
What criterion was used to select the maize variety to be tested in the current season?
Response
Time of maturity was the criteria farmers used in selecting maize varieties to be tested in the current and previous season. Note that the varieties are also being tested for adaptability and acceptability.

Question 9.
FPR make technology more appropriate cost effective and increases adoptation process. So why do you say it is time consuming?
Response
FPR is time consuming in the initial stages but later as farmers grasp the concept of FPR experimentation, it becomes cost effective. Why? Farmers design and implement their own trials.

Question 10.
High expectations were a problem initially, yet the number of participating farmers increased from 40 to 60. How was this achieved?
Response
Increase of farmers from 40 to 60 was advocated by FRC and the enthusiasm and interest in the project by neighboring farmers.

Question 11.
Is digging 1m deep trench for porcupine and mole rat control not a laborious solution? How did farmers suggest that?
Response
It was a solution traditionally known to farmers. But as it is tiresome it was not adoptable. Alternatives suggested were zincphosphate and use of traps.

PARTICIPATORY RESEARCH FOR IMPROVED AGROECOSYSTEM MANAGEMENT IN SURAKOYO PEASANT ASSOCIATION, SOUTHERN ETHIOPIA

Shiferaw Tesfaye[1], Daniel Dauro[1], Tenaw Workayehu[1] and Kefale Alemu[2]

ABSTRACT

A multi-institutional Farmers' Participatory Research (FPR) project has been carried out in Surakoyo Peasant Association in southern Ethiopia for the last three years with the objective of testing the efficiency of the FPR approach in addressing farmers' problems, strengthening their experimentation skills and improving their capacity to solve their problems through informal agricultural research. In order to meet this end, the farming systems of the area have been characterized and a series of farmer-managed, on-farm trials were initiated based on the problems identified and prioritized by the farmers of the community. Farmers selected the trials they wanted to conduct on their farms.

Though many of the farmers were reluctant and skeptical the first year, a considerable change in attitude was observed in the following years not only on the part of farmers but also on the part of researchers. Farmers who conducted the trials adopted and disseminated the results that they believed were useful.

In the course of undertaking the research with the identified groups of farmers, some achievements have been made which could warrant institutionalization of the approach in the agricultural research systems of the Awassa Research Center. These include: increasing adoption of improved varieties, winning farmers' confidence in research, increasing efficiency in research and extension and improving farmers' research capacity. However, these achievements were limited by several challenges, including: low time investment on the part of the FPR practitioners, limited knowledge of FPR, lack of test materials, failure of the Farmers' Research Committee to perform as expected and the farmers' high expectations.

The experience we had at Surakoyo clearly indicates that, for successful and sustainable technology generation and dissemination, farmers must be convinced that they can actively contribute to the research process. Only in this case can it be said that farmers are participating in the real sense of the term. Their participation will make it possible to link the power and capacity of agricultural sciences to the power and priorities of the farming community in order to develop productive and sustainable farming systems. In order for this to happen, it is necessary to develop a relationship of trust with the community and a better understanding of the core concepts: empowerment, participation, indigenous technical knowledge, motivation of the Farmers' Research Committee and improvement of farmers' research capacity.

The objective of this paper is to give an overview of our experiences with the participatory appraisal of the farming system and with Farmer Participatory Research, and of our achievements, the challenges we faced and the measures that need to be taken to further promote Farmer Participatory Research.

INTRODUCTION

Among the factors that contribute to the poor performance of the agricultural sector in Ethiopia and other developing countries is the low level of adoption of modern technologies generated by conventional research. Until the 1970s, when Farming Systems Research (FSR) became widespread, it was erroneously assumed that when farmers do not adopt technologies it is out of sheer ignorance or traditionalism (Collinson, 1976). In addition, it was assumed that smallholder-farming systems are static, and that yield and profit are the only factors farmers consider. It was

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thus believed that commodity-oriented research could generate broad-based technologies relevant to smallholder farming systems. In time, however, many scientists began to notice that the so-called improved technologies seldom enjoyed farmer adoption, and to look for the reasons for the low adoption rates. Advocates of farming systems research contend that the reason for low adoption of modern technologies is the inappropriateness of those technologies to the real physical and socioeconomic circumstances the farmers face. This lack of relevance is in turn attributed to the low level of farmers' involvement in all stages of research, from problem identification/diagnosis and planning to technology generation, monitoring and evaluation.

In the 1970s, amid scientists' growing perceptions that conventional research and extension did not work, many developing countries including Ethiopia institutionalized farming systems research and extension in their national agricultural research systems. Following this institutionalization, much effort has been expended to make farming systems research problem-oriented through conducting diagnostic surveys and on-farm trials. Now, however, about two decades after the institutionalization, controversy has arisen over the appropriateness of the approach in meeting the objective of developing technologies which are best suited to farmers' actual circumstances. The controversy is related to the extent and significance of farmers' involvement in the research process. The opponents of this approach contend that the FSR approach does not empower the farmers to do research. They advise the relevant governmental and non-governmental organizations to promote the approach called Participatory Rural Appraisal and Farmer Participatory Research (PRA/FPR).

Farmer Participatory Research (FPR) is a set of methods designed to enable farmers to make an active contribution as decision makers to planning and executing agricultural research aimed at resulting in technology generation. It is a complementary process which involves linking the power and capacities of agricultural sciences to the priorities and capacities of farmers, in order to develop productive and sustainable farming systems (Reijntjes, 1992). It is considered to build upon farmers' knowledge and encourages the optimal use of locally available resources, complemented by external knowledge and external inputs where appropriate and available. Fisher, et al. (1996) note that it is an important way for farmers to reflect on their farming systems and establish better communication with other farmers and with researchers.

On the basis of these concepts and experiences, the Awassa Research Center set out to test the effectiveness and efficiency of PRA/FPR in addressing farmers' problems and complementing conventional research. It then sought to institutionalize the method in the Center's formal research programs. To this end, a team of researchers was identified. The team comprised an agricultural economist, a plant breeder and an agronomist from Awassa Research Center, and a field officer (Agronomist) from FARM Africa Soddo. Then a site was selected: Surakoyo Peasant Association is located in Damot woyide woreda in the North Omo zone in southern Ethiopia. It is located approximately 170 km from Awassa town and 45 km from Areka town, the respective locations of the Awassa and Areka Research Centers. This area was selected for PRIAM work because it was accessible and because no such interventions had been made there so far, which condition was necessary in order to be able to assess the project's impact at its conclusion. This study area was selected in discussion with the head and relevant extension staff of Damot woyide woreda agriculture office.

After selecting the site, the team approached the officials and the development agent of the peasant association to persuade them to participate. A meeting was called to discuss the objectives of the approach with the farmers of the PA. When the team initially outlined its objectives, the farmers were suspicious, and it was only after lengthy discussions that they agreed to participate. The team then began the appraisal of the farming system using Participatory Rural

Appraisal tools in small groups. Each of four groups collected information on one of the following topic areas: soils and land forms, agronomic practices, socioeconomic concerns and livestock systems. Following this exercise, a general meeting was called to present the results, identify and prioritize problems and plan farmers' participatory research. Experiments were planned in discussion with farmers and executed for five consecutive cropping seasons. This paper presents an overview of the results of the participatory rural appraisal and the participatory trials conducted by the interested farmers in Surakoyo peasant association.

DESCRIPTION OF THE STUDY AREA

A preliminary description of the farming system of the PA was generated by FPR team members and farmers in their group discussions of such topics as soils and land forms, crop varieties, cropping systems, cultural practices, livestock systems, non-farm and off-farm activities. The groups' dialogues yielded the information presented below.

Physical Characteristics

Rainfall

According to the farmers interviewed there is rainfall throughout the year, though the amount varies from month to month. There are two growing seasons: *belg* (January-May) and *mehir* (June-October). There is more rainfall in the months of June to August. About 19% of the total annual rainfall is received in June while 17% and 15% of the annual rainfall in July and August, respectively. There is inter-moisture stress during the growing seasons, which favors insects that damage crops.

Topography

The altitude of Surakoyo peasant association is about 2000 m asl. The landscape is undulating with gentle and steep slopes. The slope falls from the southwestern to the northeastern part of the peasant association.

Soils

During our transect walk with farmers in the PA, we observed mainly red and dark grayish soils. Water and soil conservation methods introduced by CONCERN are used in some farmers' fields. This seems to have protected against soil erosion, and silt is filling the eroded places. But at present some of the bunds have been destroyed by floods, especially in the steep slope areas of the PA.

Farmers in Surakoyo peasant association classify soils of their area into two types: *karata* (dark gray) and *tela* (red) soils.

<u>Karata (dark gray) soils</u>

This type of soil is considered to be good (not best) for almost all types of crops. It is fertile, is found on gentle slopes, and has good water-holding capacity. It is preferred especially for maize.

Tela (red soils)

This type of soil is found on steep slopes of the PA. All eroded/infertile soils are called tela beta. According to the farmers, fertile soils can erode and become infertile. This type of soil is not preferred for most crops. However, farmers say that teff, beans, taro and some other root crops are grown in it. This soil is shallow, and its location on steep slopes means that it is continuously washed away and thus doesn't have good water-holding capacity. This soil is not common in Surakoyo PA. It is also found on plains, where waterlogging is common, but in this case it is considered fertile.

Soil Fertility Status

The fertility of the soil decreases considerably from the south to the north of the PA., and soil fertility is one of the most important problems the area faces. The reason for the low fertility is that the lower part of the PA is located on steep slopes with red soils. The erosion the area suffers from can be seen in the shift from black/dark gray soils to red soils.

Few farmers in this area can afford to buy fertilizer, and even those who want to buy it cannot get it at the markets in time for the growing season. However, the farmers are trying to enhance soil fertility on their farms by applying organic fertilizers (manure and household refuse). Manure is limited, though, as the majority of the farmers have few or no animals. Consequently, the amount of manure they get is insufficient to cover all of their farmland. Only that part of the homestead, which is very near the house, is fertile. There are two reasons for this: first, manure is broadcast near the house where enset is growing; second, farmers also claim that enset plantations improve the fertility of the soil. The ever-increasing population density also affects soil fertility. People have started to farm fallow and natural forest areas.

The chemical fertilizers DAP & urea were introduced into the area during the Haile Selassie regime. Since then Wolayita Agricultural Development Unit (WADU) and Ministry of Agriculture (MoA) have broadly supplied it. The farmers realized its importance and adopted it, but in recent times the cost of chemical fertilizers has increased three-fold and now farmers cannot afford to buy it. Moreover, chemical fertilizers are not always available in markets. Since farmers have been using chemical fertilizer for decades, the land cannot give good yields without it. As one of the farmers said, "First we were encouraged to use it; when we started using it, the government has raised the price. Without fertilizer, our crops, especially maize, perform very poorly and only weeds grow well."

Socioeconomic Characteristics

Wealth ranking

In the Surakoyo peasant association, four levels of wealth have been identified: *Durie* (rich), *Bana danday daga* (self-sufficient), *Gidua* (middle) and *Mankua* (poor). The major criteria of classification are land holding (mainly land planted to enset and coffee), livestock herd size and house structure. It was mentioned that the number of wives goes with the wealth status. The Durie, bana danday daga, Gidua and Mankua men may have as many as 6, 3, 2 and 1 wives respectively. The number of children is also directly proportional to the wealth status.

Income

Coffee, teff, field pea, taro, maize, sweet potato and barley are the major sources of cash income. In addition, off-farm and non-farm activities also generate cash income. When some of the male farmers run short of cash, they go to Shashmenie, Awash, Metahara and other neighboring towns to look for temporary jobs.

The sources of income for the women are spinning cotton thread, selling enset products, milk and its products, local beverages and maize flour, and engaging in business, going from one market to another (e.g., retail trade, sale of injera). The highest proportion of income (26%) is acquired from the sale of livestock. Sales of haricot bean (10%) and sorghum (8%) contribute a good share of income. The other crops are marketed depending on production. Livestock are usually marketed in August-September; coffee in December-July (both fresh and dry); teff in June-August and November-January; maize in June-August (fresh cobs) and October-March (dry grains); haricot beans the same as teff, and sorghum in January-March. Most haricot bean is consumed.

The time during which farmers typically have cash is June-January, and the scarce period is March-May. The timing of income from sales of crops does not comply with the timing of the demand for income. As a result, farmers often sell their livestock when they need cash and replace the same type of livestock they sold using the income they earn from sales of crops. But farmers are often left without livestock, for they frequently find they cannot earn enough income from crops sales to replace the livestock they have sold.

The income farmers earn from whatever source is spent to meet social commitments, to celebrate holidays like *meskel*, Easter and Christmas, to purchase clothes, food, seeds and fertilizer, for recreation, and for other expenses including land tax and health care. The highest proportion of the income earned is spent to meet social commitments and make food purchases (19% each), followed by recreation (17%), holidays and purchase of clothes (12% each), purchase of seed and fertilizer (15%) and other expenses (6%).

The proportion of income men spend on alcoholic drinks is very high. The farmers in the PA have become so addicted to local beverages that quarrels often ensue if their wives refuse to give them money to buy drinks.

Food

Almost all food crops grown in the PA are used for home consumption to varying degrees. Teff is mainly sold to generate income, and is usually consumed only during special occasions, for example during holidays. The most important sources of food are enset and maize, which are consumed almost year-round, followed by sweet potato. During the period of June-October, maize, Irish Potato, sweet potato and Wolayita dinch are available. From November-February, the main food sources are wheat, barely, Faba bean, field pea and sorghum.

The scarce period is March to May. In this period, men are engaged in off-farm activities while women engage in beverage sales and retail trade. The food availability calendar indicates that September is the month of greatest food availability. Food availability starts to increase in June, reaching its apex in September, after which it starts to decrease, reaching its nadir in May-June. The standard dish is *kita*, a meal prepared from maize flour. During special occasions like meskel holiday, different, preferred meals are prepared. These are *wotaya, suso, micho* and *kotchkocho*.

Wotaya: Boiled meat is chopped fine, cheese is well drained and barley is well prepared and crushed. Then the three are mixed and boiled with onion, spices and butter.
Sulso: Raw meat is chopped fine with butter and served with *kita*.
Mucho: Bulla is fried with butter and served with meat.
Kotchokotcho: Dried meat boiled and served with kale and butter.

Cropping System

Cropping seasons

Since the area has two cropping seasons, farmers harvest two crops in a year. Crops grown in *belg* are cereals (maize, sorghum, teff, barley), root crops (sweet potato, Wolayita dinch, taro) and pulses (Faba bean, field pea and haricot bean). Cereals (wheat, barley and teff), pulses (Faba bean, field pea, haricot bean, chick pea) and root crops (sweet potato, Irish potato) are crops grown in the *mehir* season.

Land preparation

Land preparation for maize, Irish potato, barley and sorghum begin in October-December, after which planting is carried out in January-March. Seedbed preparation for haricot bean and teff takes place in January-February, and planting is done in March. Land preparation for *mehir* crops (field peas, faba bean) is carried out in June, and planting takes place in July. The *belg* crops are harvested in April-July.

Crop varieties

The major crops (based on area coverage) grown widely throughout the PA are enset, maize, haricot bean, teff, sorghum, yam, Faba bean, field peas and coffee. According to the farmers, the different crops have different purposes: food, market/cash, animal feed, planting material (enset, sweet potato), fiber (enset), local beer, and enhancement of soil fertility. Farmers grow different varieties of maize, haricot bean, teff, sweet potato, Irish potato, barley, wheat, sorghum and field pea. They can easily identify the different varieties of each crop on the basis of maturity, yield, seed size, color, plant height and lodging. They can also identify varieties according to their performance either for food or for market.

Currently certain crops are out of production due to their late maturity and low resistance to bird attacking. Some wheat varieties are also out of production because of late maturity, low threshability, non-palatability of the straw for animals and destructive effect on soil fertility.

Since Surakoyo is located in the mid-altitude area, various crops (cereal, root, and leguminous) are produced. The major crops of the area in descending order of importance are:

<u>Cereals</u>
1. maize
2. maize
3. sorghum
4. teff
5. barley
6. wheat

<u>Pulses</u>
1. haricot bean
2. field peas
3. faba bean
4. chick pea

Roots
1. enset
2. sweet potato
3. Irish potato
4. yam
5. taro
6. Wolayita dinch (*Coleus edulis*)

Cash crops
1. coffee
2. avocado
3. banana

Others
1. cabbage
2. pumpkin
3. spices

Trees

The most important and common trees planted by the farmers are eucalyptus, *Cordia abyssinica*, *Erythrina*, *Juniperus* and *Olea africana*. Other tree and shrub species are also found at the margins of farmlands, near roads, along rivers and in uncultivated fallow lands. There is no natural forest area in the PA because of deforestation due to the high population density. People get timber and fuel wood from their own land or they buy them from other people.

Cordia africana, Juniperus and *Olea abyssinica* yield high-quality timber and are also used as shade trees in front of houses. *Erythrina* is good for animals as forage and is used for storing maize without removing the husk and shelling it. It is also used for fencing. In addition, farmers claim that this species is drought-tolerant, grows easily from cuttings and improves soil fertility. Eucalyptus is very important as a source of income. It attracts a good price when sold as fuel wood or for house construction. Each farmer owns a small patch of land in front of the main gate of the house. This place is called *kere* (Wolayitigna). When a member of the household dies, the people of the locality gather together there before and after the burial ceremony to express their sympathy. Moreover, the farmers keep animals, especially calves and small ruminants, at this particular place. Next to *kere* is sometimes found a wider area used as a common grazing area for the people who live around it. Some farmers also own a small portion of confined or fenced land beyond the food crops, usually located behind the house at the edge of their farmland. From this land they get *hyperrinia* grass for milking cows and calves. Farmers do not allow animals into this place but rather cut and carry the forage for them. The major forage grass and legume species found in the PA are *Digitaria, Erograsses, Neonelinia weghty, Cynodon dactylon* and *Hyperrinia*.

Livestock System

Livestock ownership

The livestock owned widely throughout the survey area includes cows, oxen, heifers, bulls, donkeys, mules, sheep, goats and chickens. Cows, including heifers, account for the highest proportion (35%), followed by oxen, including bulls (22%), sheep (18%), donkeys (14%) and goats (8%). Equines account for the smallest proportion (3%) (Table 18).

Only 40% of farmers own livestock. Of these, 22%, 11%, and 22% have one, two and three-four oxen, respectively. Farmers who co-own one cow in common account for the highest proportion (46%) (Table 19). These figures indicate that the shortage of livestock is a critical problem for the majority of farmers.

Farmers who do not have livestock of their own make various loan arrangements to take advantage of milk, manure, draft power and profit. The modes of loan arrangement in which acquisition of livestock is effected are *Kota, Worea, Hara* and *Olokota.* These arrangements are such that both parties are benefited to varying degrees, depending on the mode of the loan:

Kota

An arrangement in which two farmers pool their resources and own an animal in common. This type of arrangement could be applied to any type of livestock. The main objective here is to fatten it and sell it at a better price to share the profit equally. But, if the animal share-raised is a cow and calves, the arrangement is such that the one managing it will use the milk for the first nine weeks alone, after which it is rotated between the two owners on a weekly basis until it stops lactating. The calf, however, is shared equally. This arrangement, when applied to calving cows, is called *Kodua.* If the animal under this arrangement is an ox, it could be used for traction purposes by turn. The common service applies to all animals.

Worea

This is an arrangement whereby one of the two owns the livestock and the other manages. The benefit obtained upon sale is shared equally. The major difference from the former arrangement is that, in this case, the owner is only one of the two. This arrangement is usually made between relatives and friends and is applied to oxen and donkeys. In this case the animal to be put under this arrangement could be from the herd of the owner, or purchased by one and given to the other to manage.

Hara

In this case too, the owner is one of the two. The one who has agreed to manage it benefits from the animal's milk, draft power and manure. In case of calving, the calves are not claimed by the farmer who is managing it. This arrangement often applies to oxen and cows.

Olokota

In this case too, the owner is one of the two. But the difference from the *Hara* arrangement is that in this case the one who manages the animal shares the benefits equally with the owner. This applies to sheep, goats and chickens.

The major form of ownership upon loan arrangement is *Kota,* followed by *Olokota* and finally *Hara.* It should be noted that it is the owner who bears the risk for death or damage to the livestock under all of the arrangements mentioned.

Table 18. Livestock composition in Surakoyo PA, 1996

Livestock type	Proportion by percent (%)
Cows	35
Oxen	22
Sheep	18
Donkeys	14
Goats	8
Equines (Horses + Mules)	3

Table 19. Livestock ownership by proportion of households in the survey area, 1996

	Animals owned by percent of households	
Number owned	Oxen	Cows
One - half	22	46
One	45	15
Two	22	30
Three-four	11	9

Note: The figures in the tables on livestock are computed by using the counter method specified by the Participatory Rural Appraisal method.

Breeding

The age at first mating is 4-5 years. The system of mating is continuous, and the method of mating is uncontrolled. There is no specific period during which cows are serviced. As a result, there is no specific period during which the cows calve. This has implications for the availability of feed. Traits preferred by the farmers in the study area are color (non-black), character (not aggressive), good stand, better productivity in terms of both milk and meat, and good traction power. However, farmers do not strictly monitor or manage the estrous cycle of their cows, nor do they attempt to get their cows serviced by bulls, which possess most of the traits they prefer. Not monitoring and managing the estrous cycle of cows also has implications for seasonal feed availability.

Farmers do not like black-colored calves because they are easily attacked by the tsetse fly, which causes trypanosomiasis. The calving interval for most of the cows in the area is two years. The calf crop reaches up to 10, and the culling age is about 30 years.

Milk production

Depending on the time of calving in relation to the availability of feed, cows in the study area are milked two or three times per day. Under good feed availability conditions, they are milked three times a day (morning, noon and evening), producing about two liters/day, for the first six months. For the following four months, they are milked twice (morning and evening), and produce one liter per day. In the survey area, the lactation period could extend up to a year.

Feeds and feeding

Sources of animal feeds include open grazing land (which is usually communal), grassland, weeds from enset and coffee fields, crop residues, maize stalks, green maize cobs and boiled maize cobs with cotton seeds, leaves and other parts of enset and sweet potato, straw of haricot bean and teff and other crops, and residues of local alcoholic beverages. Among the major wet season feeds are fresh grass including weeds (70%), followed by fresh maize stalks (30%). In the dry season, teff straw accounts for the highest proportion (30%) followed by the dry leaves and stalks of maize and sorghum (25%) (Table 20).

The method of feeding is the cut-and-carry system by which the animals are fed in the morning and in the evening. The different types of feeds are available at different times of the year. Maize stalk is available in April-October, weeds in May-August. The supplementary types of feed, which include green roasted or boiled maize cobs, enset corm and sweet potato tubers, are provided depending on whether the cows are calving or the bulls are being kept for fattening purposes, and when the oxen are used for traction purposes. The amount of feed available also varies according to the season. The feed availability period ranges from May to October, during which fresh grass, weeds and maize stalks are available. The scarce period is from January to April, during which the farmers try to manage the feeding by providing leaves from sugar cane, enset and sweet potato, and residues from sorghum and maize. The period of relatively low feed availability is from November to December, during which leaves of sugarcane and enset and dried leaves of sorghum and maize are fed. When feed is scarce, farmers boil salty soil and give the liquid to their cattle after precipitation. The salty soil is also roasted and given to the animals to lick. This is not, however, given to pregnant cows, for it causes them to abort the fetus before becoming ready for birth.

Communal grazing land is also used for social purposes such as marking funeral ceremonies. As a result, attention is not given to its grazing management: neither deferred nor rotational grazing management is practiced. Rather, the land is used simply to tether animals, regardless of their sex or age. The livestock are either tied to a stake or herded by children.

Table 20. Proportional contribution of feed types by season in the survey area, 1996

Feed types	Contribution (%)
Dry season	
Teff straw	30
Dry stalks and leaves of maize and sorghum	25
Leaves of enset and sweet potato	20
Sugarcane leaves	15
Leaves of trees and others	10
Wet season	
Fresh grass and weeds	70
Fresh maize	30

Livestock disease

The types of livestock diseases reported by the farmers in the study area are anthrax, black leg, trypanosomiasis and other parasitic and infectious diseases. Among these, anthrax and black leg are the most severe, and anthrax is responsible for the most animal deaths. Farmers reported that there is no discernible pattern with regard to the timing of the occurrence of disease. The Woreda agricultural office at Bedessa town in the survey area offers veterinary services.

Income generation

The main way of profiting from livestock in the study area is through sales. Farmers sell their livestock to meet cash requirements in the case of the birth or death of a household member and for purchase of medication, debt repayment, food purchase, wedding or circumcision ceremonies and house construction. The types of livestock sold depend on the amount of cash needed. Though the woman is consulted about which animal is to be sold, the husband makes the final decision. Women have control over the disposal of chickens and milk and its products without much interference from their husbands.

PROBLEM IDENTIFICATION AND PRIORITIZATION

A meeting was called to identify and prioritize problems and plan research with farmers. The farmers were encouraged to express their opinions and outline their problems freely. Problem identification took place in individual discussions followed by a group discussion. During the group discussion in particular, farmers listed about 30 problems, both researchable and non-researchable. After researchers convinced the farmers that the objective of the farmer participatory research is to enhance their research capacity, only the researchable problems were selected for prioritization and planning of experiments. Farmers prioritized researchable problems using both voting and pair-wise ranking techniques. In the planning session, causal analysis was used to identify specific areas in which interventions should be made. This method is believed to enhance the capacity of farmers to analyze problems and plan experiments when they start to do research on their own.

The problems listed by the farmers (in no particular order of importance) during the group discussion were:

1. Mole rats
2. Porcupines
3. Sweet potato butterfly
4. Winds/hail
5. Weevils/bruchids
6. Land shortage
7. Erosion
8. Feed shortage
9. Livestock disease
10. Food shortage
11. Human disease
12. Malnutrition
13. Oxen shortage
14. Lack of farm implements
15. Lack of seeds
16. Lack of improved seeds
17. Low soil fertility
18. Stalk borer
19. Bacterial wilt of enset
20. Coffee berry disease and other coffee diseases
21. Lack of cash
22. Late blight of Irish potato
23. Field pea aphids
24. Orange disease
25. Untimely availability of chemical fertilizer
26. Labor shortage
27. Unavailability of flour mills
28. Long distance from water
29. Lack of modern cotton spinning devices
30. Lack of modern enset processing devices
31. High cost of fertilizer

Following the identification of problems the farmers were requested to prioritize them by voting. They selected the following problems in descending order of importance.

1. Oxen shortage
2. Lack of improved varieties
3. Sweet potato butterfly
4. Feed shortage
5. Low soil fertility
6. Erosion
7. Late blight of Irish potato
8. Field pea aphids
9. Bacterial wilt
10. Malnutrition
11. Lack of farm implements

In addition to the voting method, the pair-wise ranking technique was also used to fine-tune the order of importance of the problems. The priority problems selected by this method were (in descending order):

1. Oxen shortage
2. Bacterial wilt
3. Lack of improved varieties
4. Sweet potato butterfly
5. Late blight of Irish potato
6. Malnutrition

The problem identification and prioritization was followed by a planning session during which causal analysis was conducted to identify possible openings for interventions.

PLANNING OF EXPERIMENTS

Based on the result of the causal analysis, experiments were planned in discussion with the farmers. Table 21 shows the types of experiments planned for the respective problems.

Table 21. Problems and farmer-designed participatory trials to address them

Problems	Planned experiments
Low yield potential of local varieties	Community-based evaluation of improved varieties
Sweet potato butterfly	Evaluation of Desmodium species as trap crop
Mole rats	Evaluation of Tephrosia species as trap crop
Low soil fertility problems	Evaluation of multipurpose tress, leguminous forage species, compost manufacturing, coffee pulp
Late blight of Irish potato	Evaluation of tolerant varieties
Feed shortage	Evaluation of improved forage species, multipurpose trees
Malnutrition	Introduction of soybean crop

Selection of Farmers and Farmer Research Committee

Following the planning session, the FPR team asked farmers to express their willingness to conduct trials, which many did. In addition, the group assembly chose a general committee to coordinate the FPR activities. The general committee was briefed that its mandate was to visit each pilot farmer's trial and hold a dialogue with the trial farmers and the community about the merits and demerits of the experiments. The five-member committee was selected by voting.

PARTICIPATORY RESEARCH TRIALS

The PRIAM project in Surakoyo was started in 1996 with community-based evaluation of improved varieties of various crops in order to address the low yield potential of the local varieties. However, as far as the FPR is concerned, the objective of this trial went beyond addressing technical problems: it sought to meet the objective of empowering the farmers so that they would develop the capacity to solve problems through research at their own initiative. This trial was selected because the top priority problem mentioned by the farmers during PRA was the low genetic yield potential of the local varieties. A total of 40 willing farmers have participated in conducting this trial over a period of five consecutive cropping seasons (1996 to 1998) (Table 25).

Community-Based Testing of Improved Varieties of Wheat

Wheat is one of the most important crops grown in Surakoyo peasant association. The yield potential of the local varieties grown by the farmers is low. To address this problem, two improved varieties (1985 and ET-13) were tested for their performance under farmers' conditions and management.

Results and discussion

Statistical analysis

Table 22 shows that the highest mean yield (18.8q/ha) was recorded by the improved variety, HAR-1685, followed by Et-13, which gave a mean of 14.7q/ha. The lowest yield was obtained from the local variety, which gave a mean of 12.5q/ha. The statistical analysis indicated that the variety HAR-1685 yielded significantly better than the local variety (P=0.01) and performed significantly better than the variety Et-13 (P=0.05). No significant yield difference was obtained between the improved variety ET-13 and the farmers' variety (Table 22). The improved variety HAR-1685, which is the highest-yielding variety, has a 50% yield advantage over the local variety.

Table 22. Wheat variety yield trial at Surakoyo PA

Variety	Yield (in q/ha) by trial farmer			
	Farmer Bonja	Farmer Assefa	Farmer Dacha	Mean by variety
Local	7.00	16.00	14.50	12.50[a]
HAR-1685	12.00	22.00	22.50	18.80
Et-13	10.00	18.00	16.00	14.7[a]
Mean by farmer	9.70	18.70	17.70	

[a] The difference between these yields is not statistically significant.

Farmer assessment

Farmers liked the improved variety HAR-1685 for its tilling ability, yield and threshability, the crushing quality of the meal, the *Kolo* (roasted grains) prepared from it, and its flour quantity and quality. They confirmed that this is the variety they would like to grow widely in the future. They did not appreciate the improved variety Et-13 because of the difficulty in threshing, the poor crushing quality of the Kolo prepared from it, and its low flour quantity and quality. In overall assessment they ranked the variety HAR-1685 first followed by the local variety.

Community-Based Testing of Improved Varieties of Haricot Bean

Haricot bean is also another important crop grown in the area. Farmers in this area have only one local variety called red Wolayita, whose yield potential is not satisfactory. In the PRA the farmers mentioned that they want varieties that perform better than their local variety. To this end, three farmers expressed their willingness to test the available improved varieties for their performance under the farmers' management and conditions. They were provided with improved varieties Awash-1 and Roba-1 to test and compare with the local variety.

Results and discussion

Statistical analysis

The statistical analysis indicated that there is a highly significant difference between the improved variety Roba-1 and the local variety (P=0.01), while the improved variety Awash-1 is significantly different from the local (P=0.05). No significant yield differences were found among the sites/farmers (Table 23). The highest mean yield (14.71 q/ha) was obtained from the improved variety, Roba-1, followed by the other improved variety Awash-1, which gave a mean yield of 11.3 q/ha. The lowest yield was obtained from the local variety, Red Wolayita, which is 6.7 q/ha. The highest-yielding variety has a yield advantage of 119% over the local variety, while Awash-1 has a 67% yield advantage over the local variety.

Table 23. Haricot bean variety yield trial at Surakoyo PA

Variety	**Yield (in q/ha) by trial farmer**			
	Mengistu	**Gona**	**Mulatu**	**Mean**
Local	7.00	6.00	7.00	6.70b
Awash-1	11.00	12.00	11.00	11.30a
Roba-1	16.50	16.50	11.00	14.70a
Mean	11.50	11.50	9.70	

CV = 8%

Farmer assessment

Both pre-and post-harvest assessments were carried out to ascertain farmers' opinions about the performance of the improved varieties viz-a-viz the local variety. The assessment was conducted by informal dialogue with the test farmers about their experiences with and observations of the improved varieties in a meeting held in the presence of other farmers in the PA.

The major evaluation criterion farmers considered during the assessment were tolerance of waterlogging and moisture stress, resistance to shattering, weed suppression power, vigorous growth, early maturity, yield, taste, cooking time, mixing quality with different crops for making boiled grains (locally called *nifro*), storage quality, market demand, color, straw yield, vigorous growth and digestibility. With regard to tolerance to heavy moisture, they preferred Roba-1 because they said that some time after germination, there was successive heavy rainfall. During this time, while the variety Roba-1 tolerated the excess water, the growth of the other varieties was affected. Roba-1 was also preferred for its tolerance of moisture stress, as farmers found it unaffected by the lack of rainfall at flowering. Roba-1 was also preferred for its fast ground cover and consequent suppression of weeds.

The other important traits for which the variety Roba-1 was preferred by the farmers were its early maturing, better yield, tolerance to shattering, high branching ability, compatibility for intercropping, good taste, short cooking time (and thus low requirement for cooking water), best storage quality, and good mixing quality with wheat and chick pea for making *nifro* and with enset for making a meal locally called *blando*.

In spite of its best performance in the aforementioned traits, its market demand is low because of its unattractive color and small seed size. However, the farmers did predict that when people become familiar with it market demand would increase. The mixing quality with maize for preparing *nifro* is hindered because its color is not red. For such a meal, the farmers prefer red colored beans so that the maize turns red. However, when the wheat and chickpea are used for preparing it, Roba-1 is preferable. It is also preferred for its easy digestibility. For most of the evaluation criteria, farmers ranked Roba-1 first followed by the local variety. The farmers only for its better yield liked the improved variety (Awash-1). They did not attach much importance to its other traits.

Community-Based Testing of Improved Varieties of Teff

Teff is another important crop grown in the study area. However, the yield potential of the local varieties of this crop is so low that the farmers wish to replace it with other, better-performing varieties. Four improved varieties were distributed to farmers for testing in their fields under their management and conditions: DZ-Cr-37, Dz-01-354, Dz-01-196 and Dz-Cr-44.

Results and discussion

Statistical analysis

Table 24 indicates that the highest yield was obtained from the improved variety Dz-Cr-37, which yielded a mean of 11.25 q/ha, followed by Dz-01-196, which gave a mean yield of 8 q/ha and Dz-Cr-44, which gave a mean yield of 7.75 q/ha. The lowest yield, 6.75 q/ha, was obtained from the local variety. The highest yielding variety, Dz-Cr-37, has 67% yield advantage over the local variety.

Table 24. Yield trial of Teff varieties by Surakoyo Peasant Association

Variety	Yield (in q/ha) by trial farmer		
	Farmer Ayele	Farmer Worako	Mean by variety
Local	5.50	8.00	6.75
Dz-01-354	6.50	7.40	7.00
Dz-Cr-44	7.50	8.00	7.75
Dz-Cr-37	10.0	12.00	11.25
Dz-01-196	7.50	8.60	8.00
Mean by farmer	7.50	8.80	

Farmer assessment

Farmers preferred test variety Dz-Cr-37 for its high yield performance and resistance to lodging, followed by Dz-01-196. All the improved varieties performed better than the local variety *Bunne*, which is red in color.

Community-Based Testing of Improved Varieties of Barley

This trial was conducted by two farmers using three improved varieties HB-120, HB-40 and Holker. Though three of them had good germination in both sites, they failed to set fruit due to problems probably related to adaptability to the area.

Community-Based Evaluation of Improved Varieties of Maize

The highest mean grain yield was produced by the variety BH-660, followed by A-511 (Table 25). Farmers preferred the variety A-511 because of its early maturity and its relatively high grain and flour yield. According to the farmers, early maturity is desirable because it helps them to overcome food and cash shortages and can be produced twice a year.

Table 25. Grain yield (kg/ha) of maize varieties in a participatory on-farm trial in Surakoyo PA, 1997

Farmer	**Yield by variety**				
	BH-660	**BH-140**	**BAH-540**	**A-511**	**Local**
Ayele	2500	1400	-	2000	-
Mengistu	2000	1200	1000	-	1100
Jemaneh	2300	1700	-	600	-
Bessa	2600	2400	-	2700	-
Mean	2350	1675	1000	1767	1100

REMARKS ON UNEXECUTED TRIALS

Community-Based Evaluation of Improved Varieties of Sweet Potato

In November 1997, two improved varieties of sweet potato (Koka-6 and Ougenseka) were provided to willing farmers so that they could multiply and maintain the planting material to use in the May 1998 planting season. However, both varieties failed to establish due to moisture stress after planting.

Community-Based Evaluation of Improved Varieties of Sorghum

On-farm testing of improved varieties of sorghum was also planned for the *belg* season of 1997. However, only one farmer expressed willingness to do the trial; others were unwilling due to fear of bird attack. The volunteer farmer conducted the trial with two improved varieties (Dinkmash and IS 9302) and the local variety. He planted the new varieties in his maize field to reduce bird attack. Despite this effort to reduce bird attack through inter-planting, he was not happy with the bird-resistant quality of the improved varieties.

Soil Fertility Management Trial

Plans were made to conduct an on-farm soil fertility management trial in the *belg* season of 1997. Farmers were to test leguminous forage species for their potential to enhance soil fertility so that it would be possible to use them in place of, or to augment chemical fertilizer. This method involves planting the forage species as a relay crop in the preceding crop with a view to benefiting the next crop. However, two problems arose. One was the reluctance of farmers to grow the preceding crop (maize) without chemical fertilizer. The other was that the lack of sufficient information about which species are best suited to meet the intended purpose. With this in mind, the FPR team did not dare let the farmers conduct the trial in 1997.

In addition, there was a plan to let farmers manufacture compost and test it against chemical fertilizer. This plan was not executed because adequate information was not collected from farmers as to why they gave up manufacturing compost, a practice which was previously initiated in the area by an NGO called CONCERN. The FPR team did not want to re-initiate compost manufacture in the absence of information about why CONCERN's effort had failed to interest farmers in compost preparation and use.

In 1997, there was also a plan to let farmers test leguminous tree or grass species so as to address the problems of low soil fertility and feed shortage. It was intended that these species would be used as a form of green manure. However, the FPR team was not sure which tree or grass species are suited to such a trial in this area, and so the trial was canceled.

ACHIEVEMENTS

Even in the absence of a generally accepted conceptual framework and indicators to assess the impact of the FPR project in the area, taking into account the objectives set, we felt that the following points could be seen as project achievements that would warrant institutionalization of the PRA/FPR approach in the formal research programs of the Center.

Adoption of Improved Varieties

The above mentioned community-based trials and evaluations of improved varieties of wheat, haricot bean, maize and teff proved so successful that the test farmers selected the best varieties and multiplied seeds. This gave them a stake in continuing to conduct farmer participatory research. The farmer trials concluded with recommendations for the improved wheat variety HAR-1685, improved haricot bean variety Roba-1and improved teff varieties Dz-Cr-37 and Dz-01-196. This does not mean that the other improved varieties did not perform better than the local varieties, but rather that these are the varieties, which were adopted following the trial seasons. The adopted varieties of haricot bean, teff and wheat have yield advantages of 119%, 67% and 50% respectively over the local varieties.

Earning Farmers' Confidence

Initially, the farmers were skeptical and it was hard to persuade them to participate; however, through discussion and during the execution of the trials, they developed an interest in participatory research. As indicated above, the participatory trials they conducted enabled them to select the varieties best suited to their conditions and reject those they did not prefer. This helped to build their confidence in and decrease their skepticism toward the project.

Improving Farmers' Research Capacity

Once the farmers developed confidence, the goal was to strengthen their research capacity. It was well understood that farmers could do good research with little orientation and support. They were provided with seeds to try on their own, that made them feel free to do their own research. After the first season of the trials, farmers asked only for test materials. They did not wait for us to design and implement trials. They have tended to move to a more collaborative relationship based on changes in decision-making relating to design and implementation.

Table 26. Outcomes of crop variety trials in Surakoyo peasant association from 1996-1998

Trial year	Season	Crop	Varieties	Number of research farmers	Remarks
1996	*Mehir*	Haricot bean	Awash-1	3	Roba-1 adopted
			Roba-1		
			Local (Red Wolayita)		
		Teff	Dz-cr-37	3	Dz-cr-37 adopted
			Dz-01-354		
			Dz-01-44		
			Dz-01-196		
			Local (Bunne)		
		Wheat	HAR-1685	3	HAR-1685 adopted
			Et-13		
			Local		
		Barley	HB-120	2	Failed
			HB-40		
			Holker		
			Local		
1997	*Belg*	Maize	BH-140	4	Not Assessed
			BH-660		
			A-511		
			BH-540		
		Haricot bean	Awash-1	4	Roba-1 adopted
			Roba-1		
			Local		
	Mehir	Wheat	HAR-1595	4	Not Assessed
			HAR-1522		
			HAR-1709		
			HAR-1407		
		Teff	The same as above	3	Dz-cr-37 adopted
		Haricot bean	EMP-236	4	Not Assessed
			Roba-1		
			A-784		
			A-788		
			A-781		
			A-776		
			Brown Speckled		
			Local		
1998	*Belg*	Maize	BH-140	3	Not Assessed
			BH-660		
			A-511		
			SG-4141		
	Mehir	Teff		3	Not Assessed
		Haricot bean		3	Not Assessed

They have grasped the concepts of trial design, layout, execution, evaluation, adoption and dissemination. They have realized that they could address their problems through research if they were provided with the appropriate test materials, and as a result their experimentation skills have been enhanced.

Sensitization of Researchers, Extension Personnel and Development Practitioners

With this project it was also possible to impress upon researchers and extension personnel the farmers' capacity for doing research. The researchers, extension personnel and others who visited the PRIAM project area in Surakoyo during cross visits and field days expressed their appreciation of the farmers' research capacity.

Efficiency and Effectiveness in Research

Most of the varieties tested by the farmers are the ones released by the national agricultural research institute long ago. Even if these varieties were recommended for the project area, they could not all be accepted. Only one or two of the varieties were selected and adopted by the farmers. This indicates that the breeders would benefit from farmers' participation in breeding. Following this project, the field crop division of the center initiated a participatory breeding project on climbing beans. In this project, a large number of farmers from three zones--North Omo, Sidama and Gedeo--were invited to evaluate the climbing bean trial on station. This is the first time that farmers have been invited to the Awassa Research Center to evaluate trials at their outset, and not just after the fact. If institutionalized, this practice will decrease trial costs and enable farmers to identify the varieties they prefer.

Efficiency and Effectiveness in Extension

Because farmers have already learned that they have to test and select the best varieties of a crop before accepting an extension package of technologies, there will be an efficient and effective extension program in the area. Farmers have multiplied seeds for the varieties of teff, wheat and haricot bean they selected and have distributed them to neighbors and relatives. The other farmers who could not gain access to seeds of the variety they selected asked FPR practitioners to provide them with seeds which they would then return in the same amount after a season. Following their request, a program in which farmers will be provided with a certain amount of seed and give back twice that amount the next season has been formulated. The Farmer Research Committee will be responsible for this program, which will provide a good number of farmers with access to seeds in a short period of time.

LESSONS LEARNED

Early participation of farmers is crucial to an efficient and effective breeding program.

From the farmers' evaluation of the participatory trials it was learned that farmers have many criteria that breeders cannot meet unless farmers participate from the very beginning. The current strategy of involving farmers in the evaluation when only one or two materials are left to be judged should be changed in order to avoid the risk of excluding from the on-farm participatory evaluation process materials that may appear promising from the farmers' view point.

It was also learned that farmers are capable of conducting experiments and identifying the best solutions for their problems in a sustainable way. The criteria farmers use to evaluate the varieties are numerous and can benefit the development of new varieties, but only when farmers participate in all stages of evaluation.

In addition, cross-visits and field days helped to disseminate the varieties and to sensitize researchers and extensionists regarding the farmers' capacity to conduct research.

CHALLENGES AHEAD

Even though we have been successful in securing the farmers' participation in the trials, the number and types of trials is very limited. During the planning session of the PRA, a number of experiments were planned to address the priority problems. For a variety of reasons, however, it was found that they were too difficult to implement. The major reasons were the low amount of time FPR practitioners had to invest in the project, the limited knowledge of FPR and the lack of test materials. The practitioners working on the project are committed to numerous other activities that claim their time. It is thus recommended that a team of facilitators committed specifically to the project be established. Such a team should have a good understanding of the concept of PRA/FPR.

Multiplication and dissemination of the selected materials was the other challenge faced in the implementation of the project.

CONCLUSION

Our experience of PRIAM in the Surakoyo PA clearly demonstrated that research/extension programs depend for their success on close collaboration between farmers and other concerned bodies. For this collaboration to take place, research organizations need to establish quality relationships with farm communities based on trust and confidence. We realized that attention should be directed first toward empowering the farmers to recognize that they have an active contribution to make in planning and executing the generation of technology. This project has demonstrated that for successful development and dissemination of agricultural technologies, as much attention must be directed to farmers' empowerment in decision making as to the development and testing of the agricultural technologies.

Enhancing farmers' experimentation skills through empowerment is the best way to address their problems, and FPR is the best method of technology dissemination. It was clear from our observations that the trial farmers multiplied seeds for the varieties they selected and distributed them to neighboring farmers and relatives.

Gaining farmers' willingness and interest by empowering them is vital, and can be achieved if the practitioners are well informed about the concepts and realities of PRA/FPR.

Farmers need to be exposed to the experiences of other farmers conducting innovative research. This will increase their own innovativeness and help them develop the concept of intentional problem solving through research.

In general, in order for successful and sustainable participatory research to generate improved agroecosystems management technologies, the following points have to be considered:

- The PRIAM practitioners should have a good understanding of the concept of farmers' participation and empowerment, as well as of PRA/FPR.
- The effort should be geared toward identifying or creating innovative farmers and local multiple technological options.
- Farmers must be involved in technology evaluation from the beginning, not just after the researchers come up with one or two technologies which they then present to the farmers.
- Farmers must be taught about the experience of FPR in other areas; their understanding of experiment design, layout and evaluation has to be increased.
- After farmers select the technical components best suited to their conditions, popularization and demonstration programs should be conducted through cross visits, workshops and field days.
- Means of disseminating farmers' findings to other farmers and to scientists must be sought. Technology dissemination and farmer-to-farmer diffusion strategies must be encouraged.
- The PRIAM farmer research committee has to be well organized and oriented to research.
- In the selection of FRC committee members and pilot farmers, such factors as educational background, wealth, access to and control of resources, inclination to conduct research and interest in teaching others should be considered.
- Farmers should be encouraged to join forces with each other to analyze their problems, determine their priorities and develop improved technologies.
- Farmers must be trained in methods of designing experiments and comparing results to help them interpret experiment results and reach conclusions. They should be provided with information about technical options for various problems.

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DISCUSSION SESSION

Question 12.
Please elaborate on the performance of the farmer research committee.
Response
The performance of FRC is low. They lack commitments. They are not well motivated. Reason for low performance is not well investigated.

Question 13.
a) Many problems (11) were prioritized but you concentrated only on varieties. Why?
b) Under which management condition (recommended or farmers) that the improved variety performed better?
c) How are you planning to disseminate the improved farmers preferred variety?
Response
a) Other problems are under investigation and results not yet ready. Variety studies are simple to start with.
b) Under farmers management but with fertilizer and row planting.
c) We are thinking of farmer-to-farmer seed dissemination.

Question 14.
Is PRA/FPR the same thing in your view? You mentioned that you have limited knowledge of PRA/FRC. Can you expand further on this?
Response
PRA/FPR are different but PRA is a step in doing FPR so this is why they are mentioned together. By limited knowledge, I mean that researchers, although they may have read the FPR literature, we do not have much knowledge about how to carry out PR

Question 15.
Explain briefly how farmers were facilitated through the process of designing the trials
Response
Farmers in the study area already have good experience in extension. They already have good understanding of research. We let them suggest solutions and we also suggest possible solutions. Then we let the farmers select the possible solutions/options and test. Then we orient them how to layout the experiment. Then they go on by their own.

PARTICIPATORY RESEARCH AT NAZARETH, ETHIOPIA

Wubishet Adugna[1] and Abraham Tesfaye[2]

ABSTRACT

Resource-limited farmers in developing countries like Ethiopia operate within a risk-prone farming system, which presents complex, interrelated problems. To solve these problems, researchers usually develop technologies on station, without the active participation of the clients. This may result in technologies that do not fit the prevailing agro-ecological and socioeconomic conditions farmers face. Thus, an alternative research approach which constitutes farmers as active participants in the research process is imperative, in order to develop site-specific, adoptable technologies.

Two farming communities were selected for farmer participatory research (FPR). A multi-disciplinary team of researchers and extensionists was involved during the PRA activities. Several problems were identified and prioritized and potential solutions were proposed. Farmers conducted trials geared to test potential solutions and select and adopt the ones that worked best. Our experience of this project indicated that it is possible to integrate FPR with other approaches such as on-station research, thus enabling researchers and farmers to develop adoptable technologies within a short period and in a cost-effective way.

INTRODUCTION

Resource-limited farmers in developing countries like Ethiopia operate within a risk-prone farming system, which presents complex, interrelated problems. To solve these problems, researchers usually develop technologies on station, without the active participation of their clients and without taking into account the diverse agroecological and socioeconomic conditions they face. In contrast with industrial and green revolution agriculture, the physical, social and economic conditions facing these resource-poor farmers differ from the conditions that prevail at research stations (Chambers et al., 1989). This difference may result in technologies that are poorly suited to farmers' needs. It is now also widely accepted that an alternative approach, less dependent on external inputs and able to cope with ecological uncertainty and diversity, is required for poor people farming in low-potential areas (Farrington et al., 1994).

Thus, reasons that justify the active participation of farmers in research include:

1. Limited farmer adoption of technologies developed by research institutes, because some of them do not fit farmers' systems and needs. This is mainly due to the fact that research outputs are suited for general purposes, but farmers operate in fragile, heterogeneous environments, and their farming systems vary within few kilometers.

2. Farmers don't adopt packages as a whole. They prefer to adopt only the components that suit their purposes.

3. There are multiple sources of agricultural technologies, including ITK, which need to be tapped in order for technology generation to be successful.

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These conditions apply to farmers living in the mandate areas of Melkassa Research Center. Therefore, Farmer Participatory Research (FPR) was initiated at Melkassa Research Center and was conducted in selected farming communities.

This paper summarizes the results obtained from the FPR sub-project conducted in farmers' fields in 1997 and 1998. The main objective of this FPR was to help resource-limited farmers develop their capacity to identify, generate, test and apply new technologies and practices which suit their particular environments. Formal research and extension programs may be enhanced and improved through cooperation with farmers.

INSTITUTIONAL CONTEXT

This FPR sub-project was coordinated and supported by Melkassa Agricultural Research Center, ECABREN and CIAT-Africa. Melkassa Agricultural Research Center falls under the Ethiopian Agricultural Research Organization (formerly the Institute of Agricultural Research).

The collaborating institutions involved during the implementation of the project were the zonal agricultural development department and the World Vision Adama project.

A multi-disciplinary team of agricultural implements researchers, including plant pathologists, a lowland pulse breeder, a socioeconomist and an extensionist, drawn from Melkassa Research Center and the zonal MoA, were involved during the PRA activities.

RESEARCH SITE SELECTION

Two farming communities located about 18 km and 45 km away from the research center were selected for the FPR sub-project. Melkassa Research Center is located 15 km southeast of Nazareth town on (8°24'N 39°21'E) at 1550 m asl. The two sites were Boffa and Wolenchiti. These sites were selected based on farmers' research capabilities and innovativeness, soil diversification, area accessibility and representativeness of low-potential areas in the Rift valley.

AGROECOSYSTEM CHARACTERIZATION

Rainfall Pattern

There is no rainfall recording station in either sub-project site, but 17 years of meteorological data indicate that Melkassa Research Center receives an annual rainfall amount of 763 mm, about 70% of which falls during the main rainy season. This annual rainfall is unevenly distributed. At Melkassa Research Center and the whole region it represents, late onset of rain, intermittent dry spells and early cessation of rains are common (Fasil and Abera, 1997).

Soil Types

There are two major soil types at the project sites; they are classified by farmers as *Shakitie* and *Gombore*. *Shakitie* is characterized by good moisture retention capacity as it is covered by rock mulch. *Gombore* is relatively more fertile, but is subject to soil erosion due to its poor infiltration capacity.

Indigenous Technical Knowledge

Over a long period, farmers have developed a wide range of practical technical knowledge about their environment in response to the various challenges they have faced. The usefulness of ITK to resource-limited farmers is not limited to reducing or avoiding problems; it is also useful because its application is simple and it relies on cheap, locally available resources. Some aspects of farmers' ITK include:

1. *Land use system:* Farmers allocate land for crops and/or varieties based on soil type, moisture-holding capacity, slope, onset of rainfall and input availability.

2. *To cope with low and erratic rainfall patterns*: Farmers plant the appropriate maturity class of crops/ crop cultivars based on the onset of rain. They optimize utilization of the available rain by constructing close-furrow *Dirdaro* before planting in such a way as to increase good soil infiltration and surface harvest.

3. *To keep animals away from their crops:* Farmers plant a guard crop of sorghum, which produces toxins at an early vegetative phase, so that owners do not allow their herds into the field.

4. *To counter shortages of animal feed:* Farmers oversow maize fields and use the thinning as a supplement feed for their livestock at the period of high draught power requirement, especially in June and July.

5. *To discourage storage pests:* Farmers cool grain after threshing by storing it in their homes for a few days rather than putting it directly into granaries (traditional storage structures/*gotera*). They store other crops after mixing them with the fine-seeded crop teff to restrict free movement of pests and air.

6. *To ensure the survival of teff crops in the absence of rain:* Teff is a fine-seeded crop, and so the seed bed preparation is intense. Farmers pull acacia twigs across the ground to cover seeds with soil. If sowing is not followed immediately by rain, the surface soil loses its moisture and cracks due to evaporation, which creates an air pocket between the root of the emerging seedling and the available moisture in the soil. To avoid such conditions, farmers compact their teff-sown fields with small ruminants when sowing is not followed by rain.

Cropping System

The major crops grown at both sites are maize, teff and haricot bean. Other crops of minor importance include sorghum, wheat and barley. At Boffa sub-project site the proportion of land covered by sorghum is limited due to bird damage. Broadcast sowing and sole cropping are common practices at both sites. Intercropping is not a common practice in the area, but in the case of poor crop stands due to moisture stress and pest attack, farmers gap-fill their sorghum and maize fields with haricot bean. *Shilshalo* (cultivation) of maize and sorghum crops is a common practice in order to retain moisture, to loosen soil for hand weeding, to reduce plant population and to control weeds.

In both areas farmers maximize rainfall utilization by planting long- and medium-maturing sorghum and maize varieties at the early onset of rain in April and May respectively. The crops normally withstand the dry spells that occur during May and June with residual soil moisture, particularly in *shakitie* soils. In the absence of early onset of rain, farmers grow early-maturing maize, teff, haricot bean and wheat in the main rainy season. The major crop production constraints are moisture stress, declining soil fertility, pests, shortage of animal feed and shortage of suitable planting material.

Crop Calendar

Table 27. Crop calendar for sub-project sites

Maize

SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.
								Medium Maturing			
									Early maturing		

Teff

SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.

Haricot bean

SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.

Gender Roles

Farming activities such as land preparation, sowing, cultivation, weeding, harvesting and threshing are mostly the responsibility of adult men, with limited involvement of children and women. On the other hand, childcare, food preparation, collection of water and firewood, other household tasks and weeding are mainly undertaken by women. Children also play an important role in farming, especially looking for livestock and scaring birds.

PROBLEM DIAGNOSIS

In each sub-project sites practical rural appraisal (PRA) was conducted in order to identify, prioritize, and propose potential solutions for the various problems of farmers.

Table 28. Major problems identified and prioritized and potential solutions proposed

Problems identified	Problems prioritized	Suggested potential solutions
1. shortage of portable water	moisture stress	- improved moisture-conserving farm implements - short cycle varieties - moisture-harvesting tillage practices
2. shortage of cultivable land	unavailability of high-yield and different maturing classes of varieties	- testing of different varieties suited to local conditions
3. low soil fertility	poor soil fertility	- crop rotation - FYM and inorganic fertilizer - compost
4. weeds	weeds	- improved tillage practices - hand weeding - herbicide - use of inter-row weeder
5. health problems	livestock diseases	- use of traditional herbal medicines - veterinary services
6. high cost of fertilizer	problem of portable water	- development of water resources such as deep wells and ponds
7. shortage of animal feed	health problems	- animal clinic
8. pests and diseases	soil erosion	- contour plowing - tie ridging - terracing - afforestation
9. moisture stress	unavailability and high cost of fertilizer	- subsidy - use of FYM and compost - crop rotation
10. soil erosion	pest and diseases	- use of botanical plants which have pesticidal properties - storage hygiene - mixing of other crops with teff - use of pesticides
11. shortage of high-yield and pest-resistant varieties	shortage of cultivable land	- renting land - inter-cropping - sharing available land
12. unavailability and high cost of pesticides	unavailability and high cost of pesticides	- subsidies - use of botanicals - crop rotation
13. livestock disease	shortage of animal feed	- testing of different forage legume and growing of multi-purpose fodder trees

RESEARCH PROGRAM

In two research seasons, at both sites, several trials were conducted by farmers to test various potential solutions proposed during the PRA sessions. Generally, the trials were geared to test, select and adopt potential solutions proposed for the problems of declining soil fertility, shortage of cultivars, shortage of livestock feed, moisture stress and lack of improved agricultural implements which fit farmers' agroecological and socioeconomic circumstances.

In order to facilitate sharing of experiences among farmers, researchers and extensionists and to summarize the results obtained, five cross visits and three seminars were conducted. In addition, non-participant farmers employed by GOs and NGOs visited the trials. The farmers' research group forwarded explanations of the trials and findings to the visitors.

Each FPR site had a Farmers' Research Committee composed of a chairman and a secretary assigned by farmers. The FRC facilitated the implementation of the program in cooperation with farmers. A total of 36 farmers, of whom 20 were from Boffa and 16 from Wolenchiti sub-project sites, participated.

Field Day

Melkassa Research Center, Boset woreda MoA and World Vision's Adama Project jointly organized field days for farmers and managers of different institutions to show the efforts made and achievements gained by farmers participating in the research. During the closing remarks at the field day, the head of the Zonal Administrative Council and Zonal Agricultural Development Department promised to give full support and encouragement for farmers' participation in research and other development activities.

RESEARCH RESULTS

Farmers' Evaluation of Maize and Haricot Bean Genotypes

Maize

Six improved varieties obtained from Melkassa maize program and farmers' local cultivars were tested by farmers to screen promising varieties suitable for different maturity periods.

<u>A-511</u>

Farmers' evaluations indicated that the sowing date for A-511 should be between May 1 and May 20. A-511 exhibits traits lacking in the rest of the varieties tested, such as higher yield, resistance to pests and diseases and tolerance of dry-spells. On the other hand, the ear is not completely covered with shuck during maturity; thus infestation by weevils starts in the field.

<u>Katumani</u>

Farmers ranked *Katumani* second to A-511 for its yield and early maturity. Unlike A-511, it is only moderately resistant to pests, diseases and dry spells.

ACV-3 and ACV-6

Results from the evaluation indicated that farmers harvested green cobs within 70 days after planting. The two cultivars showed better resistance to diseases and pests than *katumani* did. Although they mature earlier than *katumani*, farmers indicated that these varieties are low yielders and possess weak stems.

Melkassa-1 and Melkassa-2

Melkassa-2 was not accepted by farmers due to its small cob size and the failure of some plants to bear ears. Farmers preferred Melkassa-1 to Melkassa-2.

Limat

Farmers indicated that their local cultivar *limat* matures later than the above-mentioned improved varieties, but it stores well and has good culinary quality.

Generally, the major selection criteria considered by farmers during the evaluation were yield and maturity period, although there were other criteria that had minor importance. Preference for a particular maize variety especially with respect to maturity time was a function of the onset of rainfall. According to farmers, they prefer medium-maturing and high-yield varieties in a season when the onset of rainfall is early, while if the onset of rainfall is delayed until the beginning of the main season, they prefer early-maturing varieties.

Haricot Bean

Four export (white pea beans) and twelve food type varieties (colored beans) including the local cultivars were tested by the farmers' research groups at both sites.

Export type

Mexican-142: Farmers ranked Mex-142 first because of its small round shape, relatively bright white color and higher marketability. Weed suppression due to its prostrate growth habit and earliness were the other factors that led them to rank this variety first.

Awash-1: This variety was farmers' second preference due to its good market demand, high yield and early maturity.

PAN-182 and PAN-173: These two varieties, which are in the pipeline for release, were not accepted by farmers because of their relatively large seed size, flat seed shape (not preferred in the market) and late maturity compared with the rest of the varieties included in the evaluation.

Limat (local variety): Farmers indicated the similarity that exists between *limat* and Mexican-142.

The result of this white pea bean evaluation indicated that the major selection criteria of farmers are seed color, shape, size, maturity class, yield and marketability. Generally, farmers prefer varieties with small seeds, round shape, bright white color, early maturity and high yield.

Table 29. Farmers' evaluation of export-type beans (white pea beans)

Criteria	**Varieties**				
	Mexican-142	**Awash-1**	**Pan-182**	**Pan-173**	***Limat* (local)**
Market preference	1	2	3	4	1
Relative earliness	1	1	3	4	1
Weed suppression	1	2	2	1	1
Disease resistance	3	1	2	1	4
Yield	2	1	-	-	3
Overall preference	1	2	4	5	3

Score 1 = Best 5 = Worst

Food type

Roba-1: During the evaluation farmers reported that Roba-1 is a promising food-type bean which suits their conditions in many respects. They ranked it first for its high yield, dry-spell tolerance, resistance to disease, short cooking time, good taste, and last but not least its potential to replace highland pulses, faba beans and field peas, commonly used for the preparation of the local stew *wot*. It is relatively free of the odor that other varieties develop after cooking. However, farmers mentioned that Roba-1 did not store well and started to be attacked by weevils within three months after harvest.

Red wolayta: Though this variety yielded less than all but the local variety, farmers ranked it second mainly for its deep red color. According to the farmers, red color is preferred both for home consumption and local markets.

A-197: Farmers ranked this third choice because of its seed color and size, its earliness and its yield. Farmers related the determinate growth habit of this line with early maturing. The explanation they gave was that once it began pod setting it finished more quickly than other varieties, which made it mature early.

Gx-1175-3: Farmers indicated that this variety was less marketable because of its brown strips of color.

Key Boleke (local): According to farmers, they have been growing this variety for several years, which has resulted in low yield and high susceptibility to disease. Therefore, they decided not to grow this variety.

Despite the fact that food-type beans are less important than white pea beans, in terms of both area coverage and the role they play, farmers prefer the food-type group. These preferences are determined by criteria such as seed color, size, shape, maturity period, ground cover and yield. Generally, farmers' preference was for red or cream color, early maturity and high yield.

Table 30. Farmers' evaluation of food-types beans

Criteria	Varieties				
	Gx-1175-3	Roba-1	A-197	Red wolayta	Local var.
Market preference	5	3	4	1	2
Relative earliness	2	1	1	2	2
Yield	1	1	2	3	4
Weed suppression	1	2	3	2	3
Disease resistance	1	1	2	3	3
Overall preference	4	1	3	2	4

Score 1= Best 5 = Worst

Soil Fertility Management

Low yield due to low soil fertility was one of the production constraints farmers identified. Fertilizer application was one of the solutions suggested, but due to the high price and limited supply of fertilizer, few farmers can use this input sustainably.

Thus farmers agreed to test farmyard manure (FYM) and crop rotation. However, only the few farmers whose farms were near their home compounds conducted the experiment due to lack of means of transporting the manure to their farms. Although land-use and land-holding systems affect crop rotation, few farmers practice crop rotation intentionally. In the context of these limiting factors, the farmers' research group started crop rotation and intercropping haricot bean with cereal crops.

Soil Moisture Management

Farmers tested various agricultural implements developed by the Melkassa Research Center against traditional implements for their efficiency in terms of both quality and quantity of work accomplished within a certain period. The quality of work accomplished was evaluated in terms of good seed bed preparation, increased weed control, minimization of soil moisture loss, increased moisture harvest and so on.

Pest Management

Based on other farmers' experiences, the PR team explained the use of *Neem* tree to control pests. As a result, the farmers' research group decided to plant this botanical tree, so about 200 seedlings obtained from MoA were distributed to farmers to plant around their homesteads.

Livestock Feed

In order to address shortages of animal feed during peak periods of draught power requirement (in May-July), farmers conducted experiments to select palatable, fast-growing, suitable and high-yielding species. They tested seven types of forage grass (buffer, rhodus and phalaris grass) and forage legumes (verano stylo, cowpea, vetch and silverleaf desmodium). However, the experimental plots were damaged by flood. In addition, multi-purpose fodder trees like *Leucaena leucocephala* were distributed (20-70 seedlings per head). Farmers planted the seedlings around their homesteads, but some of the seedlings did not establish since goats and cattle browsed them.

ADOPTION OF NEW TECHNOLOGIES

Farmers at both sites conducted different experiments to meet their needs. They tested, evaluated and disseminated promising results with regard to varieties, farm implements, forage and botanical trees and management practices. As a result, they have increased their productivity and economic returns. Promising varieties such as food-type bean *Roba-1* were multiplied on large plots for further dissemination: ten farmers multiplied *Roba-1* on four hectares of land. In addition, maize varieties such as A-511, *katumani* and ACV-3 were adopted on large plots. This encourages farmer-to-farmer informal seed diffusion, thus reducing the cost of seed production. The farmers' research group at the Wolenchiti site is spreading technologies and management practices to adjacent districts. They have trained other farmers on how to use implements and employ such related management practices as:

1. Moisture conservation, mixing broadcast fertilizer, leveling of teff seedbeds and row planting of beans and maize using winged plows.

2. Better seedbed preparation and weed control using mould board plow.

3. Row planting of different crops using row planters to optimize plant population, to avoid moisture and nutrient competition and to enable farmers to practice row planting of beans within the rows of maize.

USEFULNESS OF INDIGENOUS TECHNICAL KNOWLEDGE

Farmers have their own indigenous technical knowledge, which they have developed to cope with various problems they face. This knowledge is constantly evolving. Incorporating it into formal research would enable researchers and farmers to develop adoptable technologies within a short period and in a cost-effective manner.

Training

The PRIAM project sponsored one of the participatory research team members, an agricultural extensionist from the Ministry of Agriculture, for further education at Alemaya University of Agriculture to strengthen institutional capacity for participatory research methodologies. The program is designed for agricultural extension staffs who are already working with farmers. The duration of the program is two and half years, involving four semesters of intensive instruction at Alemaya and eight months of off-campus Supervised Experience Project (SEP). The student agreed to conduct his SEP on farmer participatory research.

TECHNICAL RECOMMENDATIONS

1. Farmers should be encouraged to use mould board plows for first plowing for better seedbed preparation and weed control and to reduce frequency of tillage.

2. Crop rotation systems must be encouraged in order to maintain soil fertility. Farms located near home compounds should be fertilized with farmyard manure and compost. If dry composting material is scarce, a boma hedge like *Kinchib* (*Euphorbia tirucalli*) can be used.

3. Winged plows should be used by farmers to mix nitrogenous fertilizer with soil in order to minimize loss due to volatilization and row planting of beans.

4. Haricot bean should be grown within rows of June-planted maize to increase harvests and minimize risk.

5. Farmers must be encouraged to raise and plant seedlings of multi-purpose fodder trees, botanical trees such as neem and other useful trees.

6. Row-planters should be used for maize, sorghum and intercropping of cereals with legumes.

7. Farmers to reduce surface-run-off and harvest moisture can use the modified tie ridger.

8. Farmers should be encouraged to grow the food-type bean variety *Roba*-1 to substitute highland pulses which are not grown in the sub-project site for *shiro* and *kik* preparation.

9. Farmers who practiced row planting should be encouraged to use weeders for better weed control.

LESSONS LEARNED

The results obtained from this project indicated farmers' potential to test, evaluate, select, modify, adopt and disseminate technologies. In addition, farmers possess indigenous technical knowledge which has been developing, accumulating and transferring over many generations in response to the challenges farmers face in their complex, ever-changing environments. Thus, potential areas of cooperation with client farmers should be exploited by formal research and extension programs in such a way as to direct outputs toward clients' needs and priorities.

Conducting research with farmers made a useful contribution to developing site-specific, adoptable technologies and to improving unadopted technologies. This achievement was made possible by the active participation of the farmers' research group. The farmers' research committee contributed a lot by facilitating and documenting the exchange of views and experiences among farmers during cross visits and evaluation of trials.

However, this FPR also faced several constraints. Some planned trials were not conducted due to limitation of time and inputs and unfavorable weather conditions. In addition, institutional support from development organizations was limited because of a lack of awareness of participatory methodologies and the concentration of efforts on the regional priority extension package program.

There is a possibility of incorporating the participatory research approach in the development of technologies at various stages that require technical, biological and statistical analysis by creating good learning and continuous interaction between farmers and researchers. This could be achieved by taking account of farmers' priorities and selection criteria and involving them in both on-station and on-farm research.

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DISCUSSION SESSION

Comment 1:
In addition to what was mentioned, I was impressed by the fact that during farmer visits and the research center, farmers have given seminars to the researchers.

Question 16.
Did farmers have an interest in testing tied ridge technology and how did they regard?
Response
Tied ridging was a recommendation for participating farmers.

Question 17.
As an extensionist, do you think that adoption of FPR technologies by farmers does not need any other accompaniment measure to be most effective? If any, what?
Response
Yes, in case of poor adoption of technologies by farmers, additional intervention by extension would be needed for effective diffusion.

Question 18.
How was farmer research capabilities and innovativeness determined?
Response
Based on their own evaluation and opinions.

Question 19.
What were some of the problems you had with establishing FRC?
Response
We did not face any problem with establishing FRC.

PARTICIPATORY RESEARCH FOR IMPROVED AGROECOSYSTEM MANAGEMENT: A COMMUNITY-BASED APPROACH IN EASTERN ETHIOPIA, ALEMAYA WEREDA

Frew Mekbib[1]

ABSTRACT

The PRIAM (Participatory Research for Improved Agroecosystem Improvement) project in eastern Ethiopia in Alemaya Wereda (District) at Ararso Peasant Association was realized with the assistance of CIAT (Centro Internacionale Agricultura Tropicale) in collaboration with the Rockefeller Foundation. This project, which was started in the 1997 cropping season, aimed to overcome the shortcomings of conventional research with regard to its extractive, piecemeal nature, and to tap ITK, empower farmers and ensure the participation of different actors in technology development and dissemination.

In the last two years, attempts have been made to gather secondary information related to the farming systems of the area and the character of its agroecosystem. Researchers have worked with farmers to identify and prioritize their problems, identify and design potential solutions, and implement and evaluate those solutions.

INSTITUTIONAL CONTEXT

The PRIAM project in eastern Ethiopia involved several organizations that provided various types of assistance:

- CIAT (International Center for Tropical Agriculture) initiated and coordinated the project's work
- Rockefeller Foundation provided financial support for the project
- AUA (Alemaya University of Agriculture) acted as the project partner for CIAT and was responsible for eastern Ethiopia
- Line Ministries, in particular the Ministry of Agriculture, linked AUA with farmers

The Participatory research team is composed of experts from different disciplines, including:

- Crop Sciences (Breeding, Pathology, Entomology, Soil Sciences)
- Social Sciences (Economics, Extension)
- Animal sciences ((Health, Nutrition, Breeding)
- Agricultural Engineering (Agricultural Processing, Agricultural Machinery)

The team also included a Subject Matter Specialist from the MoA.

RESEARCH SITE SELECTION

As PRIAM's principles differ from those of other research approaches, care was taken in selection of the site. The selected site was Ararso Peasant Association in Alemaya Wereda (District). The criteria used for the selection of the sites were:

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1. proximity to the University, as PRIAM entails close and frequent follow-up
2. minimal previous intervention by NGOs, and thus little risk of an established dependency syndrome
3. high population density, to enhance the need for and potential impact of the participatory community development approach
4. regional representativeness of the selected sites in farming and cropping systems, livestock culture, ethnic dimensions, etc.

AGROECOSYSTEM CHARACTERIZATION

The agroecosystem of Ararso PA is characterized by four subsystems: socioeconomic, soil, crop and livestock.

Socioeconomic Sub-system

According to the peasant association's recent census, the Ararso PA consists of 615 households with a total population of 2973 people, of whom 1,527 and 1,446 are male and female respectively. The main ethnic group is Oromo and the dominant language in the area is Oromipha. Attempts have been made to characterize labor availability (Figure 2) and food availability (Figure 3). With regard to gender roles, men mainly do land preparation and planting, whereas weeding, intercultivation and transportation are normally the responsibility of men, women and children. Marketing of large quantities of agricultural produce is done by men, whereas marketing of small quantities is done by women.

Figure 2. Food availability across months of a year in Ararso PA, Alemaya district

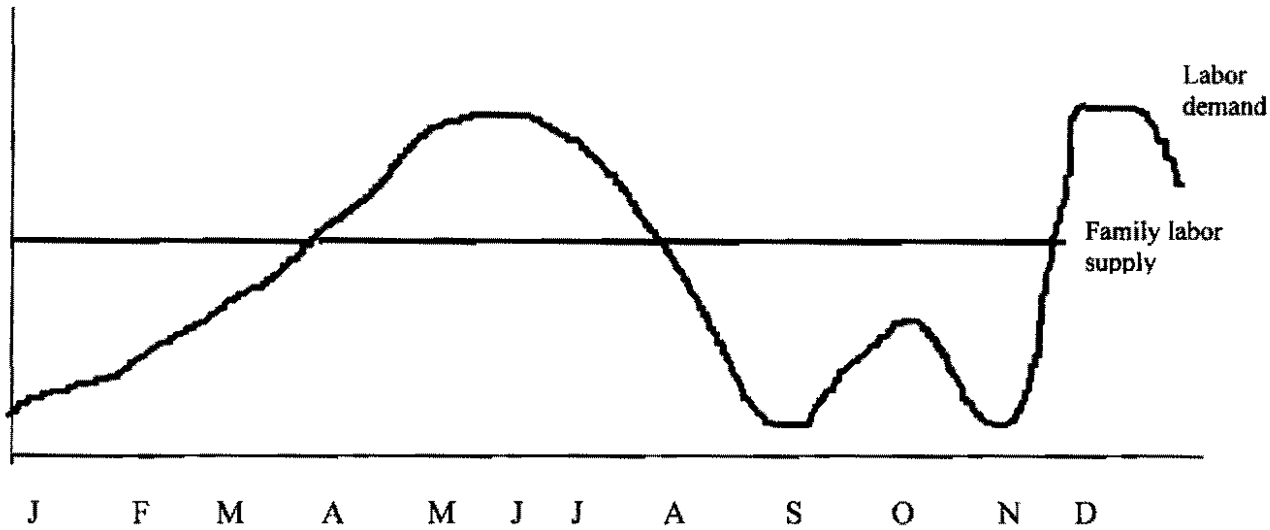

Figure 3. Labor demand and availability

Soil Sub-system

Diverse types of soils are found at the selected sites. According to the farmers' indigenous soil classification, there are three soil types: Red Sandy Loam (Entisols), Black Sandy Loam (Inceptisols), Black/Guracha (Vertisols). The criteria used in this indigenous soil classification are color, water absorption/retention, particle size and topography. The primary criterion used by the farmers for indigenous soil classification is color. Farmers exercise different management measures for maintaining and upgrading the fertility of the soil. Soil type varies across topography as depicted in Figure 4.

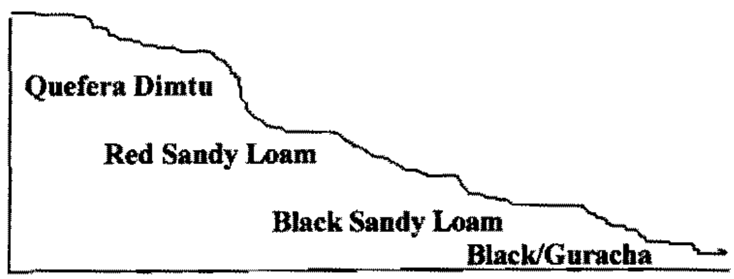

Figure 4. Soil types along slope

Crop Sub-system

The Ararso PA's area is typical of intensively cropped areas in the eastern Ethiopian highlands. Diverse type of crops and operation calendars is followed, as Table 31 indicates. The site is located at 2000 m asl, has a bimodal rainfall pattern and receives an annual rainfall of 700-850 mm.

Table 31.Cropping calendar of major crops grown in Ararso PA (as indicated by farmers)

Month / Crop	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Sorghum	tr tr tr		p p p p	p p pl, fd	w w w w	pr, th, fu,	pr, th, fu,I	pr pr pr pr				h h h h
Maize	tr tr tr			p p p p	pl, fd, pl	w w w w	th, fu, w, I	th, fu, w, I		h h h h		
Wheat/Barley	tr tr tr					p p p p	pl, fu, fd	w w w w		h h h h		
Haricot bean							I I I I			h h tr tr		
Sweet potato	p p p p	p p p p	p p p p	p p p p	p p p p p	p p p p p …………	p p p p p h h h h h	pl pl pl	w w w w	w w w w	w w w w	h h h h
Other vegetables	p p p p	p p p p	n n n n	n n n n	tp tp tp	tp tp tp tp	w w w w	w w w w	h h h h	h h h h		

Key

p- land preparation **pl**- planting/sowing **fd**- fertilizer application, DAP **w**- weeding/cultivation **pr**- protection **th**- thinning **fu**- fertilizer application, urea **I**- intercropping **n**- nursery development **tp**- transplanting **h**- harvesting **tr**- threshing

Livestock Sub-system

Various parameters were used to characterize the livestock production system. Farmers agreed that the number of livestock per household was decreasing as compared with previous years. When crop failure occurs, animals are sold in order to purchase food grains and clothing for the family, and to make payments on loans taken out for the purchase of inputs such as fertilizers and pesticides. Generally, farmers view livestock as a cash resource that is kept in reserve to augment family income in case of unexpected problems such as illness or crop failure. However, once sold it is difficult to replace the animals because, in the absence of surplus produce, the family's capital remains very low. Consequently, a large proportion of the households in the peasant association own 0-2 animals--mainly cows, sheep, goats or donkeys. Only a small proportion of farmers owns oxen. As a result, most farmers experience a serious shortage of draft power, which in turn leads to poor, and untimely land preparation and subsequent lower yields and crop residue.

Ararso PA farmers keep a number of domestic livestock species including cattle, sheep, goats, donkeys, and poultry. The breed types are:

--cattle: indigenous zebu type
--sheep: blackhead Ogaden and highland types
--goats: Ogaden and highland types
--chicken: mixed indigenous types

Milking cows are abundant among cattle. Goats and sheep of different age groups are kept. Donkeys are mostly males (stallions) and laying chickens are found in great numbers.

Livestock production plays an essential part in the livelihood of farmers in Ararso PA. Cows produce milk and give birth to replacement animals (oxen and heifers). Goats and sheep are the most important cash-raising animals and occasionally provide meat to the family. To some extent, land preparation is done by ox-drawn plows. Donkeys are used for transportation of goods. Sales of animals and of animal products such as milk, hides and skins, and eggs contribute significantly to farmers' income. Manure from animals is used to make compost.

Since the land holding per household is very small, there are no individually owned and -managed grazing areas. The only grazing areas available in the peasant association are the small swampy areas located around lake shores. These are used for communal grazing. Livestock in this PA, therefore, depends on crop residues (stalks and dry leaves of maize and sorghum) which are collected, stored and fed to cattle during dry seasons. During the rainy season, animals depend mainly on farm wastes and thinned crop seedlings. During the dry season, animals are tethered around homesteads in the morning and the late afternoon and are fed on crop residues. In the day time, they are herded by either school-aged children or women to graze around swampy areas and at farmlands. During the rainy season, when farm wastes and thinned crop seedlings are abundant, animals are tethered near farmlands and fed almost the whole day. Generally, it is possible to say that the feeding system practiced here is a cut and carry system in which stored crop residues, farm wastes, and thinned crop seedlings are fed to tethered animals.

Irrespective of the kind of livestock, animals are housed in the same house with the family. Responsibilities for looking after the animals are apportioned to various family members according to the age and gender of the family member and the type of animal being cared for. Herding animals while they graze is primarily the responsibility of children and women. Oxen and donkeys are cared for by men while cows are cared for by women.

Diseases pose a problem to livestock in the area. Access to veterinary services is limited and medicines are often too costly. Hence, farmers rely primarily on traditional medicine, using plant leaves, animal tallow, etc., to treat the various livestock diseases they recognize.

PROBLEM IDENTIFICATION, PRIORITIZATION AND SOLUTIONS

Basic tools in Participatory Rural Appraisal (PRA) were employed in the characterization of each subsystem. Following the characterization exercise, problems were identified and prioritized and solutions were proposed, with the strong leadership and participation of the farmers. The outcomes of these discussions appear in Table 32 (socioeconomic subsystem), Table 33 (soil subsystem), Table 34 (crop subsystem), and Table 35 (livestock subsystem).

RESEARCH PROGRAMS AND RESULTS

Crop Sub-system

Crop variety assessment trials

Sorghum (*Sorghum bicolor* L.) variety trial

Background: Sorghum is the most important crop for the farmers in eastern Ethiopia, who have been using the crop for thousands of years. The AUA has been conducting sorghum research for the last thirty years. The impact of this research has been very limited. Farmers are very reluctant to use the "improved" sorghum varieties for many reasons, including plant height, caloric value of the stalk, stalk strength, leaf biomass and palatability for livestock. To date, however, no quantified information is available on farmers' sorghum selection criteria and farmers' developed varieties. To fill this knowledge gap, a trial was conducted to compare varieties developed by researchers with those developed by farmers.

This trial was conducted during the 1997 cropping season in three farmers' fields with plots sized 5 m x 5 m.

Table 32. Socioeconomic subsystem: priority problems and potential solutions

No	Problems	Potential Solutions	Research Method	Implementation	Partners
1	Marketing - Low output price - High input price - Unfair taxation	- Establish marketing cooperatives; - Seek government intervention	- Farmers' seminars on advantages of coops - Collaboration with the concerned government bodies	As of June 1997	- AUA - MoA - NGOs
2	Water - Potable water scarcity - Maintenance problem of damaged water pumps	- Develop water resources such as springs, deep wells, streams, etc. - Maintain water pumps	- Farmers' seminars on effort mobilization and development - Collaboration with governmental and non-governmental organizations	As of Sept. 1997	- MOWRD - NGOs
3	Fuel wood - Inadequate energy sources	- Introduce minor agroforestry practices - Introduce energy efficient stoves or ovens	- On-farm demon strations and farmers' seminars	As of July 1997	- AUA - MoA - NGOs
4	Credit - Unfavorable lending terms or collateral unaffordable	- Organize rural saving and credit groups - Collaborate with lending agencies	- Farmers' seminars - Collaboration	As of Sept. 1997	- MoF - NGOs - ASHDI
5	Road - Poor road system	- Mobilize farmers for continuous maintenance of roads - Seek external support from GOs and NGOS	- Farmers' seminars - Collaboration	As of June 1997	- MOCC - NGOs

Table 33. Soil subsystem: priority problems and potential solutions

No.	Problems	Potential Solutions	Research Method	Implementation	Partners
1	Soil-borne pests	- Crop residue management - Crop rotation - Use of botanicals	- Demonstration - On-farm trials - Farmers' seminars	1996/97 and 1997/98	MoA
2	Shortage of draft power	- Oxen credit scheme - One-ox (-cow or -donkey) plow - Improved hand tools - Tractor hiring scheme	- Demonstration - On-farm trials - Farmers' visits	1996/97 and 1997/98	MoA, ILCA IAR, AUA, NGOs
3	Shortage of chemical fertilizer	- Use of manure and compost	- Demonstration - On-farm trials - Farmers' visits	1996/97 -1997/98	MoA, AUA, NGOs
4	Soil erosion	- Terracing with bushes, trees and grasses on hedges - Ridges - Agroforestry - Contour plowing	- Demonstration - On-farm trials - Farmers' seminars	1996/97-99	AUA, NGOs, MoA
5	Need for timely land preparation	Refer to number 2	Refer to number 2	Refer to number 2	Refer to number 2

Table 34. Crop subsystem: priority problems and potential solutions

No.	Problems	Potential Solutions	Research Method	Implementation	Partners
1	Low soil fertility	- Improved compost production - Alley cropping - Use of green manure	- On-farm demonstration - On-farm demonstration - On-farm trials	- Starting from May 1997 - March 1998	- ILRI for seed - IITA
2	Sorghum stalk borer	- Residue management - Use of botanicals	- Demonstration - On-farm trials	- December 1997 - April 1997	- AUA
3	Lack of potato seed tuber	- Supply of enough seed tuber - Promotion of the use of TSP	- Local seed diffusion channels - Initiation of secondary seed multiplication scheme	November 1997	- Provision of support from NGOs
4	Late blight of potato	- Supply of relatively resistant seed material	- Local seed diffusion channels - Initiation of secondary seed multiplication scheme	November 1997	- Provision of support from NGOs
5	Draught power shortage	- Credit for oxen - One-ox (-cow, donkey) plow - Improved hand tools	- Demonstration	March 1998	- NGO credit - Fodder from ILRI
6	High cost of vegetable seeds	- Supply of enough seed tuber - Promotion of the use of TPS	- Utilization of the local seed diffusion and channels - Initiation of secondary seed multiplication scheme	May 1997	- NGO credit

Table 35. Livestock sub-system: priority problems and potential solutions

No.	Problems	Potential Solutions	Research Method	Implementation	Partners
1	Disease	- Access to affordable medicines - Improved management of grazing lands (swampy areas)	- On-farm survey of major internal and external parasites in the PA - On-farm assessment of major livestock diseases	Starting June 1998	AUA, MoA, Dire-Dawa vet. lab.
2	Housing practices	- Construction of simple separate house for livestock	- On-station demonstration - Farmers' seminar and visit	Starting January 1998	AUA, MoA, IAR NGOs participation in construction of model houses
3	Feed shortage	- Growth of multi-purpose leguminous fodder trees and fodder shrubs around farmlands and chat plantation - Growth of improved forage grasses or legumes along traditional terraces in the crop land, chat plantation and farm roadsides	- Establishment of forage nursery (on farm) - Demonstration - Farmers' seminar and visit	Starting October 1997	AUA, MoA Participation of NGOs ILRI, IFAD, IAR

Table 36. Characteristics of sorghum varieties used

Variety name	Description
Muyra	Late maturing, long and strong stalk, large seed, red color, single stem, *farmers' variety*
Red Fendisha	Late maturing, long and strong stalk, medium seed, red color, single stem, compact head, *farmers' variety*
Fendisha lax	Late maturing, long and strong stalk, medium seed, Red color, single stem, lax head, *farmers' variety*
ETS 3235	Medium maturing, short with medium stalk strength, tillering type, white color, large seed, *researchers' variety*
ETS 2752	Late maturing, long and strong stalk, large seed, white color, single stem, *researchers' variety*
Awash 1050	Early maturing, short with medium stalk strength, tillering type, red color, medium size, *researchers' variety*
AL-70	Late maturing, long and strong stalk, large seed, white color, single stem, *researchers' variety*
Chirro	Late maturing, long and strong stalk, large seed, red color, single stem, *researchers' variety*
Wegere Adi	Late maturing, long and strong stalk, large seed, white color, single stem, *farmers' variety*
Wegere Dima	Late maturing, long and strong stalk, large seed, red color, single stem, *farmers' variety*

Table 37. Pairwise ranking matrix of researcher- and farmer-developed sorghum varieties (ranking matrix made by 40 male farmers and 12 female farmers)

Varieties	1	2	3	4	5	6	7	8	9	10	Score	Rank
ETS-2752 (1)	x	1	1	1	1	6	7	8	9	10	4	6
ETS-3235 (2)		x	2	2	2	6	7	8	9	10	3	7
Awash1050 (3)			x	3	5	6	7	8	9	10	1	9
Chirro (4)				x	5	6	7	8	9	10	0	10
Alemaya-70 (5)					x	6	7	8	9	10	2	8
Red Muyra (6)						x	7	8	9	10	5	5
White Wegere (7)							x	7/8	9	10	6	3
Red Wegere (8)								x	9	10	6/7	3
Red Fendisha (9)									x	9	9	1
Fendisha Lax (10)										x	8	2

Table 38. Farmers' selection criteria for sorghum varieties

Selection criteria	%*	Selection criteria	%*
Field emergence (stand establishment)	60	Panicle (head) size	56
Seedling vigor	40	Panicle compactness	36
Plant color	30	Threshability	46
Plant height	52	Shattering	36
Stalk (stem) strength	62	Bird resistance	48
Stalk juiciness	46	Seed color	40
Stalk feed value	42	Seed size	44
Stalk caloric value	58	Seed plumpness	48
Stalk resistance to termites	26	Yield	74
Stalk marketability	56	Marketability	62
Disease resistance	30	Resistance to weevil	54
Stalk borer resistance	52	Resistance to storage fungi	40
Lodging resistance	46	Storability	52
Senescence	50	Flour-to-water ratio	44
Leaf palatability	46	Millability	42
Tillers	30	Injera quality	52
Flower synchrony for tillers	28	Nifro quality	38
Peduncle exertion	28		

* Percent of farmers mentioning the selection criteria (n=54)

Assessment: The 1998 cropping season failed because of insufficient moisture content for proper seedling establishment. As indicated in Table 36, researcher-developed varieties perform poorly and do not meet farmers' selection criteria. As a result, the farmers do not adopt most of the released varieties. For comparison of farmers' and researchers' varieties both pairwise (Table 37) and direct matrix ranking was made. The ITK on sorghum seed systems was characterized. Farmers select sorghum varietal mixtures as a means of risk minimization. The different varietal component lines have been included for crop protection, agronomic and gastronomical reasons. In short, it was found that farmers' varieties could be used in more ways--as food, feed, fuel wood and construction materials--than can researchers' varieties. Farmer's varieties also produce better yields than do researchers' varieties. This study identifies the reasons for farmers' low acceptance rates of researchers' varieties, and indicates that capitalizing on farmer-developed varieties should be the next step. Future sorghum breeding programs for the eastern Ethiopia highlands should attempt to include farmers' selection criteria.

Bean variety evaluation for the *belg* and *meher*-cropping season

Background: Farmers in eastern Ethiopia usually produce beans in intercopped systems with sorghum and maize. Beans are a major crop component in farming systems and represent one of the strategies pursued by farmers to overcome farming systems' physical, biological and socioeconomic constraints. Beans are intercropped with sorghum/maize, alley cropped with chat, and crop rotated with wheat/barley. The major type of bean being produced by the farmers is Red Wolaita. This variety has been in production for many years, but yield is declining from year to year, primarily due to this variety's susceptibility to leaf rust (which makes it difficult to grow in *meher* season). The need to replace this variety is urgent. One of the crucial roles of beans in the area is as a strategic crop to fill the "hunger period" from June to September by planting it in the *belg*. To date no actual assessment has been made with the farmers on the potential of different varieties for the *belg*-cropping season.

Three varieties were planted in three farmers' fields, in plots sized 10 m x 10 m.

Table 39. Descriptions of varieties tested

Variety	Bean type	Seed color	Seed size	Maturation period	Remarks
Red Wolaita	food bean	red	small	100-120 days	local control
Roba 1	food bean	cream	small	100-120 days	newly released variety, NRC
Ayenew	food bean	speckled (pinto)	large	100-120 days	newly released variety, ALARC

Assessment: The bean varieties planted were assessed by 50 farmers. The harvested seeds were provided to the farmers, who then evaluated them. Over 95% of the farmers preferred Ayenew. Most farmers asked for the Ayenew seed and 50 farmers were provided with it. 'Nifro' was prepared from Ayenew and the farmers rated it the highest. In addition, for the *meher*-cropping season *Gofta* was given to 50 farmers.

Wheat variety trial

Background: Wheat is one of the major crops that contribute to food security in the region. It is planted both in both the *belg* and *meher* cropping seasons. However, farmers do not have access to suitable wheat varieties. It is imperative, therefore, to have farmers select the varieties they need.

Seven bread wheat varieties were planted at two farmers' sites in plots sized 5 m x 5 m.

Assessment: Twenty-two farmers participated in the evaluation of these seven bread wheat varieties. Farmers used spike length, number of seeds per spike, presence or absence of awn, seed color, etc., for evaluation and comparison. Varieties Har-1522, -1407, -710 and -1594 were ranked from one to four respectively (Table 40). To fine tune selection criteria and reassess these varieties' yield performance, four of the seven varieties are planted again this year.

Table 40. Pair-wise ranking matrix of improved bread wheat varieties

Varieties	1	2	3	4	5	6	7	Score	Rank
Har-1594 (1)	x	2	3	4	1	1	1	3	4
Har-1522 (2)		x	2	2	2	2	2	6	1
Har-710 (3)			x	4	3	3	3	4	3
Har-1407 (4)				x	4	4	4	5	2
Pavon-76 (5)					x	5	7	1	5
Har-1685 (6)						x	6	1	5
Har-604 (7)							x	1	5

Maize variety trials

Background: In the current maize extension package program farmers are using hybrid varieties. As a result, farmers must buy maize seeds every year. From the farmers' point of view, this has compromised the sustainability of maize production. Non-hybrid varieties with yields comparable to the hybrid varieties must be sought. Therefore this trial used open pollinated varieties.

Three composite varieties were evaluated: Alemaya composite, Raare 1 and EAH-75.

Assessment: Farmers compared the three varieties by seed size, color, ear length and number of kernels per ear. They preferred Raare 1 to the other two varieties. Following the evaluation, 36 farmers were given Raare-1 seeds and have planted the variety on their farms.

Table 41. Pairwise ranking matrix of the test varieties (17 farmers)

Varieties	EAH-75	Alemaya Comp	Raare-1	Score	Rank
EAH-75	x	Alemaya Comp	Raare-1	0	3
Alemaya Composite		x	Raare-1	1	2
Raare			x	2	1

Farmers have disseminated both bean and maize seeds to at least two neighboring farmers through informal channels, a practice, which facilitates quick and cheap seed dissemination.

Crop protection trials

Sorghum stalk borer management trial

Background: Sorghum is the major crop. The key pest that threatens sorghum production and causes major yield loss is the stalk borer. The yield loss due to this pest can reach up to 100%. Though there are many methods for managing this pest, farmers prefer to use botanical treatments.

Treatments were prepared from Lantana (*Lantana camara*), Datura (*Datura stramonium*), Pepper tree (*Schnius molle*), Carbofuran and a control, and were applied to Red Fendisha at 3 test sites.

Assessment: Procedures for preparation and spraying of botanicals were demonstrated to 56 farmers and subsequently applied to the farmers' sites. The low incidence of stalk borer in 1997 resulted in very insignificant yield differences among the treatments. Much of the impact has been educational: the farmers who participated were very pleased to learn that plants growing around their farms and homesteads can potentially be used for the control of stalk borer. This year's trial failed because of lack of rainfall.

Livestock Sub-system

Livestock is a major component of the farming system. Eastern Ethiopia is one of the major livestock rearing areas of the country. It exports livestock to the Middle East and the region bordering Ethiopia. As rated by farmers, diseases, housing practices and feed shortages are the major problems facing livestock production in the region.

Livestock health

Veterinary services

Background: Livestock health is a pressing problem for many farmers, with regard to both large and small ruminants. To administer any sort of medication it is important to know the major health problems these animals can develop.

Close to 20 volunteer farmers who own more than three head of livestock each participated in an exercise to survey and monitor livestock health

Assessment: Based on the preliminary assessment, prevalent health problems include internal parasites (such as fasicola), external parasites and skin diseases. After having more samples taken from the livestock medication will be provided.

Quality livestock feed shortages

Alternative feed services

Background: In Ararso PA, there is no sufficient area for grazing except the swampy areas around Lakes Alemaya and Kurro. Hence the feed for animals derives entirely from dried crop residues during the dry season, and farm wastes (weeds and seedlings collected through thinning of crops) during the rainy season. Furthermore, farmers mentioned that crop residues are limited in quantity due to the low crop production. Crop residues--matured maize and sorghum leaves and stalks—are poor-quality feeds. As a result of these problems, livestock productivity is very low. Therefore, an additional animal feed is necessary. To meet this need for a feed supplement, an experiment involving forage crops is being carried out.

The types of forage pasture crops are listed in Table 42. These have been planted at three farmers' sites in five rows.

Table 42. Types of multipurpose forage and pasture crops

Species
Trifolium quartiniaum
Trifolium tembense
Vicia atropurpurea
Vicia dayscarpa
Vicia villosa
Phalaris aquatica
Desmodium discolor
Panicum coloratum
Avena sativa
Chloris gayana

Assessment: Farmers will evaluate the adaptation and performance of the forage crops at different stages. The high-performing species will be promoted for feed, green manure, compost production and soil and water conservation.

Forestry

Reforestation

Background: The Ararso PA is substantially deforested. *Eucalyptus spp* can be found only in patches around home yards. Hence fuel wood and construction materials are very limited. Promotion of forest trees, which have multiple purposes, is essential.

In the 1998 rainy season, 43 farmers who have prepared pits properly were given the seedlings described in Table 43.

Table 43. Seedlings distributed

Tree species	Number	Purpose
Leucaena leucocephala	1340	Feed, fuel wood, construction materials and upgrading soil fertility
Sesbania sesban	1200	Feed, fuel wood, construction materials and upgrading soil fertility
Eucalyptus saligna	1500	Fuel wood and construction materials

Soil Sub-system

Soil fertility management

The soil fertility of Ararso PA varies with topography. Guracha is much more fertile than Quefera Dimtu, and soil erosion is much higher in Quefera Dimtu than in Guracha. In general, the productivity of the soil is very low as it has been used for many years without proper soil fertility management. Hence measures to restore fertility must be taken.

To this end, the following activities have been initiated:

- Fifty farmers were trained in composting dry materials. Five compost wells were constructed and are being used by the farmers.
- Two bean varieties, *Ayenew* and *Gofta,* which are better at nitrogen fixing than *Red Wolaita,* were given to the farmers.
- Potential multipurpose forage and pasture crops that can be used for fertility restoration are being evaluated.
- Multipurpose tree species seedlings, *Leucaena leucocephala* and *Sesbania sesban*, have been distributed to farmers.
- Seedlings of grasses *Panicum maximum* and *Chloris gayana,* which can be used in soil and water conservation, are being prepared for distribution to farmers.

Agricultural implements

One of the most pressing problems facing farmers in eastern Ethiopia is a lack of farm implements. Also, few farmers are aware of ox-driven plowing. Thus, cultivation is usually done with hoes--an inefficient, labor-intensive practice. Simple, low-cost and traditional plow-(Maresha-) based farm implement technology can find easy acceptance among farmers.

The following activities were aimed at increasing the efficiency of land cultivation:

Fifteen farmers participated in a one-week training course (including lectures, handouts, a video show and practical evaluation) on the following implements:

- Ox-drawn modified moldboard plow
- Ox-drawn hand-operated row planters
- Winged plow and inter-row weeder

Implements were distributed to some farmers, who were very excited and pleased to receive them.

As the demand was very high for modified plows and hand-operated planters, attempts were made to provide four plows and one planter from AIRIC, Nazareth Research Center. Currently, an effort is being made to duplicate ten plows in collaboration with Menschen fTr Menschen Agro-technical School. It has been very difficult to cope with the demand.

Socioeconomic Sub-system

One of the most challenging aspects of this participatory project has been finding solutions to the socioeconomic problems of the Ararso PA, because doing so would require the full participation of the government ministries and non-government organizations as well as the mobilization of considerable resources. Attempts have been made to communicate with many NGOs, but the response has not been very encouraging, as "participatory community development" is not well understood by NGOs. Funds for this project have not yet been released. However, attempts are being made to work in collaboration with Self-Help Development International (SHDI) on a community-based project.

The following activities are being planned:

Water: plans are being made to increase the water supply by developing springs and constructing hand-dug wells.

Roads: The community is being mobilized to maintain the roads for seasonal usage.

Fuel wood: As discussed above, *Eucalyptus, Leucaena* and *Sesbania* seedlings have been given to the farmers.

Farmers' Visits

- Farmers visited the University twice. In the course of their visits, emphasis was placed on livestock-related technologies. Subsequently, farmers expressed great interest in using dairy goats and Rhode Island poultry breeds.
- A considerable number of cross visits were made by farmers.

- A member of the FRC, Mohammed Ibrahim, visited the University and presented FPR results at the Annual Research and Extension Review meeting. This is the first time a farmer participated in the annual research and extension review meeting at the University. The farmer reported on the PRIAM activities from their inception to the present. The audience appreciated and was surprised by the farmer's report. The farmer asked the audience and the University to work closely with the farming community.

ACHIEVEMENTS

Participation

- Researchers: participation by researchers is easier said than done.
- NGOs: do not work according to PRIAM principles.
- Farmers: do not keep promises.
- The FRC (Farmer Research Committee) which was composed of 5 men and 2 women did not work as expected because of the many commitments that claimed the members' time and attention. Making the chair of the PA the chair of the FRC as well had a negative impact on PRIAM'S efficiency.

Subproject Implementation

- Good support, follow-up and guidance from CIAT.
- Holistic implementation, though good for integrated development, is difficult to achieve. Although attempts have been made to address issues in the soil, crop, livestock and socioeconomic subsystems, it has been difficult to implement solutions with an integrated approach because of the inconsistent participation of actors and the lack of sufficient resources.
- Solutions to socioeconomic problems have been difficult to implement within the project's current domain and capacity, as proper implementation really requires substantial assistance from NGOs and concerned government ministries.

Indigenous Technical Knowledge (ITK)

- Characterization and quantification of farmers' ITK in sorghum variety development has been documented and found useful for future sorghum breeding programs. These findings will be published in one of the international journals.

Integration of Participatory Research

- Researchers in livestock, crops, forestry, etc., have appreciated the farmers' strong involvement and participation.
- Farmers have become less suspicious and hesitant and more transparent.
- Farmers' 'dependency syndrome' was partly reduced, which resulted in resource sharing.

Institutionalization of PRIAM

- Attempts are being made to incorporate PRIAM into the academic curriculum in courses such as research methods in plant sciences, animal sciences and agricultural economics. PRIAM is also a major part of the Farming Systems Research course.

- Dr. Cary Farley gave two seminars on the PRIAM project and general approach to some 600 students, instructors and researchers.
- PRIAM has been accepted as a research agenda in the University research system.

LESSONS LEARNED

Participation

- Lack of consistent participation by the researchers and farmers. This requires reorganization of the FRC and the core FPR members.
- NGOs are not attuned to farmers' needs.

Resources

- Lack of sufficient funds to implement the project.
- Lack of potato tuber.
- Limited accessibility to the sites during the rainy season.

Other

- Lack of ways to make the PRIAM activities sustainable.
- The farming systems activity of the area is centered on the mild drug crop chat (*Chat edulis*). This has resulted in the overlooking of PRIAM.

FORTHCOMING ACTIVITIES

Table 44. Subsystems

Sub-system	Activity	Actors
Socio-economic sub-system Water Fuel wood Gender	Hand-dug well and spring development Introduction of energy-efficient stoves or ovens Establishment of on-farm forest nurseries Training of women and/or men on family planning and promotion of women's role in agriculture	AUA with Self-Help Development International (SHDI)
Soil sub-system Shortage of draft power and implements Soil erosion	Duplication of implements (e.g., planters) Provision of seedlings for Rhodes and Setaria grasses	Larnstein University draft center and MfM SHDI and Forestry section
Crop sub-system Potato and other vegetables	Participation in secondary seed multiplication and World Bank Seed Project Purchase of some vegetable seeds	PRIAM project and Seed Project
Livestock sub-system Housing Supply of dairy goats and Rhode Island poultry breed	Construction of simple and low-cost housing Supply of improved breeds	Larnstein University Department of Agricultural Engineering and SHDI

CONCLUSION

- Research in PRIAM refers to research, extension and development. It has a researchable component (research and extension) and a non-researchable component (development). If holistic and sustainable development is to be achieved, attempts must be made to put both of the components into effect.
- It is easier, faster and more cost-effective to engage in integrated community development, but it requires a lot of commitment, devotion and patience from all actors.
- The sustainability of some of the activities--notably, those that require external complements--has been difficult to achieve.
- In order to promote this system to researchers not currently employing it, it is necessary to specify the methodologies of PRIAM activities--how to do it? what methodology to use? what are the minimum requirements?--and the benefits to be derived from adopting these methods.

ACKNOWLEDGMENTS

Alemaya University extends its thanks to Dr. Cary Farley, The Rockefeller Foundation, CIAT, participating farmers, SHDI (Self-Help Development International) and MoA.

DISCUSSION SESSION

Comment 2:
I am very pleased with what Frew has presented with to regard to variety breeding. In breeding strategy, less attention has been given to the socio-economic aspect, which has great impact on acceptability and adoptability of the variety. Thus, we have to consider more criteria than the few being used for conventional breeding.

Question 20.
Lantana, Datura and peppertree sprays mixture against sorghum, stalk borer, could it be extended to maize stalk borer control?
Response
Yes, it can be potentially used for control of maize stalk borer.

Question 21.
On the issue of seed supply/distribution – you have raised concern that this is not sustainable. In FPR, do we make a clean distribution between provision of experimental material seed from the conventional supply of already tested/released seed materials?
Response
I have not raised concern. But I have indicated the difficulties existing to make sustainable seed supply through secondary seed multiplication's (farmer seed production) and farmer to farmer seed dissemination. This works for non-hybrid crops and varieties.

Question 22.
You mentioned asking farmers about their ideotypes for sorghum, do you find that what they select is based upon an ideotype – constant set of characters – or reflects other factors, such as events in a particular season?
Response
Both. More importantly the selecting criteria of farmers and natural selection.

Question 23.
Is it cultural that one has to sleep with his livestock in the same house?
Response
It has been a tradition by the farmer to house livestock with the family for security reasons. If the housing is well and secured, livestock can be housed separately

Question 24.
How do you manage to incorporate PRIAM in curriculum?
Response
1) Organize seminars for students, teachers
2) Add chapters in some related course e.g. farming systems, research methods.

Question 25.
You said you found that farmers' varieties of sorghum are superior to the researcher's varieties, and that you would like to popularize those varieties among farmers. Could you explain further?
Response
I said, I would popularize them to the formal system and to farmers of other areas.

Question 26.
Do you have any observations so far on implications of the farming system interactions that you have identified, e.g., are farmers likely to reduce their concern with sorghum stalk production if introductions of agroforestry species are successful?
Response:
I hope they will reduce their concerns if multipurpose tree species fulfill the demand they use to meet from sorghum. This may in turn put the stalk to be used for animal feed. We have to wait and see.

Question 27.
Does your analysis and conclusion made on highland sorghum hold true for lowland sorghum?
Response
Not necessarily an approach for lowland sorghum may have to still emphasize the conventional approach.

Question 28.
Are you currently incorporating farmer selection criteria in the existing conventional improvement?
Response
Attempts are being made but it might be difficult to beat the varieties developed by farmers in the coming ten years. For resistance against stress, there might be a need for a conventional research to import new germplasm and improve the farmer-developed varieties.

PARTICIPATORY RESEARCH IN SOUTHWESTERN UGANDA

Ruzamba Katareiha[1]

INTRODUCTION

A Participatory Research for Improved Agroecosystem Management (PRIAM) sub-project was implemented in Nyarurambi Parish, Rubanda County (Kabale), southwestern Uganda, during the period of January 1997 to July 1998; this period covered three cropping seasons. The program was funded by the International Center for Tropical Agriculture (CIAT) and also supported by the Kawanda Agricultural Research Institute (KARI) in Kampala, Uganda.

The program operated at a grassroots level to encourage local farmers to take an active role in identifying and solving their problems, with the objective of increasing their knowledge and skills in farm-level research. The PRIAM sub-project also aimed at enhancing the effectiveness and impact of both formal and informal research.

To achieve these goals, the PRIAM sub-project collaborated with the extension staff of the Ministry of Agriculture. Local and international NGOs were incorporated in the research, including CARE, ICRAF, and UNFA. Staff of these NGOs participated as partners and facilitated the Participatory Rural Appraisals (PRAs). Church leaders and Local Councils (LCs) also helped to mobilize farmers. The PRIAM team consisted of researchers from CIAT and KARI. For proper implementation of the research process, a research assistant was based at the research site.

To enhance understanding of Participatory Research (PR), a seminar on Participatory Research for Improved Agroecosystems Management (PRIAM), a community-based approach was organized for the team. Several cross visits were also conducted.

At the beginning of the sub-project more than 50 farmers participated. For a number of reasons, however, this number eventually declined to about 27.

The components of this program included: the participatory planning and implementation workshop; team development; research program planning; seasonal evaluations; and follow-up visits.

AGROECOSYSTEM CHARACTERIZATION

The PRIAM site is located at an altitude of 1866 meters (asl), in hilly country. The potato research center is located 25 km away at Kalengyere, at 2500 meters (asl). The soils are characterized as a mixture of older sandy and sandy loams, and volcanic soils. There are two rainy seasons a year, although farmers report that rainfall patterns have been erratic in recent years.

The population of the research area is largely comprised of the rural poor. This area exhibits low potential for agricultural production: it is hilly, the soils are poor, and it is located far away from communication and markets. Most of the farmers are women who are low-income earners and are fully occupied with agricultural production and other agriculture-related activities. Most men are redundant and only indulge in drinking. Some men, however, try to earn an income through saw milling and long-distance trade in potatoes.

[1] Formerly with CIAT/PRIAM Project in Kabale, Uganda

These factors combine to present a situation of overall poverty in which standardized or "blanket" solutions are unlikely to succeed. Because farmers have been involved in the agricultural production for a long time, there are some elements within their local farming system that formal researchers would not be aware of, e.g., the use of indigenous pesticides and repellents. In fact, the farmers have considerable indigenous technical knowledge that formal researchers can utilize.

The main crops cultivated are low-value food crops, including: bush beans, field peas, sorghum, vegetables and potatoes. These crops are generally low yielding due to soil erosion and low soil fertility. Moreover, the land holdings are fragmented and good quality seed is also not readily available, so farmers are continuously searching for improved crop planting materials, new varieties, production techniques and management practices and alternative livelihood options.

PROBLEM DIAGNOSIS

The PR activities began with group discussions to identify and prioritize problems and identify possible solutions. These prioritization of problems is presented below:

1. Problem: Soil erosion
   Solutions:
   Afforestation
   Terracing
   Formation of grazing units

2. Problem: Plant diseases
   Solutions:
   Use of chemical sprays
   Use of resistant crop varieties

3. Problem: Lack of farmland
   Solutions:
   Family planning to reduce land pressure
   Emigration
   Monogamy

4. Problem: Crop pests
   Solutions:
   Early weeding
   Short storage period
   Use of chemicals
   Crop rotation

5. Problem: Poor crop yields
   Solutions:
   New crop varieties
   Use of manure and fertilizers
   Farmer training and disease management
   Use of fallow

6. Problem: Lack of farm tools
   Solutions:
   Employment opportunities for farmers
   Stockists for tools

7. Problem: Lack of good seed
   Solutions:
   Supplies from government and NGOs
   Introduction of research centers
   Control of post-harvest pests
   Farmer seed selection

8. Problem: Uncontrolled cattle grazing
   Solutions:
   Fencing
   Zero grazing
   Controlled numbers of livestock

RESEARCH PROGRAMS

In the period from January 1997 to July 1998, activities were conducted in three cropping seasons:

1. Long rains	January-July 1997
2. Short rains	September-December 1997
3. Long rains	January-July 1998

The activities each season began with participatory characterization and diagnosis (PC&D) exercises, during which problems to be addressed during that season were selected and discussed. Each season ended with a participatory evaluation of the season's successes and shortcomings.

During the PC&D exercises conducted during the first season, a Farmers' Research Committee (FRC) was formed. It was comprised of five members: three men and two women. The FRC elected a Chair and a Secretary. Following its establishment, the FRC coordinated PRIAM activities in collaboration with the field assistant. It was entrusted with information collection and sharing, technology dissemination, and farmer mobilization. FRC members kept records of field activities and meetings, and each member was assumed responsibility for the oversight of one or more of the field activities. The storage, management and distribution of inputs (e.g., seeds and seedlings) was also the responsibility of the FRC.

Throughout the PRIAM program, some trials or activities were farmer-managed and others were researcher-managed. Many of the researcher-managed trials also doubled as demonstration plots. During the second and third seasons, both crop and green manure (GM) research activities were conducted on farmers' plots. Another GM trial was set up for demonstration during the third season.

Crop Variety Trials

First season

During the first season, farmers established the following crop variety trials:

Beans - K131, K132, UBR 92 95	Millet
Maize - Longe 1	Wheat - UW0029

Some of these crops were established as sole crops, others as intercrops. Introduced varieties were tested against local controls. The research assistant tried the green manure. They included:

Larna Vetch	Silverleaf Desmodium
Purple Vetch	Lucerne
Rose Clover	Stylostanthes
Gliricidia	Tephrosia

NB: Tephrosia was not planted in demonstration plots. It was distributed to a number of farmers to try as fallow and to fight mole rats.

Second season

Crops tried during these seasons included:

Beans - K131, Climbing
Maize - Longe
Sunflower
Soybean: Nyalla, Gazelle, Promiscuous

The second season GM trials included:

Lana Vetch
Purple Vetch
Lucerne
Stylostanthes
Silverleaf (Desmodium)
Green leaf (Desmodium)
Lupines: Blue, Plain white, Sweet white, Yellow
Tephrosia

The agroforestry trees included in second season trials were:

- Alnus
- Grevillea
- Calliandra

Third season

Crop trials in the third season included:

Sorghum (sekedo)
Climbing beans
Bush beans (K20)
Maize - Longe 1
Upland rice
Soybean
Sunflower
Finger Millet

Third Season GM trials included:

Lupine - Sweet, blue, yellow
Larna Vetch
Purple Vetch
Faba bean
Green leaf (Desmodium)

Demonstration Plots

The first season, a GM demonstration plot was set out as a seven-unit plot. Each unit was 5 m^2 and was planted with one of seven varieties of GM.

The experiments were established at two sites: one in the valley and the other on the hillslope. No demonstrations were established during second season. The third season demonstration was established on a hill and planted with seven GM varieties. In addition, this plot utilized "Fanya Juu" channels for water harvesting and soil erosion control. Several agroforestry trees were also planted along the bunds, including:

- Calliandra as hedgerow
- Grevillea for border establishments
- Alnus for small woodlot at the backslope portion of plots.

NB: Some of the varieties of agroforestry trees mentioned above were also directly distributed to farmers to establish fodder systems and provide staking materials, (e.g., Calliandra), for climbing beans, boundary tree-lines and small-woodlots.

RESEARCH RESULTS

At the outset of the PRIAM project, it was difficult for researchers to adequately explain the relevance of PR approaches to farmers, especially as compared to other development work. As a result, many farmers expected free inputs and were disappointed. Consequently the enthusiasm and level of participation of many farmers, and even FRC committee members, gradually diminished.

During the course of the project, there generally a was higher participation of women than men--both in relation to field activities and in meetings. On the whole, the FRC effectively also executed its duties.

It was easier for farmers to adopt new crop varieties, especially the food crops, and Tephrosia. The new crop varieties adopted include maize, climbing beans, sunflower, millet and bush beans (KZ, K131). GM varieties other than Tephrosia were not adopted as easily as researchers expected due to the difficulty in establishing them. Other varieties that were adopted quickly were agroforestry trees, but adoption was also limited by the lack of seedlings.

Some crop varieties failed in the field trials, but farmers for a variety of reasons, including rejected others: intensive labor requirements, failure to establish and failure to meet taste and cooking preferences. Because many adopted crop varieties lacked some characteristics preferred by farmers; the local varieties were still conserved. For example, Longe 1 maize was adopted only for posho/porridge because it had less taste than the local variety, which was preferred for roasting. For detailed results of trials and evaluations, please see Table 45.

ACHIEVEMENTS

- PR is about facilitating farmers' participation (involvement) in research projects aimed at farmer prioritized problems. There was farmer involvement in all aspects of the research program, from problem identification and prioritization to planning and implementing experiments to monitoring and evaluating the activities. Farmers' indigenous technical knowledge was also utilized in the project.

- Some crop varieties were found to be superior to others and adopted. Although seed materials for trials was not always available, some farmers managed to multiply their own seed, and they established a local "seed bank" have preferred crop varieties.

- The PRIAM project was conducted in the farmers' environment, under their own conditions. Researchers made regular follow-up visits and conducted seasonal evaluations of the research activities, as well as planning sessions for the next season together with farmers. This helped to facilitate more of a bottom-up (as opposed to top-down) approach, which also cultivated a sense of ownership of the project by farmers.

- The PRIAM program involved local leaders in the mobilization of the local villages. Participatory research teams and farmer research committees were collaboratively developed for proper implementation of the research project. Participatory research training and implementation workshops were held every season.

- During the PRIAM program, the farmers' awareness of the importance of good seeds was heightened and seed dissemination was improved.

LESSONS LEARNED AND CHALLENGES AHEAD

- Despite many attempts to liase with district-level extension staff, there were minimal interactions between the researchers and the extension staff.

- Because there are similar research and development programs operating in the area, some efforts were duplicated.

- The PR approach was generally not quantitative; and presented a potential problem in terms of replication of activities and the overall sustainability of the project.

- Some data were not available because as adaptive variety trials were generally conducted on a farmer-designed, farmer-managed basis without heavy researcher oversight.

- Although farmers understood some aspects of PR, they did not wholly grasp its meaning and objectives. Expectations of inputs were therefore relatively high.

- More demonstrations and farmer-to-farmer visits would have been useful to expand farmers' knowledge.

- Successful PR requires social and technical skills on the part of the multi-disciplinary teams. This would help to identify and address the needs of all the farmers in the community. Because the PR team/staff was too small, their coverage was low. Consequently, there was a low rate of adoption of technologies.

- Farmers' were mainly interested in alleviating their crop production problems. However, researchers identified low soil fertility to be the main problem in the area. The lack of farmers' understanding of soil fertility issues meant that the problem was not prioritized or addressed in depth.

- There was generally little seed material or variety diversity available for adaptive variety trials. These shortcomings caused discord between the research team and the farmers.

- For more accurate results, the research cycle should be relatively longer. This might also facilitate adoption of new technologies.

- There was generally low institutional and logistical support to the field researcher. For example, the research assistant had to rely on public transport and fieldwork was by foot.

- Farmers tended to rely on the program for resources. However, the PRIAM project did not provide financial incentives to participating farmers, nor to the FRC--although it was expected. This lack of financial or material support meant that many farmers dropped out of the project. Consequently, some resources that were initially contributed by farmers, (e.g., land for experimental activities or labor), were later withdrawn or withheld.

Table 45. Trial Results and Variety Comparisons[1]

MAIZE	
Longe 1 Germination: good Establishment: vigorous(short, thick, vegetative) Diseases: yellow stripes on leave characteristic of streak virus; later disappeared	Pests: stalk borers--serious infestations Maturity period: late maturity Yield: good, but not significantly higher than local control Taste: less taste when roasted
BEANS	
K131 Germination: low Field vigor: higher Pests: black bean aphid--high infestation levels during short rains (2nd season). Diseases: yellowing of leaves, mottled leaves characteristic of the common bean mosaic; destruction not serious Yield: high only in long rains (1st season); yield loss was high during short rains Taste of leaves: poor Taste of Pods: good; pods are very small, though Maturity period: long	K132 Germination: good Field establishment: poor; less vigorous Pests: black aphid Diseases: root rot--serious damage Yield: very low Taste of fresh beans: good Maturity period: long
UBR (92)25 Germination: poor Establishment: low vigor Leaf/pod sauce: not good: hard pods Pests: black bean aphid Diseases: yellowing of leaves; root rot Maturity: late Yields: low	K20 Germination/vigor: good Pest: high aphid infestation Diseases: nil Maturity: early maturing Taste: good: pod and leaves taste fresh Yield: moderate
Climbing Beans Germination/vigor: good Pest: mouse birds, flower beetles, rats--high infestation levels of beetles Diseases: nil	Taste of fresh beans: good Yield: very high Staking material: big problem
FINGER MILLET	
Germination: good Vigor: less in sandy soil; good in loam Pests: caterpillar—not a serious problem Diseases: nil	Maturity period: late maturing Yield: high Taste (bread/porridge): good

[1] The variety trials involved comparisons between the introduced varieties and the local types.

Table 45 (continued)

WHEAT <u>UW0029</u> **NB:** There was no follow-up of the wheat trials by researchers due to the long distances to farmers' fields. (The farmers had actually planted the trials in an area they believed to be a more suitable environment for wheat production.)	
SORGHUM Germination: space Field vigor: low: short, slender stems Pests: stalk borer--not a serious problem Diseases: not identified; caused drying of leaves after withering a long time	Yield: low; empty heads more prevalent; grain size is big Maturity period: late maturity Taste of porridge: less tasty than local variety
NB: The variety is hard-seeded and difficult to grind using local grindstone.	
SUNFLOWER Establishment: good Diseases: not identified	Yields: good, considering the high infestation Pests: bird of birds
NB: No farmer thus far has used sunflower products for any domestic purposes	
UPLAND RICE Germination: poor Field vigor: low	Diseases: nil Pests: nil Yield: nil
NB: Rice planted in low land was promising but never formed grain, probably due to long droughts.	
SOYBEAN Germination: good Field vigor: high	Pests: green stinkbug—not a high infestation Diseases: nil Maturity period: longer than bush beans
GREEN MANURES (GM)	
<u>Larna Vetch, Purple Vetch</u> Germination: good Field vigor: high: established in 2 weeks Weed competition: weeds suppressed after first weeding Soil cover: high potential; impenetrable at 4 Weeks Pests: black aphids only on purple vetch Diseases: nil Number of weedings: one Formation of seed: seed at 16 weeks; high seed yields Life span: annual	<u>Rose Clover</u> Germination: poor Field vigor: low; established after 3 months Number of weedings: 3; weed competition for Rose Clover was low Pests/diseases: nil Soil cover: no capacity Formation of seed: at 5 months; dries thereafter

Table 45 (continued)

Stylostanthes Germination rate: low Weed competition: low; completely out-competed Number of weedings: 3 Pests/diseases: not identified Seed formation: not observed. Soil cover: low capacity; vigorous only after 20 weeks Life span: perennial; no seeds formed	Gliricidia and Silverleaf (Desmodium) Germination rate: low Establishment: low: 3 weedings before vigorous Pests and diseases: not observed Seed formation: not observed Soil cover: only after 16 weeks; high vigor Propagation: both seed and vegetative
Lucerne Germination/Vigor: high in 14 days Flowering time: 12 weeks, at 1 m high Soil cover: upright crop: no capacity Pests and diseases: not observed Seed formation: not observed.	Tephrosia The crop has performed very well in almost all respects. It did better when planted directly as seed than when nursery bed was made (and transplanted). Tephrosia formed seed at 10 months. No tests were made to confirm viability of this seed. The plant was vigorous, tolerating both droughts and heavy rains. No pests or diseases were observed.
Lupine This crop performed well in the field. Germination and vigor were high. No pests or diseases reported. Seed formation was observed at 13 weeks.	

AGROFORESTRY TREES

The trees sprouted vigorously as soon as they were planted.

Alnus spp. had perforated leaves while Calliandra fell prey to livestock. Grevillea trees performed best.

NB: Because animals fed on Calliandra, it was not easy to establish a stabilized hedgerow on the Fanya Juu. Consequently, less was observed at this demonstration plot.

FARMER PARTICIPATORY RESEARCH IN IKULWE - IGANGA DISTRICT, UGANDA

K.C. Kayuki[1] and C.S. Wortmann[2]

ABSTRACT

A participatory approach to research on system improvement was initiated in five communities around Ikulwe District Farm Institute in Iganga District, Uganda. The site is located in the southeastern tall grassland zone, where perennial and annual crops are produced in mixed farming systems. Farmers identified and prioritized 15 problems related to crop production using a PRA approach. Crop pests and diseases predominated; soil-related problems included low soil fertility and soil erosion. Other problems included low crop yields and unreliable rainfall. However, the priorities change as new problems are identified during regular semi-annual planning and evaluation meetings.

Farmers and researchers agreed to focus research on Africa cassava mosaic virus, groundnut rosette virus, bean diseases, banana weevil, soil erosion control and soil fertility management. Several crop varieties have been evaluated for either tolerance or resistance and farmers have adopted Nanse 2 and SS4 cassava varieties; K131, K132, MCM 2001, MCM 3030, OBA1, UBR (92) 32 bean varieties; some sweet potato varieties; and two upland rice varieties. Farmers are paring corms to control banana weevils, and researchers have promised a cheaper alternative to the hot water treatment with which farmers had experimented.

Canavalia, Mucuna, Crotolaria, and lablab were evaluated as either green manure or improved fallow for soil fertility improvement, and for their incorporation into the farming systems. Information obtained from FPR and on-station research was used to develop a decision guide to the use of these species in Eastern and Central Uganda.

Living barriers of vetiver grass were evaluated and are now being used for controlling soil erosion. Through independent experimentation farmers have found Tephrosia effective in controlling root rats (Tachyoryctes splendens).

Other activities carried out included cross visits by participating farmers to research institutes and non-governmental organizations; testing of weeders and solar dryers; and use of inoculums and P fertilizer on soybeans and common beans.

Ikulwe FPR farmers have contributed to technology dissemination by hosting numerous groups of farmers and students. Though Ikulwe Bean Farmers Association, they have multiplied and sold seeds of improved bean varieties. The farmer research committee was formed in 1996. It has not performed well, but should be commended for holding monthly meetings and for mobilizing farmers to join the FPR.

Challenges ahead include securing increased budget support to fund heightened involvement of researchers and technology dissemination by the farmers' committee. Furthermore, the local leaders and extension service need to be sensitized on the value of FPR in technology generation and dissemination. Sustainability of the whole FPR process needs to be addressed.

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INTRODUCTION

Farmer participation in planning and implementation of research has been widely recognized as valuable for successful on-farm experimentation, (Chambers et al., 1989; Haverkort, 1991). Nevertheless, farmer participatory research (FPR) is often restricted to information gathering for problem identification and management of on-farm trials (Ashby, 1986), while the design of research still tends to be the domain solely of the researchers. Ignoring farmers' knowledge in the design of research has often led to failure in on-farm experimentation (Lightfoot, 1988). Farmers are capable experimenters who carry out research on subjects relevant to them (Haverkort, 1991; Rhoades and Bebbington, 1991). On the other hand, farmers can be limited in their experimentation if the causes of problems are not understood. In such cases, researchers provide complementary biological and methodological knowledge (Fernandez, 1991). A joint effort by farmers and researchers in setting the research agenda capitalizes on the technical knowledge of both groups and thus provides a better basis for development than efforts of either group working alone (Raintree and Hoskins, 1988).

A participatory approach to research for system improvement was initiated in 1992 in the Ikulwe community in Iganga District in southeastern Uganda. The participatory research site activities are coordinated by a researcher from the National Agricultural Research Organization (NARO) and a Farmers' Research Committee, a group of farmers that provides a liaison between the farming and research communities.

A major collaborating institution is the International Center for Tropical Agriculture (CIAT). The participatory research team consists of a soil scientist from NARO and a systems agronomist from CIAT. Researchers from other disciplines are called in when the need arises, especially at planning and evaluation meetings. The NARO institutions involved are Kawanda Agricultural Research Institute (KARI), Namulonge Annual Crops and Animal Production Research Institute (NAARI) and Agricultural Engineering and Appropriate Technology Research Institute (AETRI).

RESEARCH SITE SELECTION

Farmer participatory research for systems improvement was initiated in 1992 in Ikulwe. The community consists of five villages (Mayuge, Buyemba, Mugeri, Kavule and Igamba) which border Ikulwe District Farm Institute (DFI). The Ikulwe FPR site is located in the southeastern tall grassland zone, where perennial and annual crops are produced in mixed farming systems. The area was judged to be representative of much of the traditional banana-and-coffee based systems of parts of Iganga, Kamuli, Jinja, Mukono and Mpigi Districts.

The farmer participatory research evolved from earlier on-farm research for variety verification and adaptation of soil management practices. There was an informal survey of farmers' perceptions of soils, soil uses and management practices (Jjemba et al., 1993). The researchers from NARO and CIAT worked with farmers for four days on a preliminary characterization and diagnosis (C&D) and problem identification for the farming systems using a participatory rural appraisal approach. Participating farmers were invited for a series of meetings to develop a research plan and to collect more background information. The information collected allowed the researchers to understand the predominant farming systems in the area and the farmers' perceptions of their soils and soil-related concerns. This exercise established a deeper level of communication, which is crucial to successful collaboration.

Then in 1993, researchers from NARO and CIAT and a Government extension agent again worked with farmers to refine the characterization and diagnosis, prioritize problems and research opportunities and develop a research plan with farmers. The plan is regularly revised at semi-annual meetings intended to evaluate the results obtained and plan the following season's activities. Farmer participation in Ikulwe PR activities is voluntary; farmers are not selected, but greater participation of women is encouraged.

AGROECOSYSTEM CHARACTERIZATION

Location and Soils

The Ikulwe DFI (0°26'N, 33°28'E; 1170 m asl). The soils mapping unit is Kabira catena: dominant soil types are reddish-brown sandy/sandy clay loams on red clay loams and laterite.

Participating farmers provided information on the local soil classification system, evaluation criteria used, crops grown and problems associated with particular soils. The information will be used in designing a research agenda on soils.

Rainfall

Rainfall distribution in the area (Figure 5) is bimodal with peaks in April and in October-November, and with an annual mean of 1345 mm (25 years from Ikulwe DFI). In some cases, farmers' perception of the rainfall patterns and distribution was similar to the recorded rainfall at Ikulwe DFI.

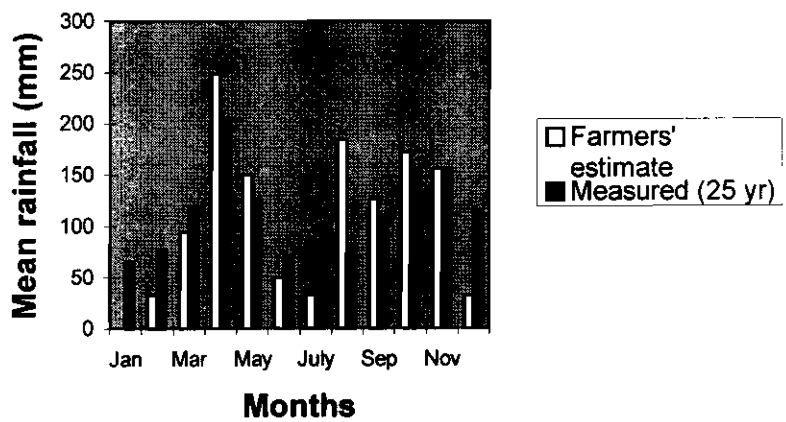

Figure 5. Rainfall distribution in Ikulwe according to long-term monthly means and farmers' perceptions

Cropping Systems

The farming systems are biologically and agronomically diverse with small but numerous parcels having varying crop associations, planting dates etc. There is little sole crop production. Farmers' perception of land allocated to different commodities is indicated in Figure 6 below.

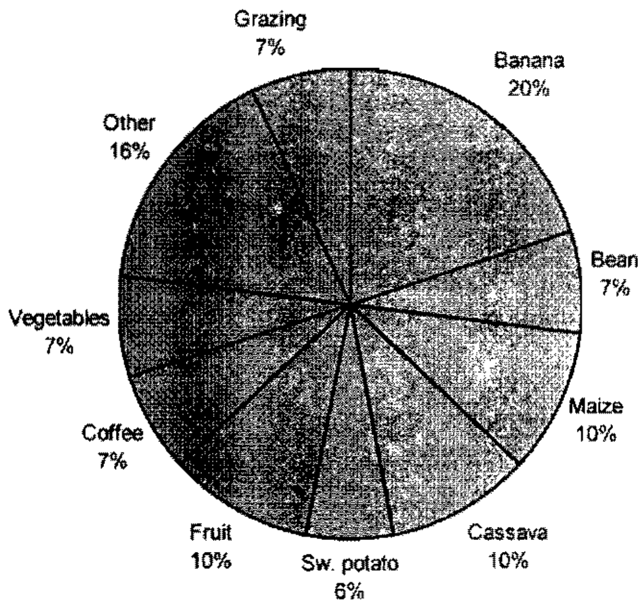

Figure 6. Land use for different crops in Ikulwe as perceived by farmers

Gender Roles

The gender division of farm labor varies according to task (Table 46), and the perceptions of the group of women sometimes differed from those of a mixed group that was dominated by men. Bush clearing and marketing of dry and uncooked produce are the responsibility of men, while women do much of the planting and weeding, and most of the harvesting of fresh produce, marketing of cooked produce and winnowing. Men and women are equally responsible for most other tasks.

The group composed of women only estimated those women's share of responsibility in several tasks was greater than was estimated by the mixed group. These tasks included planting and weeding of annual crops and winnowing and drying of beans.

Monthly Labor Demand

Farmers estimated the demand for labor to be greatest in March, April, September and October (Figure 7). These periods coincided with sowing and weeding times. For at least five months of the year, the labor capacity of the farmers appeared to be very much underutilized, which implies a potential for increasing productivity.

Table 46. Labour distribution between sexes for different crop operations as indicated by farmers from Ikulwe ('X' for the mixed-gender, 'x' where an all-women group suggested modification)

Crop operation	Man	Woman
Maize		
Slashing	XXXXXXXXXX	
Tilling	XXXXX	XXXXX
Planting	XXXXX	XXXXX
	xx	xxxxxxxx
Weeding	XXXXX	XXXXX
	xx	xxxxxxxx
Harvesting	XXXXX	XXXXX
Drying	XXXXX	XXXXX
Selling		
uncooked	XXXXXXXXXX	
cooked		XXXXXXXXXX
Bean		
Tilling	XXXXX	XXXXX
Planting		
chop and plant		XXXXX
line planting	XXXXX	XXXXX
	xxx	xxxxxxx
Weeding	XXXXX	XXXXX
	xx	xxxxxxxx
Harvest		
dry	XXXXX	XXXXX
fresh		XXXXXXXXXX
Threshing	XXXXX	XXXXX
	xx	xxxxxxxx
Winnowing		XXXXXXXXXX
Drying	XXXXX	XXXXX
	xx	xxxxxxxx
Selling	XXXXXXXXXX	
Groundnut		
Tilling	XXXXX	XXXXX
Planting	XXXXX	XXXXX
	xx	xxxxxxxxx
Weeding	XXXXX	XXXXX
	xx	xxxxxxxx
Harvesting	XXXXX	XXXXX
Selling	XXXXXXXXXX	

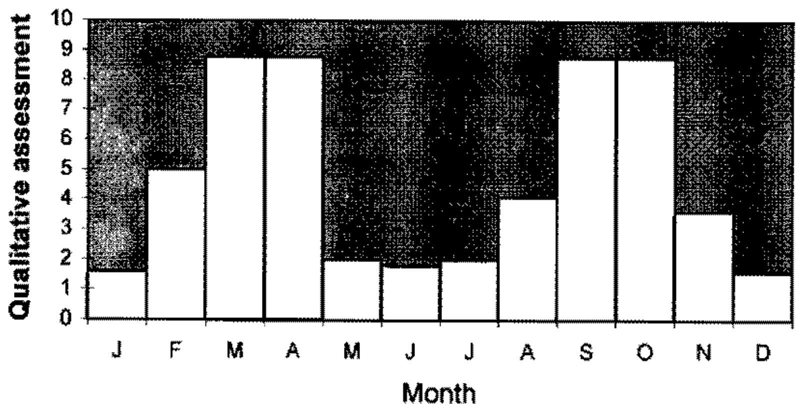

Figure 7. Monthly labor demands as indicated by farmers

PROBLEM DIAGNOSIS

Identification and Prioritization of Problems

A similar format for research planning as suggested by Tripp and Woolley (1989) was followed during four farmers' meetings. Farmers participated fully in all steps of research planning, including identification and prioritization of problems, identification and evaluation of potential solutions, and design and implementation of trials.

During the characterization and diagnostic exercise, farmers listed 15 problems related to crop production (Table 47). Crop pests and disease predominated. However, farmers had difficulty specifying the individual pests and diseases as in most cases only symptoms, but not causal agents, were known. Furthermore, most farmers did not distinguish between pests and diseases of a particular crop. Soil-related problems were also mentioned. They included soil erosion, "old soils" (low soil fertility) and low yields of coffee. Farmers expressed concern about unpredictable rainfall patterns.

Crop pests and diseases were ranked highest whereas medium and low priority was given to soil erosion and old soils respectively.

The high ranking of pests and diseases may have been due to farmers' expectation that researchers would provide pesticides to solve the problems quickly. Soil erosion and "old soils" were given low priority possibly because farmers thought that there were no quick solutions. Thus farmers' ranking of the problems was apparently biased by their expectations of receiving inputs and finding quick solutions. However, after emphasizing the researchers' long-term commitment to collaborating with the farmers without providing substantial inputs, farmers decided that research on low soil fertility (LSF) and soil erosion is important.

Table 47. Priority problems identified by farmers in Ikulwe

Problem	Priority ranking
African cassava mosaic	1
Groundnut rosette	1
Banana weevil	1
Bean diseases	2
Sweet potato weevil	2
Cassava mealy bug	2
Tomato wilt	3
Soil erosion	3
Low coffee yield	3
Maize diseases, esp. streak	4
Root (mole) rats	4
Termites	4
Low soil fertility[1]	5
Unreliable rainfall	5
Monkeys	5

[1] Later farmers revised their view on low soil fertility and gave it a high priority rating

Identification of Causal Agents

Farmers easily identified the major causes of low soil fertility (LSF), including: continuous cropping, overgrazing, monocropping, removal of vegetative cover, soil compaction, soil erosion, lack of farmyard manure and low availability and high cost of inorganic fertilizers. They had difficulties in identifying the primary causes of crop pests and diseases. Most frequently, non-use of pesticides and abiotic stresses or management practices that increase the severity of crop pests and diseases were mentioned (e.g., high rainfall, drought, poor soils, late planting, late weeding). Researchers explained the primary causes of more complex problems (e.g., aphids and white flies as vectors of the virus causing rosette disease of groundnut and cassava mosaic, respectively).

Identification and Evaluation of Potential Solutions

When farmers were asked to list potential solutions to the problems mentioned, they objected initially, responding that researchers should know the solutions. After emphasizing that FPR builds on farmers' knowledge complemented by researchers' knowledge, farmers agreed to work in small groups (6-10) to identify potential solutions for low soil fertility, cassava mosaic virus, rosette disease in groundnuts, bean diseases, and banana pests (Table 48 below). The solutions listed by farmers proved that they have considerable knowledge on how to deal with most of the problems.

The solutions were presented to the large group and complemented further by suggestions from researchers. The proposed solutions were evaluated taking into account the resources required as well as the benefits expected. Farmers found some solutions to be inappropriate due to lack of labor or capital.

Farmers and researchers agreed to focus research on African cassava mosaic virus, groundnut rosette virus, bean disease, banana weevil, soil erosion control and soil fertility management.

Trial Design

To stimulate a thorough debate on experimentation, farmers were asked how they traditionally test new technologies. It was noted that all cases mentioned turned out to be trials initiated by extension staff. One farmer indicated that he evaluated a new variety by planting it in a plot adjacent to one planted with a local variety for comparison.

Researchers then explained some principles of experimentation, including: objectives, treatments, plot size, site selection, replications, trial management and observations to be made.

Farmers then worked in small groups and designed trials for agroforestry, green manure, mulching, variety trials for beans and cassava and spacing trials for groundnuts. Each group then presented its design to the whole group for further discussion and refinement. The trials had 3-12 treatments with two replications per farm. The choice of the two replications is likely to have been influenced by previous on-farm bean variety trials that also had two replications. For the bean variety trials, farmers expressed willingness to test 12 new varieties. For the more complex trials involving alternative management practices (e.g., green manure, agroforestry) two to four treatments compared with the local practice were chosen.

Thirty-two participating farmers chose the trials they wanted to carry out. The groundnut spacing trial and cassava variety trial were the most popular (chosen by 50% of the farmers); other trials included Crotolaria as manure (38%), bean varieties (34%), agroforestry (22%), banana weevil management (19%) and mulching (13%). Most farmers (60%) decided to carry out two trials, 31% and 9% chose three and one trial respectively. A few farmers did not implement any trial but wanted to observe the trials of their colleagues.

RESEARCH SEASONS

To date, the project has been carried out over 11 research seasons. The following trials have been conducted.

Variety Trials

Cassava

Five cassava varieties were evaluated for resistance to African cassava mosaic virus; farmers have adapted Nanse 2 and SS4.

Table 48. Potential solutions suggested by farmers and researchers for the problems ranked highest by farmers

	Problem				
	Cassava mosaic	**Rosette of groundnuts**	**Leaf diseases of beans**	**Banana weevils**	**Low soil fertility/soil erosion**
Potential solutions suggested by farmers	Treat cuttings before planting; burn infected stems after harvest; use planting material from uninfected plants.	Observe proper spacing (high plant density); practice crop rotation; use clean seed; plant at the appropriate time, in fertile soil.	Use resistant varieties, practice crop rotation; use clean seed; prepare land properly; plant and weed early; use manure; observe proper plant density; reduce shading; dry and store properly after harvest; use pesticides.	Use clean planting material; practice fallow; plant good trees in banana field; split old stems and apply insecticides; trap weevils	Plant trees (agroforestry); use mulch; use manure; use fertilizer; avoid burning crop residues; plant varieties that optimize nutrient use; use catchments, contour planting and grass strips
Potential solutions added by researchers	Use resistant or tolerant varieties			Use clean planting material	Use green manure (Crotolaria); plant complementary intercrops and cover crops; compost weeds instead of burning

[1] Underlined solutions were those chosen by farmers as research topics.

Bean

Diseases

Web blight, angular leaf spot and common bacterial blight were important constraints on bean production. Twenty-nine varieties were evaluated. Farmers have adopted K131, K132, MCM 2001, MCM 3030, OBA1 and VBR (92) 32, while a few farmers continued to grow SUG 50, 731 and RAB 490.

Characteristics considered included seed appearance, marketability and drought tolerance.

Pests

Trials on control of bean storage pest using onion, dust, *Crotolaria, Tephrosia,* millet chaff and ash were carried out. The results were inconclusive because only two out of the seven farmers who participated brought the beans for evaluation.

Banana

Disinfection of banana planting material through paring of corms coupled with hot water treatment was carried out. Results were promising and farmers would like to use the hot water treatment. The National Banana Program has promised to provide the farmers with a cheaper alternative.

Upland rice

Two varieties of upland rice were evaluated. Seeds were in limited supply. One interesting development was that farmers managed to multiply the few seeds supplied for sale to other interested farmers.

Sweet potatoes and Soybean

Several varieties have been tested and farmers have selected a few, which they are growing now.

Groundnuts

A plant spacing trial for the control of groundnut rosette was conducted.

Soil Erosion Control Trials

Vetiver grass

Vetiver grass was tested for control of soil erosion. Planting materials were given to farmers on whose fields and household compounds soil erosion was observed. Initially, farmers planted the vetiver strip close to their homes, where they observed runoffs and soil accumulation in front of the barriers and in the crown of the plants. They have now planted it in living barriers across their fields. Evidence of its effectiveness reported by farmers included: reduced run-off, less rill formation, less damage to crops by runoff and less soil erosion with soil accumulation in front of the barrier and in the crown of the plants.

Despite vetiver's proven effectiveness in controlling soil erosion and runoff and its adoption by a number of farmers, dissemination of this technology is limited by low availability of planting materials. The farmers who have it want first to cover their fields before giving it to other farmers.

Some farmers expressed a preference for a grass that is palatable to livestock.

Soil Fertility Management Trials

Green manure

Farmers selected testing of green manures to solve the problem of declining soil fertility. Species evaluated included Crotolaria (*C.ochroleuca*), Mucuna (*M.pruriens*), and lablab (*Dolichos lablab*). In 1995, farmers started experimenting with jack bean (*Canavalia ensiformis*) as a green manure in maize and beans and as a cover crop in other crops.

Crotolaria

Yields of maize and beans were increased by 41% and 43% respectively in the season following a one-season Crotolaria fallow as compared to two seasons of weedy fallow (Table 53) (Wortmann et al., 1994; Fischler and Wortmann, in press). This was after farmers had complained of reduced crop yield when Crotolaria had been intercropped with maize and beans during 1994.

Lablab and Mucuna

Mucuna was sole cropped and relay cropped with maize by sowing one month after the maize. Sole-cropped maize was planted in one plot. In the second season, maize was planted to all plots but farmers wished to leave the less-developed relay-cropped Mucuna for another season. Therefore maize was planted on all plots in the third season. The layout for the lablab experiment was the same as for Mucuna. Maize grain yield was reduced by 24% and 28% when intercropped with Mucuna and lablab respectively. Maize grain yield, following a one-season Mucuna or lablab fallow, was 60% and 50% higher respectively as compared to maize following maize (Table 54) (Fischler and Wortmann, in press).

One interesting development is that farmers decided to carry out their own independent experimentation testing the compatibility of different green manure species within the cropping systems.

The results of the research on green manures including farmer evaluation of the species are presented Tables 55, 56, 57 and 58.

Information generated from FPR and on-station research was used by researchers and farmers to develop jointly a decision guide to direct the use of these green manure species in Eastern and Central Uganda (Table 49). The guide allows farmers to choose from a basket of green manure options based on their particular objectives and the conditions in which they farm.

Farmers have started using Mucuna as an improved fallow and as an intercrop. Canavalia is also common as an intercrop with banana. However, farmers mentioned some problems, which are likely to inhibit the adoption of the green manure species:

- Crotolaria is laborious to produce because it is tedious to sow and weed control is time-consuming
- Lablab and Mucuna are difficult to uproot
- Lablab has a low seed multiplication rate

Table 49. Guidelines to the use of four green manure species in Central and Eastern Uganda

If you want to.....	Plant	Do not plant ....
Produce in sole crop	Mucuna or lablab	Canavalia
Intercrop with maize	Canavalia, or lablab at very low density	Mucuna
Intercrop with newly-planted banana or coffee	Canavalia	Mucuna or lablab
Intercrop with established banana or coffee	Canavalia or Mucuna at low plant density	Crotolaria
Intercrop between sweet potato mounds	Crotolaria or Canavalia	Mucuna or lablab
Intercrop with newly-planted cassava	Canavalia or Crotolaria between rows of cassava	Mucuna or lablab
Intercrop with established cassava	Canavalia or Mucuna at low density	Crotolaria
Produce fodder	Lablab or Mucuna	Canavalia or Crotolaria
Suppress weeds	Mucuna or lablab	Crotolaria or Canavalia
Reduce nematodes	Crotolaria	Canavalia
Produce durable mulch	Crotolaria and Canavalia (allow to mature)	Lablab or Mucuna

Source: Fischler and Wortmann, in press.

Agroforestry

Agroforestry was a research area chosen by farmers. An experiment on hedgerow intercropping with *Calliandra calothyrus* was designed jointly by farmers and researchers Seedlings of Calliandra were planted as single hedgerows in April 1993 (2 rows per plant 5 m apart, 0.25 m spacing within row). The first pruning was carried out in October 1993 with four prunings per year thereafter. The cuttings were applied as mulch between crop rows. In the 1994a and 1995a seasons, phosphorus was applied at a rate of 46kg P_2 0_5/ha to maize on half the plot. Data from six farms were available up to the 1995b season. Hedgerow intercropping did not result in increased maize and bean yield results, but there was a response to P (Tables 59, 60 and 61).

Nitrogen Fixing in Bean and Soybeans

Nitrogen fixing trials were conducted for two seasons with beans and one season with soybeans. Bean yield was significantly improved with the use of P (Table 50). Beans responded to inoculation with rhizobia only when P was applied. Using P fertilizers and inoculation together appeared to be the most economical option. Soybean yield was dramatically improved with inoculation but there was less response to P (Table 51).

Table 50. Effects of P fertilizer and inoculation on N fixing and bean yield

	N fixed		Yield
	% of N	(kg/ha)	(kg/ha)
Control	22	8.0	605
Inoculation	13	5.6	694
100 kg/ha phosphate	28	18.0	851
Inoculation plus P	30	29.6	985

Source: Wortmann et al., 1998

Table 51. Soybean yield response to P fertilizer and inoculation

	Yield (kg/ha)
Control	609
Inoculation	1048
100 kg/ha phosphate	906
Inoculation plus P	1082

Source: Wortmann et al., 1998

Despite the dramatic increase in soybean yield farmers have not adopted inoculum use on soybeans. One of the reasons given is unavailability, but it may also be due to the fact that soybean is not an important crop in the area, as farmers have requested inoculums for groundnuts.

***Lantana camara* and *Cassia hirsuta* as Soil Amendments**

Lantana camara and *Cassia hirsuta* are abundant in Eastern and Central Uganda. On-station decomposition and nutrient release studies indicate that these materials decompose quickly and release N, P and K rapidly. One tonne of *L. camara* releases 27, 1.6 and 27 kg of N, P and K respectively, while *C. hirsuta* supplies about 30, 1.8 and 46 kg of N, P and K respectively over 16 weeks. On-farm work at Ikulwe evaluated maize and bean response during the 1997a and 1997b seasons to the application of the following combinations of soil amendments:

- 4 t/ha *L. camara*
- a combination of 2 t/ha *L. camara* and 40 kg N/ha
- 30 kg K_2O/ha and 23 kg P_2O_5/ha and 80 kg N/ha
- 30 kg K_2O/ha and 46 kg P_2O_5/ha.

Results are indicated in Table 52 below. Combining *L. camara* with inorganic fertilizers resulted in the same yields statistically as using large amounts of inorganic fertilizers. This is likely due to the P from the inorganic fertilizers, since the P applied in *L. camara* is low.

Table 52. Grain yield of maize and beans in seasons 1997a and 1997b as affected by *L.camara* and inorganic fertilizers

Treatment	Maize grain yield (kg/ha)[a] Season 1997a	Maize grain yield (kg/ha)[a] Season 1997b	Bean seed yield (kg/ha)[b] Season 1997b
L. camara	2433	1189	537
L. camara + fertilizer (F1)	2819	1985	907
Fertilizer (F2)	2967	2407	863
Control	1952	1011	559
LSD (5%)	710	556	249
CV %	25	22	21

[a]average of 7 farmers

[b]average of 5 farmers
F1 40 kg N/ha + 30 kg K_2O/ha + 23 kg P_2O_5/ha
F2 80 kg N/ha + 30 kg K_2O/ha + 46 kg P_2O_5/ha
(Kaizzi, 1997)

Tephrosia vogellii for the Control of Root Rats

Crop damage by root rats (mole rats, *Tachyoryctes splendens*) was among the priority problems mentioned by farmers. Researchers advised farmers to experiment with Tephrosia, which is common in the area. Farmers planted it in borders around their fields, and scattered a few plants within their fields. They reported that Tephrosia is effective in controlling root rats; the effect is achieved within 6-12 months. Its effectiveness is evident in that the crops are no longer being damaged, tunnels left open while the land is tilled are not blocked and food reserves are not found in tunnels. Several farmers have planted Tephrosia and have given out seeds to other farmers.

Farmers also reported that Tephrosia is a medicine traditionally used for treating wounds, and as an insecticide against storage pests, ticks and termites.

Other Activities

The following activities were carried out in response to the weeding and high post-harvest losses. They were ranked as priorities during the 1997 semi-annual planning and evaluation meetings.

Evaluation of weeders from AETRI

In response to the farmers' need to reduce the labor requirement for weeding, AETRI provided two weeders for farmers' evaluation. Farmers reported their observations and requested modifications.

Evaluation of the solar dryer developed by the post-harvest program at KARI

Post-harvest loss is currently among the priority problems faced by farmers. KARI's post-harvest program responded by providing solar dryers for farmer evaluation. Materials for making "a model dryer" were provided to the farmers. Evaluation is in progress.

Lack of inputs

In the 1998a season planning meetings, farmers presented lack of inputs (good quality seeds, fertilizers, pesticides) as one of their constraints. They suggested that we provide inputs through the FPR committee for them to purchase.

Cross Visits

Participating farmers are sponsored to visit research institutes, NGOs, etc. to obtain new ideas for FPR. In 1996, farmers visited Vi Tree Planting Projects in Masaka and Rakai districts. They reported to the larger group the various technologies they observed, including: pit storage of sweet potato, firewood-efficient stoves, agroforestry, management of tree nurseries, liquid manure, composting, use of A-frames and concoctions for insect/pest control. Farmers obtained seeds for various tree species, which they sowed to establish nurseries for seedling production. Three farmers were selected to test fuel-efficient stoves.

Farmers visited KARI, AETRI and NAARI to get acquainted with activities/research going on at these Institutes. They reported their observations to the larger group.

Formation and Function of the Farmer Research Committee (FRC)

The Farmer Research Committee was formed in 1996. The committee consists of three men and three women who are among the pioneer FPR farmers. The committee members were selected from different villages to enable farmers in all the villages to consult with them whenever they need information about or assistance with the technologies. The responsibilities of the research committee include: supervising and guiding the participatory research, encouraging farmers to participate, identifying needs and opportunities to be addressed, coordinating with researchers and convening meetings. They are assisted in facilitating the dissemination of technologies, which their trials have proved useful.

The committee meets the first Thursday of every month and participating farmers are called for meetings when the need arises.

Initially, more than 50 farmers participated. Currently, the number of participating farmers is around 70. Among these, about ten farmers have been active since the initiation of FPR, and they have two or more trials per season. They do much independent experimentation. Another 12 farmers have continued to participate, but less actively, and another 10-20 farmers come and go, typically staying active for 1-3 seasons. The villages covered by the FPR have increased to ten from the initial five. During semi-annual meetings, we stress to the new members that FPR is voluntary and they should not expect payment from researchers.

New members are mainly involved in testing/adopting the technologies which have been proved effective.

ACHIEVEMENTS

Despite some shortcomings, the implementation of the sub-project has enjoyed a number of successes:

- Participating farmers have adopted some of the technologies introduced by researchers and evaluated by farmers.
- Vetiver grass is now used for controlling soil erosion, Mucuna is being used as an improved fallow crop and as an intercrop, and Canavalia is also being used as an intercrop. Lablab and Mucuna are fed to livestock.
- Through their independent experimentation, farmers have provided researchers with information, which has been incorporated into a guide to the use of lablab, Canavalia, Mucuna and Crotolaria in Central and Eastern Uganda.
- Information about and seeds for the four green manure species have been provided to numerous government and non-government organizations, including: Kigulu Development Group in Iganga District, SAFAD and IDEA in Kamuli District, Vi Tree Planting in Masaka and Rakai Districts, ACORD in Gulu District, Appropriate Technology in Lira and Apac, Talent Calls in Mukono District and the Kabaka Foundation for Development.
- Participating farmers have contributed to technology transfer including multiplication and sale of seeds for improved bean varieties through the Ikulwe Bean Farmers Association.
- The participating farmers have hosted numerous groups of farmers and students who visit to observe and discuss alternative practices which the participating farmers have adopted.
- Cassava, bean, soybean and upland rice varieties have been introduced to Ikulwe through the FPR process. These varieties are now being grown by both participating and non-participating farmers.
- The FRC holds regular, monthly meetings. It has mobilized farmers to join the FPR, with the result that FPR now takes place in more than ten villages and new members always come during the semi-annual planning and evaluation meetings. The FRC is also involved in technology dissemination activities through visits to nearby villages, and in assisting new participating farmers.
- Farmer participatory research is now recognized as an effective methodology for technology development and transfer by the National Agricultural Research Organization (NARO). The organization has strengthened the Research-Extension Liaison Unit (RELU) by posting a RELU officer at each Institute to ensure an effective link between researchers and farmers. Hence, there is potential to integrate the FPR approach with the RELU activities within NARO.
- Indigenous technical knowledge is useful in the development of the farmer participatory research approach. Farmers usually feel honored whenever they are asked how they solve a particular problem. This builds the farmers' confidence and they feel that they are equal partners in the technology development process.
- Last but not least, the problem-solving abilities of farmers have been improved through access to information, acquisition of additional research skills and the establishment of problem-solving relationships with neighboring farmers.

LESSONS LEARNED

The Ikulwe FPR process has had its problems:

- Payments made to community-based facilitators who serve as part-time field assistants to researchers and assist in the establishment of the more difficult trials and data compilation tasks has been misconstrued as payment for FPR activities. This has led to quarrels among the participating farmers, with the consequences that researchers have had to waste a lot of time solving the internal wrangles, and that some participating farmers have given up FPR activities.
- The formation of the Ikulwe Bean Farmers Association (IBFA) also affected the FPR process because almost all IBFA members are participating farmers, and the two organizations have the same executives. IBFA got a loan to rent a piece of land for their activities, which participating farmers misunderstood as money meant for FPR activities. This implies that if there are several players in the same area farmers get confused due to the different methodologies used.
- There are no follow-up visits by FPR committee members to the farmers/organizations which visit participating farmers and adopt some of the adopted technologies. This has contributed to the lack of documented information on the extent of technology dissemination and transfer.
- The Farmer Research Committee has not performed well. Its members have not developed an independent mentality, and they still feel that researchers should guide them in almost all activities.
- The research team has also let the farmers down in that researchers do not visit farmers at regular intervals and few farmers are covered during mid-season visits.
- Impact assessment studies have not been carried out since the initiation of the FPR activities.

CHALLENGES AHEAD

Non-involvement by extension staff and local leaders has hampered the technology dissemination process. Furthermore, the amount of time researchers have invested in the FPR process does not meet the farmers' expectations; researchers fail to visit all trials during mid-season visits. This challenge must be addressed by increased involvement on the part of researchers coupled with the participation of local leaders and extension staff and by the assumption of more responsibility by the FRC. The elasticity of trials implementation by farmers causes problems regarding correct timing of the planning and evaluation meeting. It delays both the meetings and the delivery of technologies for farmers' evaluation, as it is in these meetings that problems are articulated, potential solutions are identified and research topics are developed. In some cases the lead scientist has to approach the commodity programs in different NARO institutes to advise/provide potential solutions for the problems identified by farmers. This additional step exacerbates the effects of delayed reporting and planning.

There is a need to carry out socioeconomic studies on some of the developed technologies.

Multiplication of vetiver grass (and *setaria spp.*) for use as living barriers for erosion control and of Tephrosia seeds for root rat control is required due to the high demand for the technologies.

Institutional Support

NARO has encouraged the use of the FPR methodology and approach. This has been strengthened by posting a RELU officer to each institute. The RELU officers are former senior staff in the government extension service and act as the liaison officers between researchers and farmers; they are expected to be part of the FPR research teams.

NARO assisted FPR at the Ikulwe site by providing a vehicle whenever required.

Researchers from different commodity programs within NARO attend the planning and evaluation meetings and get to know the technological needs of the farmers.

The Extension service has not provided much support. Extension staffs do not attend the planning and evaluation meetings that are held on a semi-annual basis despite the invitations sent to them. They do not participate in the FPR process.

Logistical Support

Financial support has come from CIAT and the Eastern and Central Africa Bean Research Network (ECABREN), and more recently from the PRIAM project. However, there is a need to increase the FPR budget if the research team is to visit the participating farmers as often as the farmers require. Financial support to the FPR committee is necessary especially for dissemination and technology transfer activities. The committee members have to make follow-up visits to find out how the technologies are faring in other places, to provide their expertise in case of problems and to cope with the increasing number of participating farmers.

Technical Requirements

The researchers provide experimental materials. Though promising, the adoption of technologies that have proved effective is still low. Farmers give various reasons for not adopting these technologies: e.g., seeds for green manures are not edible, good/improved planting materials (including seeds) are not available. An attempt has been made to solve the problem of lack of planting materials by encouraging participating farmers to pool their resources together, and we assist them in acquiring seeds from Uganda Seed Project.

CONCLUSION

The FPR approach is effective in technology development and dissemination. Much applicable information is generated through the collaborative research and farmers assist in disseminating it to other farmers.

The semi-annual meetings held are very useful because it is in these meetings that research topics on the problems encountered by farmers are developed. Farmer participatory research is thus an effective tool/method for enhancing the development and transfer of technologies relevant to the needs of farmers.

There is a need for the Farmer Research Committee to accept more responsibility, and researchers too should invest more time in the FPR process, since the number of villages covered by the FPR is increasing. Sensitization of the local leaders and extension staff needs to be carried out. The issue of the sustainability of the FPR activities needs to be addressed.

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Table 53. Grain yields (t ha^{-1}) of maize and beans grown as the first and second crops after sole cropped crotalaria and weedy fallow[a]

	1st subsequent crop		2nd subsequent crop	
Treatment	**Maize**	**Beans**	**Maize[b]**	**Beans[b]**
Crotolaria[c]	3.99 a	0.56 a	2.63 a	0.74 a
Weedy fallow	2.82 b	0.40 b	2.15 a	0.66 a

[a] Mean separation in a column by LSD (0.05).

[b] Maize and beans grown on alternate sub-plots.

[c] All crotolaria biomass was applied as mulch to the first subsequent maize crop.
Source: Fischler, 1997; Fischler and Wortmann, in press.

Table 54. Maize and bean yield over four seasons as affected by one season legume fallow, legume intercrop and continuous food crop.

Treatments, first season	**Grain yield (t/ha)**			
	Maize			**Bean**
	1st season	2nd season	3rd season	4th season
Mucuna-maize	2.40 b	n/a	3.71 a	0.80 a
Mucuna	n/a	4.24 a	3.42 a	0.67 ab
Maize	3.18 a	2.66 b	2.28 b	0.50 b
Lablab-maize	1.60 b	n/a	2.75 a	0.88 a
Lablab	n/a	3.88 a	2.28 ab	0.70 ab
Maize	2.23 a	2.59 b	1.58 b	0.50 b

[a] Mean separation in a column for same green manure by LSD (0.05) for maize and by LSD (0.10) for beans.

[b] First (maize) and second (beans) crop after intercropped mucuna and lablab.
Source: Fischler, 1997; Fischler and Wortmann, in press.

Table 55. Evaluation of green manure species conducted by farmers in small groups

Observation	Green manure (sole crop) Crotolaria	Mucuna	Lablab	Maize
Observation of soils at planting of the first subsequent crops	The soil after a sole crop of crotolaria was soft (pliable) and thus easy to till.	The soil was dark, soft, and loose (porous). In most cases, a thick layer of leaves protected the soil from erosion.	The soil was moist, cool and soft at the end of the season. A thick layer of leaves protected the soil from erosion. Improved soil tilth persisted.	The soil was hard and dry at the planting of the subsequent maize crop.
Labor demand for uprooting green manure crops, and planting and mulching of subsequent crops	Most farmers found it easy to uproot and mulch the crotolaria. (Two elderly farmers said that uprooting and mulching was tiresome.)	Uprooting Mucuna was difficult: it was deep-rooted and the base of the twining plant was hard to find. It was very easy to till.[a] Weeds were few at planting of the subsequent maize crop.	Uprooting lablab was difficult because it was deep-rooted. Coarse material had to be cut to ease the planting of maize. Little tillage was needed and weeds were few at planting of the subsequent maize crop.	Tillage and weeding were laborious but planting was easy.
Incidence of weeds in first subsequent crops	Generally, no weeding or only one weeding was needed for beans and maize, because weeds were few.	There were no weeds at planting of the subsequent crop. A few volunteer Mucuna plants emerged.	There were no weeds at planting; there were only a few weeds during the season.	There were a lot of weeds at planting and during the season.
Growth of first subsequent crops	Both maize and bean established and yielded well, in most cases.	Maize germinated well and was greener and taller than maize grown after maize. The yields were high.	Maize grew and yielded better than maize, which followed maize.	The maize crop did not perform well compared to maize grown after the green manure crops.

[a]Farmers did not till the whole plot but only a narrow band where maize was planted. Source: Fischler, 1997.

Table 56. Evaluation of four green manure species by 12 farmers, using a matrix ranking method, for different production methods and uses (more favorable status indicated by higher numbers)

Green manure Species	Sole crop	Intercrop with banana	Intercrop with maize	Intercrop with sweet potato	Intercrop with cassava	Fodder quality	Soil Improvement	Weed suppression
Crotolaria	5.7	4.4	5.0	4.3	4.8	2.5	6.4	5.4
Canavalia	4.7	6.8	4.2	3.8	5.0	0.9	5.5	6.0
Mucuna	8.8	6.3	6.0	0.6	6.8	5.2	8.7	9.0
Lablab	8.1	5.3	4.7	0.8	5.0	7.5	7.7	7.9
LSD (0.05)	1.04	1.77	1.26	2.03	ns	2.09	1.06	1.27
Error df	32	30	31	17	36	23	32	32

Source: Fischler, 1997; Fischler and Wortmann, in press

Table 57. Crops/green manure specie combinations which were topics of farmer independent experimentation[a]

	Canavalia n = 11	**Mucuna n = 17**	**Lablab n = 11**	**Crotolaria n =10**
Banana	73	18	18	10
Coffee			9	10
Bean/Coffee	18			
Maize	9	88	73	90
Bean				80
Cassava		18		10
Sole crop		6	18	10

Source: Wortmann et al., in press
n = number of farmers interviewed
(a) the figures represents percentage of the farmers interviewed who carried out IE

Table 58. Positive and negative features of four green manure species as indicated by percent of farmers who mentioned the characteristic

Green manure induced these positive effects	**Canavalia n = 11**	**Mucuna n = 17**	**Lablab n = 11**	**Crotolaria n = 10**
Improved soil fertility	82	88	91	100
Suppressed weeds	55	47	45	50
Kept soil cool, reduced evaporation	64	41	27	
Produced much seed	18	29		30
Prolonged growth	9		18	
Yielded good fodder		12	64	
Reduced erosion	27	29	18	30
Improved soil tilth		4		
Green manure had these negative characteristics				
Climbed on associated crops		76	45	
Seed not edible	18	18		
Laborious to produce		12		70
Uprooting was difficult		18	7	10
Threshing was difficult		6		30

Source: Wortmann et al., in press.

Table 59. Grain yield of maize as affected by Calliandra hedgerow intercropping (cuttings applied as a mulch) and P fertilizer

	Maize grain yield (kg/ha)[1]		
Calliandra	**With P**	**Without P**	**Mean[2]**
1994A			
With Calliandra	1822	1265	1544 b
Without Calliandra	3360	2607	2984 a
Mean [2)] CV = 19.5%	2591 a	1936 b	
1995A			
With Calliandra	2640	2222	2431 b
Without Calliandra	3982	3387	3685 a
Mean[2)] CV = 17.4%	3311 a	2804 b	

[1] Average of six farms with three replications per farm.

[2] In a row (or column), means followed by a common letter are not significantly different at 5 % level.

Source: Wortmann et al., 1998

Table 60. Grain yield of beans as affected by Calliandra hedgerow intercropping (cuttings applied as a mulch) and residual effect of P fertilizer

	Bean grain yield (kg/ha)[1]		
Calliandra	**With P in previous season**	**Without P in previous season**	**Mean[2]**
1994A			
With Calliandra	528	392	460 b
Without Calliandra	612	480	546 a
Mean [2] CV = 22.0%%	570 a	436 b	
1995A			
With Calliandra	1198	722	960 a
Without Calliandra	1413	873	1143 a
Mean[2] CV = 23.9%	1305 a	798 b	

[1] Average of six farms with three replications per farm

[2] In a row (or column), means followed by a common letter are not significantly different at 5 % level

Source: Wortmann et al., 1998.

Table 61. Grain yield of bean and maize (kg/ha) in seasons 1996A, 1996B and 1997A[1] (Combined over sub-plots with previous P treatments); hedgerow intercropping trial, Ikulwe

Calliandra	**Beans 1996A**	**Maize 1996B**	**Beans 1997A**
With Calliandra	770 a	1504 a	491 a
Without Calliandra	710 a	1840 a	285 a
Mean	740	1672	388
CV(%)	29.6	24.0	42.6

[1]Average of two farms in 1996A and 1996B, data of 1997A from one farm only
Source: Wortmann et al., 1998

DISCUSSION SESSION

Question 29.
Are there indigenous soil classifications associated with management?
Response
Yes

Question 30.
How do you insure that the choice made by the farmer is going to work under different environments? What methodology do you follow to arrive to a decision?
Response
It is very difficult, you have to allow some degree of freedom by giving farmers a basket full of technologies from which to choose.

Question 31.
Why was vetiver technology introduced only as planting material for farmers independent experimentation, when knowledge about contour establishment fertility, density and multiplication are also important elements?
Response
These were introduced by farmer to farmer visits to Masaka.

Question 32.
Can the shortcoming that FRC members are also members of an income generating "bean association" be looked at as an advantage, e.g. as a source of credit?
Response
It can be an advantage or disadvantage. However, the two groups operate differently and can compromise their role in FRC, which has no cash component.

Question 33.
One of the main reasons for conducting participatory soil classification is to improve the understanding of the DA's (development agent) from boss. ITK a classical soil classification. Did you attempt to match the local?
Response
The farmers' ITK describes well the textual classes of soils, and some of the selected physico-chemical characteristic described by farmers match well with lab-analytical data. However, we have not matched the farmers' ITK to the FAO or USDA classification systems. The names given to the soils have the same meaning over large areas. They are simply synonyms.

SECTION III
PARTNER PROJECTS

DYNAMICS OF VILLAGE ORGANIZATIONS, WEALTH AND GENDER IN WESTERN KENYAN VILLAGES: ANALYTIC METHODOLOGIES AND CHALLENGES

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ABSTRACT

Knowledge of farmers' socioeconomic situations and the biophysical conditions prevailing on their farms is key to the success of farmer-participatory technology development. In western Kenya a pilot project is underway to test biomass transfer technology and improved fallow technology (BTT & IFT), which are potentially beneficial for soil fertility replenishment. A participatory approach to characterizing the communities (Luhya and Luo) is being used to analyze village organizations, wealth categories and gender participation. Seven Luhya and five Luo villages were characterized regarding village organizations and wealth categories. A gender analysis was also carried out in two villages (one Luo and one Luhya). It was found that the Luo villages, with an average of four groups per farmer, had more organizations than Luhya villages, which had an average of two groups per farmer. Although the Luhya villages had fewer organizations and many members did not belong to any group at all, the total number of clans identified was 26 compared to three in the Luo villages. Wealth ranking (WR) exercises identified three or four groups in both Luo and Luhya villages, and the criteria to distinguish them were similar in some respects. When wealth categories were linked to farmers participating in the two technologies it was found that most of those not participating were in WG (Wealth Group) 3 and WG4 (WG1 being the most wealthy), and the majority were female/widow-headed. It was also evident that those in WG3 and WG4 were more associated with church groups in the Luhya villages and women's groups in the Luo villages. An extension and dissemination model has been proposed which will use elected delegates from each of the organizations to form village committees and then locational committees.

INTRODUCTION

Farms in western Kenya have acute phosphorus (P) deficiencies, (< 5 mg/kg soil; Olsen), low nitrogen (N) (< 0.2 mg/kg soil) and low pH (4.2-5.2; 1:10 soil:H_2O). Acrisols and Oxisols dominate in some areas and Ferralsols in others, but all have a high P-fixing capacity. Resource-poor farmers who live in these areas have a population density of 800-1200 people/km^2 with farm sizes of a maximum of 0.4 ha per household (~7-9 people). The highlands of western Kenya represent 15% of the country's total area and account for 40-45% (6.3 million people) of its total population. Increased population is having a profound effect on the fertility status of these soils due to continuous cropping of maize to meet the demand for food (Hoekstra and Corbett, 1995), which averages 800 kg of maize /household/year. For example, at the farm level, based on the 120 kg of maize/person/year nutritional requirement, the quantity of maize needed by a household of 7 is 840 kg/year or 70 kg/month. With a crop yield of 1000 kg/ha/season (best crop yield), the shamba's production for two seasons under maize (30% of the land) is 600 kg. This rate of production leaves a deficit of 240kg/year, which translates to 3.4 months of deficit. If the land holding is less than 1 ha (e.g., Tiriki area of Vihiga district, where approximately 28% of the household is under maize crop), the crop yield is less than 1000 kg/ha/season and the N and P deficiencies are high, the deficit can grow to 9 months (Maseno RRC, 1998). In addition, wood fuel resources are quickly growing scarcer. Harvesting of maize and wood has contributed to a net nutrient depletion. Nutrient budgets for sub-Saharan Africa show a net annual depletion of N, P and K as a result of long-term cropping with little or no external nutrient inputs (Stoorvogel et

[1] Maseno Regional Research Center, Kisumu, Kenya.

al.,1993). The depletion of soil nutrients is particularly high in the densely-populated humid and subhumid highlands of East Africa (Smaling, 1993; Smaling et. al.,1993). These factors combine to threaten food security.

Farm forestry and agroforestry are 'technologies', which are being advocated as ways of addressing soil fertility problems in this region. They have met with considerable success. For example, improved fallows technology (IFT) and biomass transfer technology (BTT) involving various tree/shrub species are showing great potential. Collaborative projects between CARE (K) and KEFRI (Kenya Forestry Research Institute) and between KEFRI, KARI (Kenya Agricultural Research Institute) and ICRAF (International Center for Research in Agroforestry) seek to research soil fertility and wood fuel problems through farmer-designed, farmer-managed trials. These trials investigate a range of technologies, from IFT, BTT, agronomic fertilizers (cheap sources of inorganic/organic fertilizers, e.g., rock phosphate, manure, etc.), to seed collection and testing, species screening, and maize and bean varieties testing. High-value trees (fruit trees) and crops (kales, onions and tomatoes) are also being tested. This research currently involves a total of 1000-1200 farmers in different agroecological zones, from high potential to low potential and with different biophysical conditions. The farmers also have varying acreage and other resources, and employ different soil fertility and conservation practices that call for different strategies. These heterogeneous conditions present challenges for research and extension work.

Current soil fertility practices: In western Kenya the farmers can broadly be categorized into three groups: those who apply no inputs at all; those who use organic inputs (e.g., farmyard manure [FYM]); and those who apply some amount of inorganic fertilizers. A small number of the above also utilize soil conservation measures such as terracing. Lack of knowledge notwithstanding, most of the farmers cannot afford external inputs; hence the current focus on cheaper sources of external inputs.

Current wood fuel practices: Most farmers in this area plant trees. However, this is usually subject to availability of germplasm/ seedlings. Boundary planting predominates; wood lots are not as common. Little attempt has been made to define a niche for these species in such a way as to avoid the perception among farmers that the trees are occupying most of their arable land. However, it is recognized that the planting of trees on farms as done with IFT could provide much-needed fuel wood as well as addressing soil fertility issues.

Pilot Project

A pilot project on soil replenishment and recapitalization was started during the short rains of 1996 with the overall objective of sustainably improving the food security situation and the socioeconomic welfare of rural households in western Kenya through increased agricultural productivity using integrated soil fertility strategies. The project focuses in particular on smallholders, female-headed households and farmers with poor access to resources.

Institutional Arrangements

Two national research institutes, namely the Kenya Forestry Research Institute (KEFRI) and the Kenya Agricultural Research Institute (KARI), are involved in the pilot project. There are several collaborating institutions (listed below). These range from international organizations and NGOs to small-holder/community-based organizations (CBOs).

Collaborating institutions

International Center for Research in Agroforestry (ICRAF)
CARE (K) International – NGO
Ideas Research and Management (IRAM) – CBO
Siaya Community Development Project (SCODP) -- small inputs CBO
Ministry of Agriculture and Livestock Development:
--Soil and Water Conservation Extension Unit
--Livestock Extension Unit
--Crops Extension Unit
--Marketing Extension Unit

PR team

K. Mwendwa - Soil Scientist--KEFRI
E. Obonyo - Sociologist--KEFRI
C. Obonyo - Agricultural Economist--KEFRI
A. Niang - Principal Scientist--ICRAF
J. de Wolf - Ecologist, Associate Scientist--ICRAF (Data manager)
N. Ogaro - Soil Scientist--KARI Kakamega
J. Rotich - Livestock--KARI Kakamega
S. Obaga - Soil Scientist--KARI Kisii
Q. Noordin - Research Extension Liaison Officer--KEFRI
T. Svan Hansen - Geographer--ICRAF (Associate Scientist)
J. Agunda - Senior Technical Supervisor--CARE (K)
D. Okello - SCODP
D. Mwango - Extension Soil and Water Conservation--MOALD

Site Selection

The pilot project devised a methodology for working with villages within our mandate area. In the short rains of 1996, the village of Luero was selected in the predominantly Luo Siaya District, and a village in the Ebukanga area was selected in the predominantly Luhya Vihiga district. In the next long rains the project spread into the neighboring villages. Currently, there are 17 villages actively involved in on-farm testing of improved fallows and biomass transfer. The Project is also involved in several locations in Siaya and Homa Bay districts where CARE (K) International is conducting on-farm adaptive research with farmers (ARFs) whom they selected after they conducted a Participatory Research Needs Assessment (PRNA).

Agroecosystem Characterization

Table 62. Characteristics of the study area in the food crop-based land use system of western Kenya

	Siaya and Kisumu	**Kakamega**
Cultural group	Luo	Luhya
Origin of cultural group	Nilotic herdsmen	Bantu cultivators
Population/km^2	400	1000
Average household size (members)	4 - 5	8
Average farm size	1 – 2 ha	< 1 ha
Cropping system	Maize and beans intercropped, cassava, sorghum (short rains)	Maize and beans intercropped, cassava, sorghum (short rains)
Labor availability	Limited	High
Gender roles	Women -- Cultivate land, collect firewood, do household chores	Same
	Men--Make decisions on farm management, sale of harvest, etc.	Same
Importance of off-farm cash income	High	Moderate
Annual rainfall (mm) (bimodal)	1500 – 1900 mm	1800 – 2000 mm
Dominant soil types	Acrisols, Ferralsols, Nitisols	Acrisols

APPROACHES AND METHODOLOGIES

Spatial Stratification of Western Kenya

Studies undertaken by Bradley (1991) and Carter (1996) have shown that western Kenya is heterogeneous in terms of demography, ethnicity, rainfall, soil types and cropping systems. Ethnically, the Luhya-speaking people dominate the region, but other important ethnic groups include the Luo, found in the south and southwest and in some parts of Kakamega; the Iteso, found in the west on the border with Uganda; and the Kalenjin (Nandi), found in the east. In terms of soil types, strongly leached acid Acrisols and Ferralsols dominate the western highlands of the Rift Valley and the Mount Elgon massif. Pockets of richer Nitisols are found in the northern parts, while the northwest part is dissected by river valleys where hydromorphic gleysols predominate. The poorest soils (acid, infertile, shallow, stony and often lateritic) are found in Siaya District. Another important characteristic to consider is the range of crops grown, particularly the food crops such as maize and beans, as opposed to cash crops. The nature and status of the road infrastructures and market places can complement these characteristics. A zoning using these parameters among others are in the process of completion at ICRAF.

Problem Diagnosis

Problem diagnosis was conducted through wealth ranking and Participatory Learning and Action Research (PLAR) techniques. Wealth ranking was conducted in three villages. Village organizations were identified in seven Luhya and five Luo villages within our mandate area.

Farmers' Categorization in Different Wealth Groups

Hypothesis 1: Through ascertaining farmers' resource endowments, it is possible to define a village in terms of what the farmers are able to afford, and this can be the first step in participatory technology development.

Hypothesis 2: Wealth ranking is a community-oriented tool that can be used in assessing impact at the village level by analyzing shifts within the wealth category groups.

Farmers' socioeconomic backgrounds are complex and diverse. Different groups of farmers have different needs and capacities that require different practices and technologies. These groups can be defined according to various criteria relative to the nature and level of available resources and their accessibility and control, as well as cultural, economic and political parameters, which can all, be defined as wealth. Referring to wealth, Grandin (1988) states that "inequality of some sort exists in every human society; the degree of the inequality and the attributes upon which it is based do however vary. Every human society defines certain differences between its members as being of great importance and values certain characteristics above others." Because farmers of different wealth categories are likely to have different needs and problems and therefore varying levels of ability and motivation to test and adopt technologies, the use of farm-level strategies need not be emphasized.

Wealth ranking was undertaken not only to categorize the different farmers and target the less resource-endowed among them, but also to identify the criteria that farmers use to define wealth and categorize themselves. Farmers identify indicators which make differences in their lives and which can be used for impact assessment.

Wealth ranking was undertaken in three villages. Farmers were asked to list and group attributes, which distinguish them on the basis of differences in resource endowments. Afterward, farmers were given cards with household names and were asked to divide them into different resource endowment groups according to these attributes (Tables 63 and 64). Using this method, farmers typically define three or four wealth categories. The indicators farmers commonly use to define different wealth categories include:

- number and type of cows possessed
- size of farm
- use of organic and/or inorganic fertilizers
- hiring of labor to perform farm activities

- use of hybrid maize
- type of house (permanent or semi-permanent thatched grass or iron sheet roofs)
- level of off-farm income
- highest level of education attained by the children in the household
- level of contact with extension services
- degree of food self-sufficiency.

Other indicators such as selling or buying napier grass or having alcohol problems seem to be related to specific villages.

Additional key variables such as gender can be added. The distribution of the female-headed households between the different wealth groups can easily be determined. When on-farm research is undertaken in the area, a wealth-ranking exercise can help to identify which wealth classes the participating and non-participating farmers belong to. However, wealth classes are not fixed and hence it is important to repeat the same exercise with different groups within the same village or cluster of villages in order to identify the most common attributes. It is also important to determine the channels, which enable households to move between wealth classes and the strategies they use to move from poor to wealthy categories. This will help to identify not only researchable problems but also researchable opportunities.

Table 63. Wealth ranking characteristics of farmers in each wealth category identified in Sarika village (132 farmers)

Group 1 (12%)	**Group 2 (39%)**	**Group 3 (49%)**
• Average farm size ≅ 2 acres	• Average farm size ≅ 2 acres	• Farm sizes < 2 acres
• Hybrid and local cows	• Some have local cows	• No cows
• Permanent houses	• Permanent/semi-permanent houses	• Grass thatched houses
• Children attain secondary education	• Children attain secondary education	• Few children get primary education
• Hire labor	• Do not hire labor	• Do not hire labor; a few work for Group 1
• Use inorganic fertilizer: DAP in long rains	• Some use inorganic fertilizer: small quantities in long rains	• Do not use inorganic fertilizer
• Use animal manure	• Use animal manure	• Some use compost
• Few sell or buy napier grass	• Few sell or buy napier grass	• None sells or buys napier grass
• Majority buy hybrid maize seed for the long rains and use local seed in short rains	• Some farmers use hybrid maize seed while others use local maize seed	• Use local maize seed
• Few have off-farm income from formal employment	• Few have off-farm income from formal employment	• No off-farm income from formal employment

Tables 63 and 64 display the results of the wealth-ranking exercise that was carried out in Sarika Village, Siaya District and Ebuchiebe Village, Vihiga District. The villagers gave several criteria for resource endowment, of which the following five were the most common:

- use of inorganic fertilizers or manure
- use of improved seeds
- timing of weeding
- farm size
- livestock ownership.

Three wealth categories were thereby identified: Group 1 comprised 14% of the villagers, who were classified as the wealthy farmers; Group 2 comprised 26% of the farmers, who were classified as enjoying average wealth; and Group 3 comprised 60% of the farmers, who were classified as poor. The farmers in Group 3 depend for their income on those in Group 1.

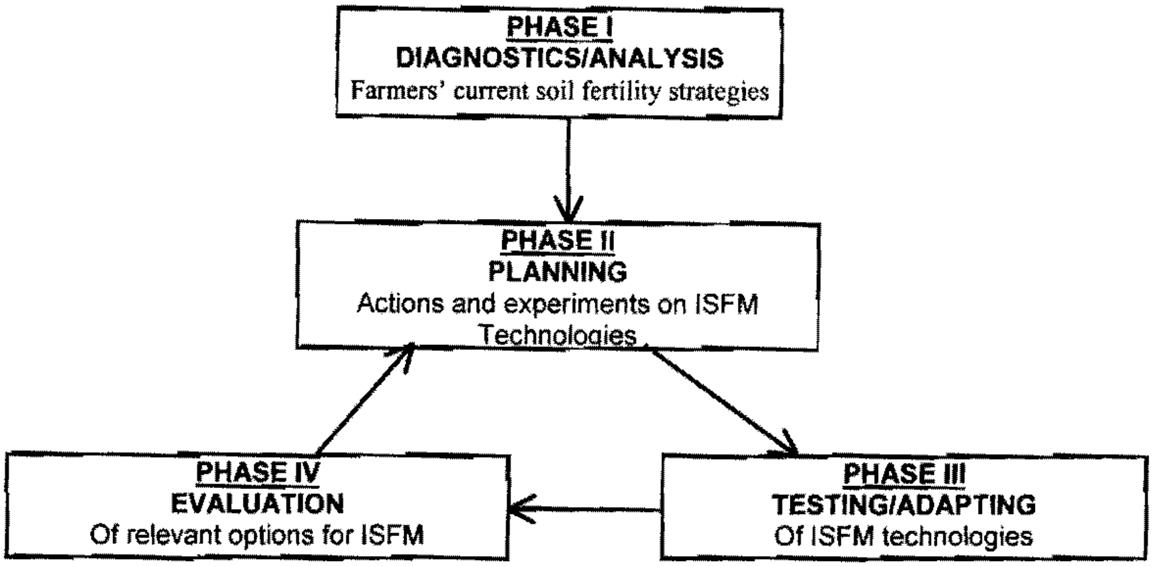
Table 64. Wealth ranking characteristics of farmers in each wealth category identified in Ebuchiebe village (75 farmers)

Group 1 (14%)	**Group 2 (26%)**	**Group 3 (60%)**
• Farm size 1-2 acres	• Farm sizes 0.5-1 acre	• Farm sizes < 1 acre
• A few have hybrid cows and 1-2 local cows	• Some own 1-2 local cows	• Few have local cows
• Inorganic fertilizer is used by most farmers	• Inorganic fertilizer used by very few farmers	• Do not use inorganic fertilizer
• Use animal manure and compost	• Use animal manure and compost	• Few use compost
• Occasionally hire labor from Groups 2 & 3	• Do not hire labor; some work for Group 1	• Do not hire labor; some work for Group 1
• Use hybrid maize seed	• Use local maize seed	• Use local maize seed
• Permanent/semi-permanent houses	• Many semi-permanent and grass-thatched houses	• Few semi-permanent or grass-thatched houses
• Children attain university education	• Children attain secondary education	• Children attain primary education
• Grow napier grass for their cows	• Grow napier grass for their cows	• Do not grow napier grass
• Off-farm income/small-scale business	• Depend on farm produce for income	• Depend on working for Group 1 for income
• No malnutrition	• No malnutrition	• Malnutrition

Participatory Learning and Action Research

Participatory learning and action research (PLAR) draws on PRA and Resource Flow Modeling (RFM) at the farm level (Lightfoot et. al.,1992) and focuses on learning by farmers and on facilitation of this learning by researchers (Defoer et. al.,1997). The process involves four complementary, interlinked phases (see Figure 8). Figure 9 details the diagnostics/analysis that lead to the initial stages of planning.

Figure 8. PLAR processes



Inter- and Intra-village Organizational Diagrams

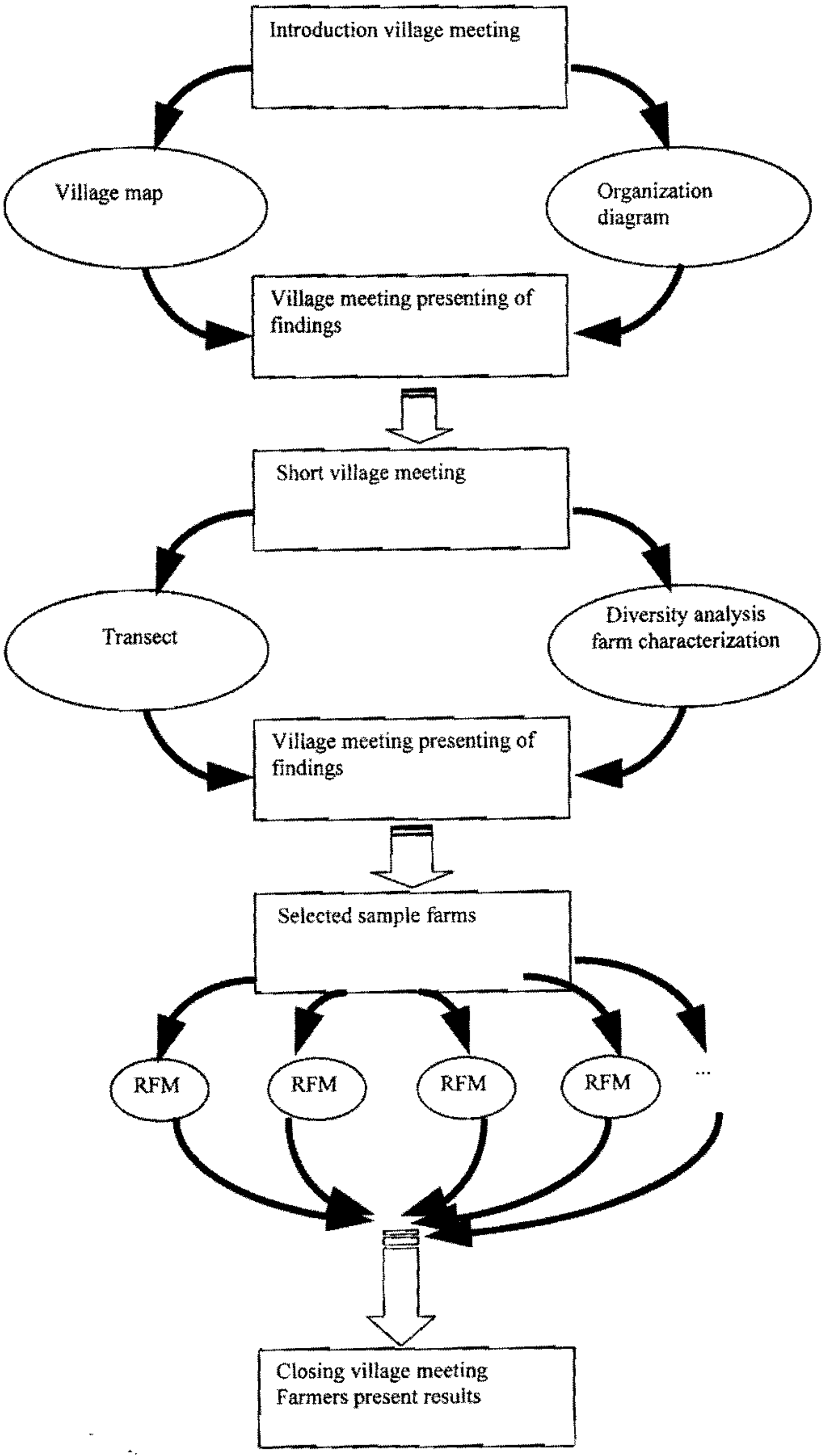
Hypothesis 1: Village organizations are constituted differently based on ethnicity

Hypothesis 2: Village organizations can be used to disseminate technologies in whose development farmers participate to other villages/communities

Hypothesis3: The poorly-endowed farmers belong to particular groups; by working with those groups we will be working with some of the most vulnerable members of the community

Organizational diagrams are developed in each village or group of villages to identify the major organizations, e.g., self-help groups, women and youth groups, church groups, etc. Their goals are listed and the groups are ranked according to their importance. Traditional structures (such as clans) of which villagers are members are identified. Exploring the links among these traditional organizations as well as the links between them and external groups assesses Farmer's information and communication networks. The social relations of all the individual farm-households in this case can also be identified. Farmers' structures associated with farmers' wealth and soil fertility classes can be used to sample participating farmers in on-farm research. Village organizations can also be used to facilitate knowledge and technology dissemination. The activities of these groups can be documented, and farmers are able to rank the groups in terms of their importance according to their own criteria. These criteria generally include the type of activities the groups undertake (especially income generating), the frequency of group meetings and attendance at those meetings, and whether the groups offer some form of credit.

Figure 9. Detailed diagnostic and analysis stages



Village organizations are groups composed of farmers in the village. They vary in size from a handful of members to the entire village. Though membership may spread to other villages, groups generally consist of residents of a single village. Group formation is inspired around issues that affect members. They can range from common interest groups to those concerned with proper management of common resources. Village organizations can play a role in stimulating community participation in any activity, since there is a greater potential for mobilization and participation of the members. In most villages, indigenous organizations provide an initial entry point for outside agencies to disseminate whatever information they have. Also, village organizations often have established linkages within the village that can facilitate common action. They provide a forum for discussing and exchanging ideas and disseminating information to a large audience.

Several villages comprised of different ethnic groups were used in this exercise. Table 65 shows the results obtained so far from seven Luo and five Luhya villages. Generally, various types of organizations operated in each village. The Luhya villages in total had fewer organizations than did the Luo villages, but similar kinds of organizations operated in both groups of villages. However, the Luhya villages had more clans than did the Luo villages. The number of farmers (23) in Luhya villages who do not belong to any (non-clan) group is high (Figure 11). However, every farmer in these villages belongs to a clan. Therefore, if some farmers cannot be reached through groups, they can be reached through their clans.

Farmers' organizations associated with farmers' wealth and soil fertility classes were used to sample farmers participating in on-farm research. In general, the majority of the farmers belonged to either church groups or women's groups. Farmers' groups attracted the fewest members.

Table 65. The types of organizations, number of groups and number of clans in Luo and Luhya communities in western Kenya

Ethnicity of villages	**Types of village organizations**								
Luhya villages	Number of groups	Women Group	Youth Group	Church Group	Clan Group	Village Group	Welfare Group	Farmer Group	Number of clans
Esikwata	4	1	2	1					3
Emakunda	5	1	1	2			1		3
Shirotsa	10	7	1	2					
Esabwali	7	1		4			1	1	9
Eshikhuyu	4	1	1	1			1		7
Ebuchiebe	10	2		3	3	1	1		4
Musikuku	5	1		3		1			
Total	45	14	5	16	3	2	4	1	26
Luo villages									
Nyaminia	24	19	1	2	1		1		
Madiri	17	10	1	5	1				
Sauri	10	3	1	4		1	1		
Luero	9	2	1	2	1	2		1	3
Sarika	11	5	2			4			
Total	71	39	6	13	3	7	2	1	3

Table 66 shows the number of farmers affiliated and unaffiliated with groups and the average number of groups per farmer. This comparison has been made between five Luhya and three Luo villages. It was found that the percentage of farmers not affiliated with any groups in the Luhya villages (16%) was higher than that in the Luo villages (5%). In one particular Luo village (Luero) all the farmers were affiliated with at least one group. Farmers in the Luo villages belonged to an average of four groups, whereas those in Luhya villages belonged to an average of two groups.

Tables 67 and 68 list the organizations and their relative importance for Musikuku (Luhya) and Sarika (Luo) villages. There were five and 12 organizations respectively. In the Luhya villages all but two of the groups were church-based. However, in the Luo villages the groups were very diverse. There was only one women's group in Musikuku while in Sarika there were as many as five women's groups. In the Luhya villages the Ematse Village Group and the Church of God Group were the most important while the women's group was the least important. In Sarika village the Sarika Women group and Sarika Welfare society were ranked as the most important groups. Of interest in Sarika village is the ranking of the Maendeleo ya Wanawake group as eighth out of 12. This is very important because Maendeleo ya Wanawake is a highly recognized, quasi-government national body with substantial backing from donors and government. These institutional advantages might lead researchers to expect that the group would be considered by villagers to be very important. On the ground, however, the reverse is true. This example underscores the necessity of analyzing village organizations in the course of targeting technologies, in order to ensure that researchers and extensionists don't end up working with the "wrong" groups when developing technologies or setting up credit schemes.

Table 66. Number of organizations and farmers affiliated with them per village

Ethnicity of villages	**Number of farmers affiliated to groups**	**Number of farmers not affiliated to group**	**Average number of groups/farmer**
Luhya villages			
Musikuku	105	23	2
Emakunda	62	13	2
Eshikhuyu	94	4	2
Esabwali	129	25	1
Ebuchiebe	75	9	3
Total	**465**	**74**	**Average 2 groups per farmer**
Luo villages			
Sarika	131	1	5
Sauri	65	13	2
Luero	61	0	5
Total	**257**	**14**	**Average 4 groups per farmer**

Detailed Look at Musikuku (Luhya) and Sarika (Luo)

Table 67. Musikuku village organizations and their relative importance according to farmers

Name of organization	Relative importance
Church of God	2
Pentecostal Church	4
Apostolic Church	3
Musikuku Women Group	5
Ematse Village Group	1

1=most important organization

Tables 69 and 70 show the three most important groups and their activities in Musikuku and Sarika villages. It should be noted that the groups in Musikuku are more socially oriented than the Luo groups, which are more concerned with income generation and development. One implication of these diverse orientations is that when going into the two villages to introduce, for example, credit organizations, different approaches will be required. In the Luhya village it might be necessary first to train the farmers on how to set up income-generating projects before embarking on the creation of credit organizations.

Table 68. Sarika village organizations and their relative importance according to farmers

Name of organization	Relative Importance
Sarika Women Group	1
New Anyiko Youth Group	6
Kinda Women Group	5
Kogwoum Wananee Welfare	4
Sarika Welfare Society	2
Sarika SDA Church	7
Okey Women Group	12
Maendeleo ya Wanawake W.G.	8
Anyiko Youth Group	3
Chuth Mbel Women Group	9
Yarengo Totieni Women Group	10
New Apostolic Church Group	11

1=most important organization

Table 69. Functions of the three main Musikuku village organizations

Organization	Tasks and activities	Sources of information
Ematse	Road repair, terracing Burial arrangement Water development	Social servicemen
Church of God	Burial arrangement Marriage eremonies Church building	Social servicemen Mass media
Apostolic Church	Burial arrangement Marriage ceremonies Church building	Social servicemen Mass media

Table 70. Functions of the three main Sarika village organizations

Name of the organization	Tasks and activities	Source of information
Sarika Women group	Zero grazing Poultry keeping Petty trade	Social Servicemen Mass media
Sarika Welfare	Water projects Funeral arrangement Road development	
Anyiko Youth Group	Splitting of wood/timber Petty trade Workshop operation	Mass media Social Servicemen

Figures 10 and 11 depict diagrammatically the types of linkages between various groups. The figures indicate that Luhya groups enjoy fewer internal and external linkages than do Luo groups. This has implications for the dissemination and diffusion of technologies. Preliminarily, it can be said that by working with one or two groups in the Luo areas, one is effectively working with several other groups. In the village of Sarika, dissemination is facilitated by the fact that all but one of the farmers belongs to one group or another.

Gender Analysis

In the course of the project two technologies were being tested in all the villages: biomass transfer technology (BTT) using *Tithonia diversifolia* as organic material; and improved fallows technology (IFT) with *Crotolaria grahamiana* and *Tephrosia vogelii* as test species. One hundred eighty-four households in the Sarika and Ebuchiebe villages were analyzed for gender composition vis-à-vis wealth categories (Table 71). Households headed by males were separated from those headed by widows (considered the most vulnerable of the female-headed households). It was found that all the WG1 households were male-headed while 85% of the WG3 and 71% of the WG4 households were widow-headed. These findings demonstrate clearly that the poorest of the poor were found in widow-headed households. With these two technologies an attempt was made to assess men and women's participation in the two villages (Table 72).

Table 71. Percent distribution of male-headed households and widow-headed households in Sarika and Ebuchiebe villages (n=184 households)

Wealth group	Male-headed households	Widow-headed households[1]
Group 1 (Rich)	100	0
Group 2 (Average)	98	2
Group 3 (Poor)	85	15
Group 4 (Very poor)	71	29

[1]considered the most vulnerable group among the female-headed households

The participation was analyzed in terms of the wealth categories the farmers belong to. Gender analysis on both technologies combined revealed that in wealth categories 1 and 2, the participating (P -- 78% of 184 households) and non-participating (NP -- 22% of 184 households) farmers were all male-headed. On average, even in WG3 a disproportionate number of male-headed households were participating compared to widows/female-headed households, while in WG4 the number of males and females participating was the same. It should be noted that some of the households were involved in both agroforestry activities.

With improved fallow technology (Table 73), the participating farmers fell mostly in wealth groups 1 and 3, with the fewest participants falling in group 4. About 57% of farmers in WG1, 28% in WG2, 43% in WG3 and 4% in WG4 generally practiced biomass transfer technology. On average, more farmers were using IFT than BTT, and farmers in WG4 had the lowest levels of participation. The majority of the widow-headed households fall into categories WG3 and WG4.

Figure 10. The linkages between various organizational groups in Musikuku village and the number of farmers within them (128 households)

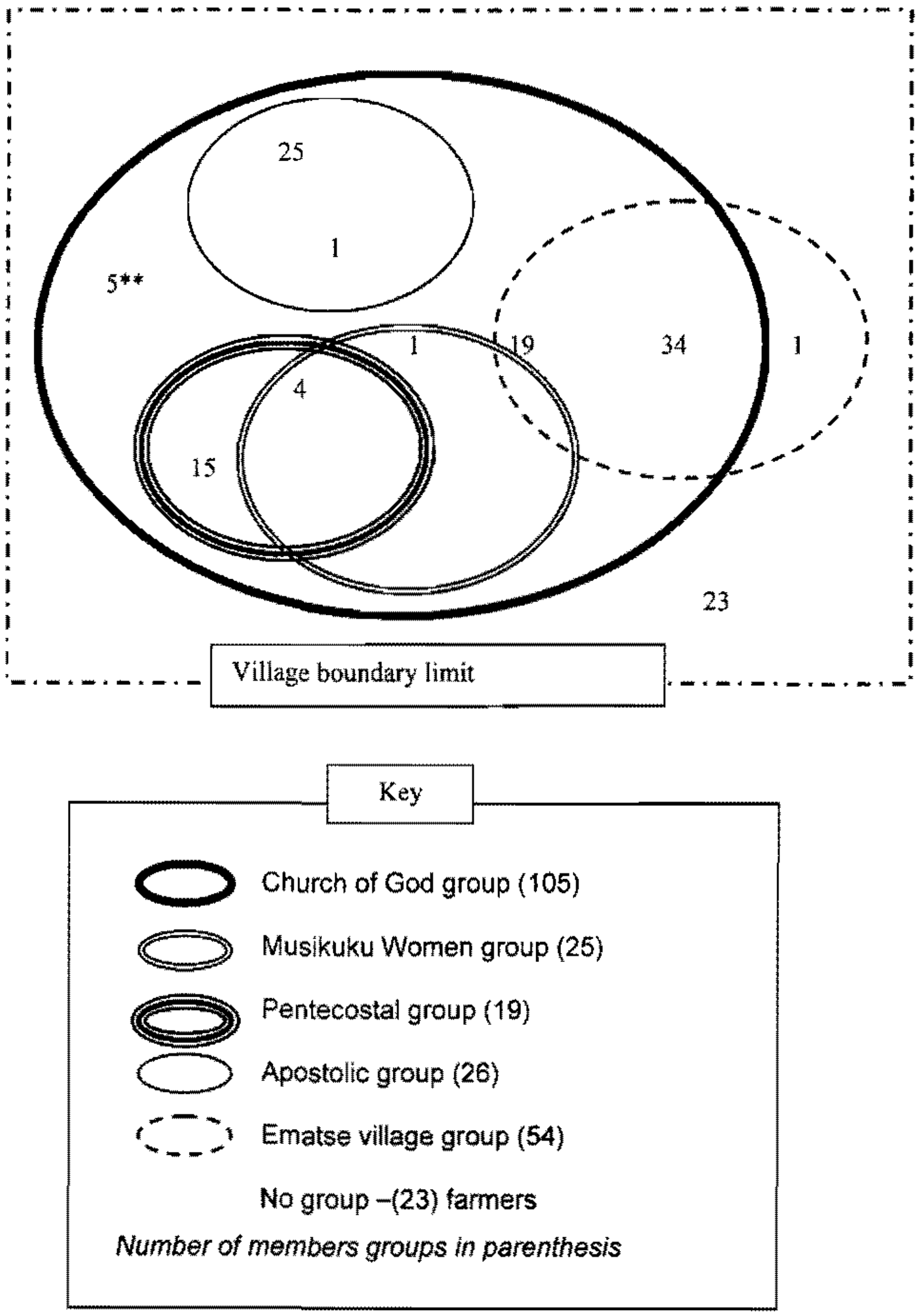
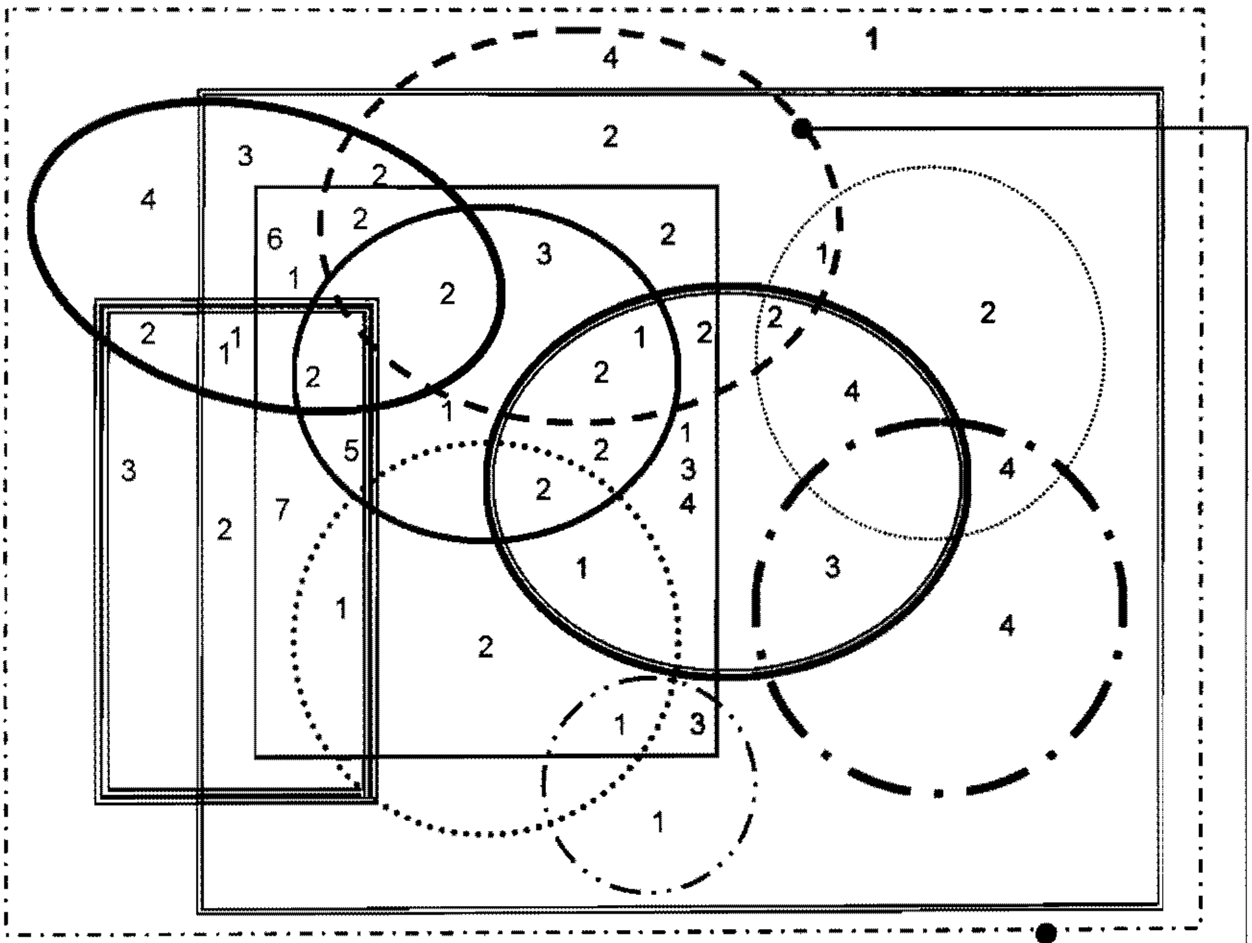


Figure 11. The linkages between various organizational groups in Sarika village and the number of members within each organization (village = 132 households)



Key

C - Nyarengo Tatyen Women Group (25) members
B - Sarika Welfare Group (56)
C - Chuth ber Women Group (27) ??
B - Kogwuom Wananee Group (88)
C - Anyiko Youth Group (7)
C - Sarika Women Group (20)
C - Kinda Women Group (11)
C - New Anyiko Women Group (26)
C - Sarika MYWO (13)
B - Sarika SDA Group (24)
B - New Apostolic Group (5)
C - No Group Affiliaton (1)

N.B: C = Circle   B = Box

Table 72. Percentage of farmers participating in agroforestry technologies (improved fallow and biomass transfer) according to gender and wealth group in Sarika and Ebuchiebe villages (n=184 households)

Wealth group households	Male-headed households		Widow-headed	
	% farmers participating	% farmers not participating	% farmers participating	% farmers not participating
Group 1(Rich)	78	22	*	*
Group 2(Average)	53	45	0	2
Group 3 (Poor)	58	27	15	0
Group 4 (Very poor)	19	52	18	11

* there were no widow-headed households in wealth group 1

Table 73. Percentage of farmers participating in improved fallow and biomass transfer technologies according to wealth category in Sarika and Ebuchiebe village (n=184 households)

Wealth group	Improved fallow technology		Biomass transfer technology		Total[1]	
	% farmers participating	% farmers not participating	% farmers participating	% farmers not participating	% farmers participating	% farmers not participating
Group 1 (Rich)	78	22	57	43	78	22
Group 2 (Average)	52	48	28	72	53	47
Group 3 (Poor)	73	27	43	57	73	27
Group 4 (Very poor)	35	65	6	94	37	63

[1]total percentage includes farmers who are either participating or not participating in either or both technologies

These findings raise a number of questions:

- were non-participating farmers not participating because of their socioeconomic disadvantages? (e.g., lack of labor)
- were they the farmers least informed about the technologies? and if so, why?
- what was their representation in the village meetings with farmers, extensionists and researchers?
- what proportion of these farmers were men, women or widows?
- were there any cultural factors that inhibited participation?

A large number of participating farmers in WG1 showed interest in the technologies. It is possible that they represent a latent pool of knowledge and can be tapped to act as trainers of the other farmers through a community-based approach.

Establishing Community-Based Trainings and Visits

Hypothesis 1: Researchers and extensionists can facilitate and catalyze extension and technology dissemination through village and locational committees

There is little presence of extension staff at the local level. For example, Vihiga district with 73,751 households (516,000 persons) distributed throughout 664 villages counts 53 field extension workers (FEWs) and 26 subject matter specialists (SMS). The number of contact groups and contact farmers receiving information from extension are 224 and 1,844 respectively. The ratio of FEWs/households is one FEW for 1,392 households. In reality each FEW is in contact with only 35 households and four organizations. Even with these contacts, interaction remains superficial because of logistical problems.

The proposed approach, which will be tested in one location in collaboration with the International Agroforestry Extension Project of CARE (K), will link all the villages and the majority of farmers to extension staff with a higher level of interaction in the context of the same logistical problems and the same number of extension staff. The first step is the identification of village structures including the clans and their respective members. This exercise is undertaken by the farmers themselves and normally takes two hours. Extensionists will be trained in this methodology to undertake the same exercise in their respective locations. After agreeing on certain criteria (e.g., individuals' dynamism, good communication skills, acceptability, gender sensitivity, knowledge, ability to enhance community mobilization, etc.), each organization will elect a delegate for a fixed period (one or two cropping seasons). Because some of the farmers belong to multiple organizations, one farmer may represent more than one organization. The delegates will form a village committee and elect a chairman, a secretary and a treasurer. At the location level a locational committee (LC) representing all the villages will be formed. This committee will be comprised of the village committee's representatives as well as members of development agencies such as NGOs and extension services.

The locational committees (LCs) will organize planning meetings. The LCs will agree on activities to be undertaken, e.g., on-farm testing, field visits, training, etc. Decisions will be reported back to the village committee delegates. Each delegate will have a list of the members of his organization. The village committee will possess the list of farmers by organization and the LCs will possess the list of farmers by village and organization. When applied in Vihiga district this approach will concern 664 villages. Instead of dealing with 35 contact farmers and four groups, each FEW will work with 12 villages through one location committee and 12 village committees. This will allow three times more interactions than the present training approach.

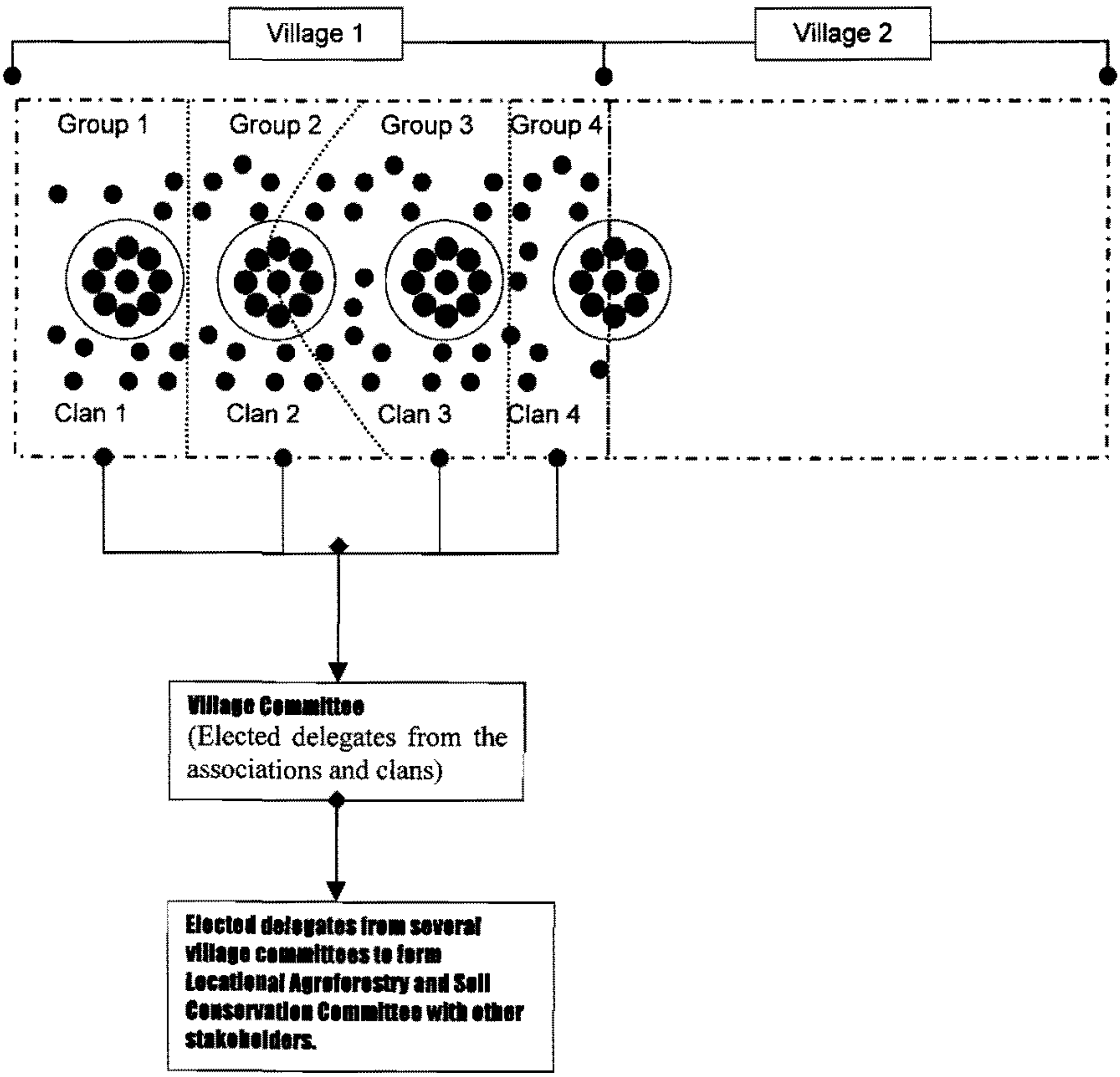


Figure 12. Proposed model for development of Locational Agroforestry and Soil Conservation Committee (LASCO): Identification of different communities at the village level

LESSONS LEARNED

During the implementation of the pilot project several lessons have been learned. The use of socio-economic information through wealth ranking was a good tool in identifying the type of clientele we are working with. This is important when we have to develop technologies that not only increase soil fertility but also correspond to the farmers' resource endowments. The inception of PLAR found that some of the villages were already active in on-farm testing. This provided us with an opportunity to counter-check any information that had been gathered during the formal PRA surveys. The use of this tool enabled us to get the farmers completely involved in analyzing their own status, socially and economically and in terms of soil fertility management. This kind of visual approach was found to be very useful in increasing farmers' interest in developing and/or testing newer technologies with us. This was more pronounced when they were able to realize that sometimes they were even more knowledgeable than the researchers and extensionists.

It has been appropriate and beneficial to work using the village approach with a multidisciplinary team of researchers, extensionists and farmers. Through such integrated forums we have been able to win the confidence of the farmers such that most of the villagers actually feel that they own the technologies. This has enhanced adoption of introduced technologies. Farmers should not be viewed only as end users of technologies but should have an active and equitable partnership with researchers and extensionists. In this respect researchers and extensionists should act as catalysts or facilitators, ensuring that information and knowledge are openly exchanged through interactive collaborative learning and research. This can ensure more targeted research results.

Farmer participatory research using the community approach has also yielded useful insights into how farmers perceive new technologies and on-farm research. When asked on how on-farm testing and participatory research has benefited his village, a village leader said, "since we started practicing improved fallow technology on maize and beans we have noticed a dramatic reduction in cases of theft of maize and/or beans because everybody in the village has some maize and bean crop growing in their lands." This was an interesting statement and a strong indicator of the impact of working with the village-oriented approach. In that case we learn that there are some benefits which although not quantifiable still have a lot of meaning to the farmers.

CHALLENGES AHEAD

Western Kenya is not a homogeneous region in terms of either socioeconomic or biophysical conditions. The differences are valid at different levels (farm, village and region) and dictate the development of specific soil fertility packages, which fit farmers' conditions. This heterogeneity provides fundamental challenges to research and extension.

The challenges in terms of methodological tools to be used when implementing the project include:

- identifying socioeconomic and biophysical differences at the regional and local (village, farm and plot) levels
- identifying female-headed households and farmers with poor access to resources
- developing technologies that take into account the socioeconomic and biophysical specificity of the farm households
- defining criteria to assess impact

- identifying approaches to improving farmers' soil fertility management skills.

Other challenges include:

- scaling up from the work currently being done with 1200 farmers to reach six million people across western Kenya
- developing effective tools to assist farmers in analyzing their own management practices and to enable them to plan improvements in various complex systems.

One of the most important forthcoming challenges is to organize village committees. These will be in charge of general village development and serve as an entry point of extension messages for communal and farm-level activities. These committees can be trained in various aspects of agroforestry and can be used to train farmers systematically for specific responsibilities within the village committees. These committees can also be reoriented to focus on credit acquisition and purchase and sale of farm inputs.

Institutional support is crucial to implementing the strategies discussed in this paper. With more villages being opened in Kakamega and Kisii there is a need to harmonize activities. This will entail preparing protocols for data collection and evaluation. With large volumes of data there is also a need to establish a functional database that will enable us to analyze the data while at the same time incorporating the geographical information systems (GIS). The extension staff from the ministries of agriculture and forestry will need to be trained in all aspects of participatory research to facilitate faster dissemination; and market surveys will have to be carried out to quantify input needs and sale of farm products.

ACKNOWLEDGMENTS

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PARTICIPATORY TECHNOLOGY DEVELOPMENT: EXPERIENCES OF THE NATIONAL AGRICULTURAL MECHANIZATION RESEARCH CENTER (NAMREC)

Melesse Temesgen[1], Agricultural Engineer

ABSTRACT

Ethiopian farmers have evolved a great deal of indigenous technical knowledge over a long period of practicing settled agriculture using draft animal power. This knowledge remains undocumented, and lack of awareness of it among agricultural engineers has limited the adoption of small farm implements by Ethiopian farmers. Participatory problem identification and evaluation of implements has been necessary to the successful development and adoption of farm implements. When agricultural engineers and farmers worked together, researchers developed a better understanding of the problems farmers face, and received useful feedback that enabled them to improve the technologies they developed. Recently, engineers modified introduced implements by combining them with the traditional plow, the "Maresha." Farmers who tested the implements were able to identify additional uses for the new implements, and to demonstrate the implements' advantages to other farmers. Newly developed implements have been adopted by farmers and have been disseminated through farmer-to-farmer training and borrowing of implements. Hundreds of farmers in and outside Bofa and Wulinchity have benefited from the use of the new implements.

INTRODUCTION

Ethiopian farmers have been practicing settled agriculture using animal power for a long time. Through the years they have acquired a great deal of knowledge about farming. However, very little of this knowledge has been documented and incorporated into our research program.

Agricultural operations in Ethiopia differ greatly from those in other countries. In contrast to their counterparts in developed countries, farmers in Ethiopia use very old and inefficient farm implements. However, introducing tractors into Ethiopian agriculture is difficult for a number of reasons, including lack of capital, fragmented land holding and rugged topography. It is therefore practical and necessary to improve animal-drawn implements. In Ethiopia, particular emphasis should be placed on agricultural mechanization because, in contrast to some other African countries, land holding of farmers is larger, and animal traction is more widely practiced than are manual methods. The widespread use of animal traction means that recommended agronomic operations such as row planting, tie ridging and early weeding will not be fully adopted without the introduction of new animal-drawn implements.

For these and other reasons, several national and international organizations have attempted to introduce new implements to Ethiopian farmers. The Italians were the first to introduce the animal-drawn mould board plow in 1939. However, farmers rejected those plows because their heavy weight complicated adjustment and attachment and because they required a lot of draft power. The Italians attributed Ethiopian farmers' rejection of the plows to their ostensible conservative nature.

FAO initiated similar activities in 1950. Between 1955 and 1965, Jimma and Alemaya Agricultural Colleges made considerable efforts to improve small farm implements. In 1968, the

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Chilalo Agricultural Development Unit (CADU) began research and development work in Arsi area, while a similar organization was established in Wolaita area. In 1976, the then Institute of Agricultural Research established what was known as Appropriate Technology for Farmers (ATF) at several research centers, including Mekele, Melkaworer and Nazareth. However, because these efforts were rather uncoordinated and disorganized, very little has been achieved. It has proved difficult over the years to persuade farmers to adopt the improved implements. Therefore, it has been necessary to establish a center that can undertake mechanization research at a national level.

National Agricultural Mechanization Research Center (NAMREC)

NAMREC (formerly the Agricultural Implements Research and Improvement Center/AIRIC) was established in 1985 to coordinate research on and testing of implements, as well as their dissemination through workshops. Centralizing research on agricultural mechanization provides researchers with the opportunity for day-to-day interaction with each other. It also avoids the limitations of small-scale implement research and duplication of efforts. In the context of coordinated research, multiplication of proven prototypes can take place at the center, so that an implement developed at one particular station can be disseminated economically in several other places. This is particularly useful as farmers throughout Ethiopia use a similar implement: the *Maresha*.

For these and other reasons, agricultural engineers who were conducting research in several places throughout the country were brought together at Melkassa to form a team. In order to conduct reliable research on implements, the team took the following steps:

1. Obtained financial assistance from UNDP/FAO
2. Recruited international experts with sufficient educational backgrounds and experience in small farm implements to give on-the-job training to the national staff
3. Recruited B.Sc. holders in agricultural engineering to replace the international experts by way of sharing experiences
4. Held long-term training courses on farm implements design and testing for the national staff
5. Conducted a national survey to document agricultural production constraints related to farm implements in Ethiopia
6. Conducted DAP (Draft Animal Power) studies on indigenous draft animals, especially oxen
7. Developed test procedures based on other countries' experiences, adapting them to suit conditions in Ethiopia
8. Collected prototypes made from different places both within the country and abroad
9. Conducted extensive laboratory and field testing on the collected implements

Thus the team was able to develop prototypes of farm implements to suit conditions in Ethiopia.

In developing the prototypes, efforts have been made to incorporate the design features of the indigenous implement, the *Maresha*. Thus, the following implements have been developed over the last 9 years:

1. *Erf* and *Mofer* attached mould board plow
2. *Maresha* attached row planter
3. Winged plow
4. Tie-ridger

In general, the process of implement development and dissemination followed this sequence:

Engineering testing □ Agronomic evaluation □ Socioeconomic evaluation □ Extension

This approach has the advantage of involving several disciplines. However, the interaction between agricultural engineers and farmers was insufficient. Some effort has been made by individuals to communicate directly to identify problems and collect feedback.

In 1996, a farmer participatory research program was started with support from CIAT and the PRIAM project. Two sites in Bofa and Wulinchity were selected. The sites are characterized by low and erratic rainfall, although Wulinchity is wetter than Bofa. Soils in Bofa are mostly sandy, (locally known as *shakite*) while those in Wulinchity are generally relatively black.

Twenty farmers from Bofa and 10 farmers from Wulinchity were selected in the first year; the number in Wulinchity was increased to 17 in the second year. Table 74 shows the results of the Participatory Rural Appraisal (PRA) specific to farm implements.

Table 74. Results of PRA of farm implements

No.	Problem	Farmers' solutions	Researchers' solutions
1	Moisture stress	• *Nish kebera* • Water harvesting	• Tie ridger • Mould board plow • Winged plow • Row planter
2	Weeds	• Repeated tillage • Hand weeding	• Mould board plow • Weeder
3	Soil compaction (crust formation)	• Resowing	• Row planter
4	High labor and time requirements during row planting	• Broadcast sowing • Hiring of labor	• Row planter
5	Shortage of draft animals	• Sharing of oxen	• Single ox tillage (winged plow) • Mould board plow to reduce tillage frequency

The following were the other steps taken after the PRA.

1. Trainings were given to farmers on the use of implements

2. Testing methods were developed in a simplified form so that farmers would not find it time-consuming.

3. Extensive testing of implements by farmers was then conducted over the last three seasons. Table 75 shows the types of implements and the number of farmers testing them.

4. Field evaluation and monitoring was carried out on several occasions to encourage other farmers to participate.

Table 75. Implements tested by year and number of farmers participating

Name of implement tested	1996	1997	1998
Row planter	1	13	40
Mould board plow	1	12	37
Winged plow	1	15	45
Animal drawn weeder	1	12	40
Tie ridger	-	-	15
Single ox tillage	-	-	2

During field days, some participating farmers were unwilling to display their implements because they feared losing them to us. This was our first indication that farmers had adopted the implements. They had taken the implements free of charge, and because many other farmers were complaining about not getting the implements, the participating ones might have thought that they would be forced to pass the ones they were testing on to other farmers. More and more demand was created and many other farmers requested to participate in the testing. However, we were not able to produce enough implements to satisfy the farmers' demand for them.

TEST RESULTS

Farmers compared the traditional implements and techniques with the improved ones. The improved implements were tested over one to three seasons.

Mould Board Plow

About 37 prototypes have been tested by farmers both in Bofa and Wulinchity. Farmers confirmed the following advantages of the mould board plow.

1. It cuts deeper and hence: --more water can be retained
   --roots can grow deeper in search of moisture and nutrients
   --grain yield is increased

2. It inverts the soil and hence: --weeds are better controlled
   --trash and crop residues are incorporated into the soil, thereby improving soil fertility
   --more weed seeds are brought to the surface and can be destroyed during the next plowing, thereby producing a weed-free field after planting

3. It reduces surface area and thus minimizes loss of moisture through evaporation

4. It leaves dead furrow that can be laid along the contour and used to check run-off, thereby conserving soil and water

5. It completes plowing in one pass, thereby reducing the frequency of tillage by 50% and hence: --more time is available to do other activities
   --draft oxen can get rest and use the extra time available for grazing.

The plow must be used properly to achieve these results.

6. Cross plowing is not required and therefore:
   --plowing only along the contour avoids run-off
   --when plowing along terraces the farmer can follow only one direction parallel to the terraces

7. The mould board plow cuts thick-stemmed weeds that cannot be cut by the *Maresha*

8. Width adjustment is possible without reducing the depth and the weight acting on the soil and hence: --depth of operation is maintained
   --draft force is reduced for weaker animals and/or hard soils

9. Furrow slices are cut from one side and thrown to the plowed area (furrow). This reduces the draft force because the soil being moved faces little resistance

10. Crops establish uniformly

11. Higher grain yields (by 50-100%) were reported by farmers

Winged Plow

1. The power requirement is lower than that of the *Maresha* and hence:
   --it can be pulled by a single ox
   --it can be pulled by a pair of donkeys
   (An innovative farmer known as Sisay modified the conventional oxen yoke and used it to harness donkeys. He has been using donkeys for inter-row weeding since 1996.)

2. It does not invert the soil and hence serves for *Nish Kebera*

3. It operates at a shallow depth and hence can be used to incorporate DAP fertilizer with soil when planting teff

4. It levels the field and makes it firm for teff planting

5. The winged plow, when used as a covering device for crops that require narrow row spacing (such as beans) can result in a row-planted field

6. The winged plow covers 2-3 times as much area per day as the *Maresha* does. Hence, it saves time and energy expended by oxen

7. In broadcast crops that suffer from crust problems, the winged plow can be used as a crust breaker

Tie-Ridger

The tie ridger forms a series of basins to check run-off in cultivated fields. It was observed that, when the implement was used, more water could be retained in rows before *shilshalo* (cultivation) and between rows after *shilshalo*. Soil erosion was reduced and farmers found the tie-ridger easy to operate.

Row Planter

1. Saves time and labor. When operated with open furrow system one person can finish in three hours a plot of land that would ordinarily take three people nine hours to finish manually.

2. In open furrow planting, the row planter facilitates moisture conservation through tie ridging.

3. In crust-forming soils, the use of open furrow planting with the row planter enables the crop to emerge better.

4. With open furrow planting, cultivation becomes more efficient in earthing up the crop.

5. The planter was also found exceptionally useful for intercropping. A farmer can do four operations at once. These are:
   --intercropping of beans or forage between maize or sorghum rows
   --incorporation of urea fertilizer
   --*shilshalo* (cultivation)
   --tie-ridging

6. The row planter places seed and fertilizer in a more desirable way.

Some farmers believe that the open furrow system of operation of the row planter and the inter-row weeder can obviate the need to use fertilizer, because they got similar results from both the fertilizer and the implement packages. A farmer in Wulinchity who used the implements without using fertilizer over two hectares of land is expecting a higher maize yield this year than any other farmer in his village. Last year, a farmer bought a heifer with the money he was able to save by using the inter-row weeder rather than hiring labor to weed.

Inter-Row Weeder

The animal-drawn inter-row weeder can be pulled by a single ox or a pair of donkeys, and has the following advantages:

1. Reduces the time and labor required for manual weeding by up to 18-fold

2. Earthens up row-planted crops with open furrow system

3. Kills weeds between rows and buries those in the row

4. Cuts shallow and move little soil so that the young seedlings are not buried as they are with the *Maresha.*

Single Ox Cultivation

1. Single ox owners can use the winged plow for cultivation.

2. Inter-row cultivation can be done with reduced damage to crops.

ACHIEVEMENTS

1. Indigenous knowledge was utilized more effectively

2. Direct communication between farmers and researchers within relevant disciplines made the farmers' needs clear and thus resulted in better problem identification

3. Testing of implements by farmers and more interaction between researchers and farmers resulted in:
   --better-understood feedback
   --increased enthusiasm among researchers, which resulted in quicker improvements to technologies

4. Farmers identified additional advantages offered by some of the implements. For instance, the compaction effect of the winged plow was found to be a desirable advantage for teff production. Even though it couldn't offer the same results and versatility in operation as the row planter, farmers were able to produce row-planted fields using the winged plow.

5. Adoption of improved farm implements has been faster.

6. Farmers were encouraged to interact better with researchers.

7. Technology was disseminated more effectively because researchers, extensionists and farmers developed more confidence when they saw the implements being used by farmers on a large scale.

CHALLENGES AHEAD

The following are problems associated with FPR:

1. The methodology is not clearly understood. Field layout is time-consuming, and test results were found to be difficult to analyze statistically. Farmers in many cases become impatient to carry out experiments.

2. Requires a large time commitment on the part of the researchers, who must spend a lot of time going to the farmers' fields. Therefore, in order to encourage them to do so, the promotion criteria should be changed so that researchers who publish papers about the implements should be required to have them adopted by farmers in order to validate the publications.

3. The philosophy objectives and methods are not clearly understood by many researchers.

DISCUSSION SESSION

Question 40.
Was gender consideration taken into account while developing the implements?
Response
Actually, the implements have been designed in such a way that they can be operated by all who operate the traditional plough Mareska

Question 41.
You mention market dissemination of implements, which seems plausible given the yield/labor gains you mention. However, how might access (ability to pay) or impact (gains) vary by user? In other words, would a cost benefit analysis vary with different types of farmers?
Response
In general, the implements developed are economically viable. However, the extent varies according to land holdings of farmers. The larger the land holding the higher will be the benefits from improved implements. Economic analysis has been made based on a 1 hectare holding. However, farmers with less land holding can have access to these implements through hiring.

Question 42.
Who is going to make these adopted implements? Is there artisan if the manufactory is not appropriate as you said?
Response
Currently, we are approaching manufacturers of different categories to multiply the implements. We have positive responses. Hopefully, these implements will be made available on sale very soon.

Question 43.
How versatile is the new planter, can it cover all cereals including teff?
Response
The row planter can be used for maize, sorghum, beans, wheat etc but not for teff. There has not been any recommendation on planting teff in rows.

FARMER PARTICIPATORY RESEARCH: EXPERIENCES OF FARMERS' RESEARCH PROJECT OF FARM AFRICA, SOUTHERN ETHIOPIA

Ejigu Jonfa[1]

ABSTRACT

This paper outlines the experiences of FARM Africa's Farmers' Research Project in promoting Farmer Participatory Research in North Omo, southern Ethiopia. It presents the FPR experiences based on participatory on-farm research. The stages in on-farm research (diagnosis, planning, implementation and evaluation) are discussed, and the project's efforts to date to institutionalize Farmer Participatory Research in the project area are described.

INTRODUCTION

Over the past decades, experiences in technology generation and transfer have shown that the majority of small-scale and resource-poor farmers, who in many cases live in diverse, complex and risk-prone situations, adopt few of the improved technologies generated at research stations. Variability at the field level imposed by rainfall patterns, crop pests and heterogeneous soil types, and variability at the economic level due to changes in market conditions, shifts in wage levels, adjustments in economic policy and diverse socioeconomic settings make the situation more complex. General solutions developed by researchers enjoy limited effectiveness in such diverse and complex situations.

This realization has led to the development of a number of approaches to technology generation and transfer, including the farming systems approach of the 1970's, the Farmer Participatory Research and the Participatory Technology Development approaches, and so on. Almost all of these approaches emphasize the need to understand the complexity of farming systems and to involve farmers in the process of research to enhance the adoption rate of the technologies that are developed.

With these needs in mind, the farmers' research project of FARM Africa began its operations in southern Ethiopia with the aim of establishing sustainable systems for the development of appropriate agricultural technologies. Our objectives were to improve local agricultural production and ultimately to contribute to the improvement of the food security of resource-poor households in the project area. Two strategies to increase the adoption of developed technologies among small-scale farmers were key: enhancing farmer involvement in research and extension by altering the traditional, top-down approach to these activities; and expanding the limited capacity of government research services by involving more actors in developing technologies that address the agricultural constraints farmers face. The Farmers' Research Project (FRP) is thus a pilot project, which provided a framework for more actively involving farmers and other actors in technology development and testing. This paper highlights the experiences of FARM's Farmers' Research Project in promoting FPR.

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PROMOTING FPR

FRP's Understanding of FPR

At the inception of the Farmers' Research Project, efforts were made to understand and discuss the concept of Farmer Participatory Research and to review the status of FPR-related activities and experiences in Ethiopia. This entailed reviewing the participatory research experiences of various organizations doing research and extension. To this end, a workshop was conducted in February 1992 which was attended by about 60 participants from IAR, AAU, AUA, CIAT, MoA, and a number of NGOs. Experiences of the various organizations were presented, and the issues raised were broadly categorized for discussion (Sandford and Reece, 1992). Among the issues discussed were: the extent, nature and desirability of FPR; the extent and nature of FPR as it is currently practiced in Ethiopia; the roles that various organizations (research and extension) play in FPR; and the merits and demerits of FPR in terms of both process and impact.

From the discussion it was concluded that the FPR approach to agricultural research involves farmers at all levels including decision making. Workshop participants observed that FPR was still in its preliminary stages, but their positive outlook regarding FPR was evident. They suggested that organizations doing research and extension should seek to:

- institutionalize FPR to coordinate the approach within the research structure
- increase the flexibility of approaches to FPR
- strengthen the compatibility of FPR with on-station research with the aim of making them complementary
- design research as simply as possible in order to target small-scale farmers
- ensure the continuation of research activities even after results have been obtained.

This workshop helped to create better awareness and understanding of the concept of FPR and its status in the country. Thus, for FRP, FPR is "agricultural research in which farmers take part in making decisions about the research at all, or nearly all, its stages." This approach is considered an improvement on farming systems research because more emphasis is placed on decision making by farmers.

With this grounding the project started its operations in North Omo, southern Ethiopia, in 1992 and made a considerable effort to promote FPR using the existing research and information networks to incorporate farmers' knowledge and empower farmers to undertake research.

Experiences and Methodologies in Testing FPR

One way of securing farmers' participation in research is by conducting on-farm trials. Farmers can take part in these trials at several different research stages: diagnosis, planning, implementation and evaluation.

Diagnosis

A representative peasant association (PA) is selected in a given wereda (district) to conduct a diagnostic survey. The PA explores the farming system and identified constraints on production. In most cases the "representative" PA is the one that represents a given agroecological zone in the wereda. The peasant association is commonly selected in collaboration with other organizations operating in the area.

Site Selection and Methodology

Selection of the PA raises a number of questions: To what extent does the selected PA represent the agroecological zone under question? What are the relevant factors in each agroecological setting? In most cases information is not readily available and it is the local people's knowledge which plays the leading role in the selection of the study area.

At the wereda level, the information available on the distribution of PAs throughout agroecological zones is assessed and discussed with farmers. The discussion addresses local categorization of the region's defining agroecological characteristics and the farmers' views on the distribution of the PAs within these categories. Ultimately, a PA is chosen by the farmers which is representative of most, if not all, of the peasant associations.

For conducting diagnostic surveys, Participatory Rural Appraisal (PRA) techniques are used. Working with the chosen PA, the Farmers' Research Project staff visits community leaders, presents the survey's objectives, sets up an activity calendar and conducts an overview survey of the area.

The project staff and community leaders, together with the collaborating organizations, identify members of the community who will be involved in the survey. Other farmers are also contacted in the course of the survey, in order to establish groups that are representative in terms of age, gender and socioeconomic status. For the diagnostic survey, a multidisciplinary and multi-institutional team is formed. During the survey the members of this team facilitate, and the farmers play a leading role.

Follow-Up

After conducting the survey, reports are produced to disseminate its findings. The report is also used to plan follow-up action and on-farm trials.

For this project, the on-farm trial program was driven by farmers' interests. Thus, the subjects for research were the main problems identified during diagnostic surveys. The problems were tackled in the order of the priority farmers assigned them during the survey. The prioritization of problems was made by a large, mixed group of farmers, and, in most cases, there was consensus in their stated priorities.

Problems whose solutions can be addressed through research became the focus of the trials, provided there was sufficient evidence to initiate research. In some cases, there was insufficient evidence to plan on-farm trials. For instance, "declining soil fertility" was one of the most important problems reported in a number of diagnostic surveys conducted in Wolaita (northern part of North Omo). Alley cropping and copper fertilizer trials were conducted in Kindo Koysha, a part of Wolaita, to investigate the soil fertility related problems and find a solution. However, the results from the trials did not show any effect in addressing the problem, and thus did not suggest a solution.

Later, it was recognized that there was not sufficient evidence to support a claim of declining soil fertility or identify its causes was not sufficient to justify seeking a solution. Hence, an additional in-depth study was carried out with increased involvement from farmers. Its aim was to investigate the problem and its causes and develop alternative solutions. This is known as the "Nutrient Cycling Project," a topical PRA, which was initiated within the framework of the Farmers' Research Project.

Problems such as cotton pests, the sweet potato butterfly pest, shortages of fuel wood, shortages of livestock feed and erratic rainfall (drought) are those problems for which on-farm trials were initiated. The PRA techniques facilitated an improved understanding of the farming systems and diagnosis of the problems. They also helped in the planning of farmer-participatory on-farm research. Furthermore, better collaboration was attained and a collegial relationship was established. The PRA process changed the attitude of the outsiders and enabled them to appreciate farmers' indigenous knowledge.

The diagnosis stage helped to identify farmers who could also be involved in the follow-up on-farm research.

Planning On-Farm Trials

The farmers are selected from the peasant associations where the diagnostic survey was conducted and from other peasant associations, which are found to operate under similar conditions. The farmers represent different sex and age groups, depending on the type and objective of the trials. For example, in cotton pest and variety trials, a total of thirty-five farmers are involved. Of these, only six came from female-headed households. This is because cotton production in the area is mainly the work of men. By contrast, all of the people participating in the fuel-saving stove trials were female. The problem of fuel wood shortage primarily affects women. Farmers were in some cases selected by the organizations involved in research/extension activities. In other cases, communities themselves selected farmers to run trials. The traditional groups in Konsso represent one example in which the community members selected farmers to conduct sorghum variety on-farm trials.

Once the farmers are selected, those problems, which can be addressed through research, are further discussed. Group meetings are a good way to learn more about the problems facing farmers and their possible solutions. Relevant research findings, specialists and literature are consulted to widen the range of possible solutions. Alternative solutions are discussed with farmers, along with the type of trial to be carried out and its objectives. Finally, an operational calendar is set up and agreement was reached regarding who was responsible for which activity.

Implementation of On-Farm Trials

In a group meeting, experimental methodologies, including the design, treatments, and data to be collected, are discussed thoroughly. Moreover, the importance of blocking, replication and field variability is carefully considered when selecting sites. These issues are discussed again during evaluation. Methodological discussions are held in the fields. This is not only practical but also helps raise the level of farmers' understanding.

For agricultural trials, the necessary inputs are distributed and site selection, layout and planting are undertaken. The trial is monitored, with observations being made primarily by farmers but also by project staff. To improve the interaction between participating farmers and outsiders, cross visits are organized. Farmers visit each other's trials and share their experiences with project staff.

Evaluation of On-Farm Trials

The main emphasis is on farmers' assessments. Evaluation of the trial starts from the time of planting. It involves individual farmers' observations and discussions during cross visits.

Farmers' preferences are identified based on their own criteria. These are listed at the time of evaluation, especially in group meetings. The treatments are then ranked and/or scored against each criterion.

For example, cotton pest and variety trials were conducted for three consecutive years and each year the trials were evaluated. The three years' evaluations indicate that nearly similar criteria are consistently applied. Furthermore, farmers have several selection criteria, which are mainly associated with the quality and quantity of yield. Interestingly, the evaluation indicates that farmers' selection criteria do not lead to the selection of a single treatment. Rather, they select a range of options to suit their diverse situations.

Most of the on-farm trials were evaluated not only by the trial farmers but also by their wives or husbands.

For example, in the cotton variety and pest control trials, farmers who were directly attached to the trials made the evaluation with respect to treatment performance. The women (wives) were also provided with a small amount of seed cotton from each variety for spinning. They made their evaluation based on the use of cotton within the home. The women indicated additional criteria to be considered, associated with quality, strength, and ease or difficulty of use for ginning.

In the case of fuel saving trials, the evaluations were conducted entirely by women as the use of fuel wood lies wholly within their domain. However, the evaluations included not only those women who were directly involved but also their female neighbors.

As part of the evaluations, quantitative data were collected and analyzed statistically. An attempt was made to correlate the results of farmers' assessments with those of statistical analyses. Some of the statistical analyses indicated no significant differences between different treatment plots. This was the case in the cotton variety and pest control trials. However, farmers had already made their decision to multiply and extend the varieties grown in their chosen or preferred plots. Clearly the farmers could distinguish differences between different plots based on their criteria for evaluation.

INSTITUTIONALIZATION OF FPR APPROACH

While testing the FPR approach in the project area, effort has also been made to institutionalize the approach in the area's research and extension organizations. This process has involved the enhancement of the capacity of farmers, government organizations (GOs) and non-governmental organizations (NGOs) in the North Omo region to carry out participatory agricultural research. Within this framework, the Farmers' Research Project began collaborative activities initially with the NGOs (1991-93) and later with the Bureau of Agriculture, the Awassa Research Center and the Awassa Agricultural College (1994-96).

In the process of institutionalization attention has been given to 1) raising awareness of FPR, 2) building technical capacity for FPR, 3) improving linkages among the key GOs, and 4) incorporating FPR into the activities of target institutions. Accordingly a series of trainings on participatory approaches, workshops, visits and traveling seminars was conducted to raise the awareness of and technical capacity for FPR on the part of collaborating organizations' staff members. The on-farm trials effectively demonstrated the FPR process. Published reports of workshops on FPR and participatory research have been useful tools to improve linkage and to incorporate FPR into the activities of target institutions.

An assessment of the impact of project activities to institutionalize FPR (Seme 1998, project review report) indicates both successes and limitations. The main successes relate to creating an environment for collaboration, raising institutional and individual awareness of FPR and building technical capacity for conducting FPR. The main limitations are related to creating formal institutional linkages among regional organizations and incorporating FPR into the activities of the target organizations. The relevant policies of the different tiers of the government (federal and state/regional) are broadly favorable to institutionalization of FPR. The federal government's Agricultural Development-Led Industry (ADLI) and statements from the recently created Ethiopian Agricultural Research Organization (EARO) emphasize the importance of a participatory approach. In this context, the institutionalization of FPR seems to be constrained not by policy but rather by the lack of priority given to participatory approaches in research and the absence of firm guidelines governing their implementation. This is the result of a lack of awareness among senior officials and councilors of the potential and techniques of farmer participatory research. Although a credible level of success has been achieved, the process of institutionalization requires more effort and further consideration at the regional level.

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DISCUSSION SESSION

Question 44.
a) How are you dealing with agro-ecosystem management as a wholistic approach?
b) How are you dealing with laying the scientific basis and methodology of farmers' participatory approach, design, if variety wide adaptation, over the years release mechanism of technology?
c) What is different in your approach as compared to the formal sector of agricultural research in Ethiopia?
Response
a) I have this for plenary discussions.
b) The effort should focus on complementality of both aspects. Experiences related to failure etc technology adoption necessitate farmers' involvement. There has to be some consideration in looking at the balance, scaling up of the existing experience is another area to focus.
3) More emphasis on farmers decision in the process of research (empower).
More emphasis on incorporation of ITK in the research.

Question 45.
What strong working (functional) relations exist between farm and other GOs (MoA, college)?
Response
Much remains to be done. But we sensitize institutions by offering:
- Training
- A joint task force of FPR
- Seeking expert advise from GOs
- Bringing heads and decisions makers to the field and facilitates dialogues between them and farmers. Still, attitudes and individual bureau heads are playing sometimes-negative roles.

Question 46.
a) As you worked in an area where many NGOs have been operation, how did you overcome the problem of farmers' expectations?
b) If the formal research system has to take up FPR, what are the possible challenges that it can face?
Response
a) At the beginning, the expectations were high, however, through discussion we overcame them.
b) The challenges are many. Evaluation and design of the trials are some of the challenges (balance between farmers' evaluation and standard procedure)

Question 47.
a) Do the traditional farmer research groups meet the participatory research group?
b) FPR and FRP
Response
a) Yes
b) FPR is an approach and FRP is a project.

Question 48.
How do you handle the issue of farm inputs to enable poor farmers to participate without problems?
Response
Improved varieties are distributed by the project/Bureau of Agriculture e.g. forage seeds. Normally the traditional practice, i.e. farmers management practices, determine whether to include or not include inputs in on-farm testing.

TOWARD IMPROVING AGRICULTURAL EXTENSION THROUGH FARMER PARTICIPATORY RESEARCH: CARE'S DTC PROJECT IN SOUTH-WESTERN UGANDA

Beda Mwebesa[1]

ABSTRACT

A farmer participatory research (FPR) pilot program was initiated in CARE's Development Through Conservation's agriculture/agroforestry extension program in August 1995. This program was initiated in an effort to develop methodologies for achieving what the project views as its extension goal, namely, improving the capacity of farming households to gain access to and manage resources to meet their short- and long-term food and income needs. For a period of two years, the FPR sub-component of the project worked with 14 different farmers' groups, assisting them in designing, conducting and evaluating various trials on new crop varieties, integrated management of pests and diseases and soil fertility improvement. Our experience showed that it was necessary to start with simple short-term trials likely to show recognizable results. This enabled farmers more rapidly to understand and gain confidence in the process. We were then able to undertake more complex diagnostic and experimental work. The selection of experimenting farmers was complicated by their expectations of the process, and the difficulty of assuring the whole community that it could benefit from the work of just a few. By introducing the FPR concept at the community level and establishing community selection of experimenters, these problems were minimized. The FPR process led to a more equitable relationship between staff and farmers, making communication and information-sharing more effective. However, none of this could have been achieved without good staff facilitation skills, which take time to develop. In July 1997 the DTC project entered a new five-year phase. In this phase one of our extension strategies (farmer experimentation) builds on the experiences of the FPR program to improve farmers' skills in experimentation and information-sharing, with the ultimate aim of developing a farmer-led extension methodology that can continue once the project ends.

INTRODUCTION

The Kigezi Highlands in southwest Uganda is one of the most densely populated regions of East Africa (150-400 persons/km^2) with livelihoods very largely dependent on agricultural production (DTC/CARE, 1997). As in most highland areas, the cropping system is diverse. A wide range of tropical and temperate crops is grown, including sorghum, beans, sweet potatoes, Irish potatoes, millet, bananas, maize and peas. In addition to subsistence production, export of certain crops--in particular beans, Irish potatoes and cabbages--to urban areas and to neighboring Rwanda is also very important to the local economy.

The rainfall pattern is bimodal, with annual precipitation ranging from 1000 to 1500 mm with the heaviest rainfall occurring in March-April and September-October. The only significant dry period is around June-July. Altitude ranges from 1500 m to 2400 m asl and most of the land is steeply sloping (> 30%). However, due to the high intrinsic stability of most soils and the widespread practice of constructing contour bunds, soil erosion is relatively minor (DTC/CARE, 1997). Nevertheless, soils are very depleted in many areas due to continuous cultivation with little nutrient recycling. Variation in soil types and several socioeconomic factors have resulted in severe land fragmentation. There is relatively little livestock to produce manure and no significant use of fertilizers. Government agricultural extension services in Uganda are very

[1] Development Through Conservation (DTC)/CARE.

weak. Levels of household livelihood security are low and seasonal food shortages are common in most areas.

CARE's Development Through Conservation (DTC) project is an integrated conservation and development project that aims to improve the management of natural resources within the project area, which comprises two protected areas in southwest Uganda--Bwindi Impenetrable Forest and Mgahinga National Park--and approximately 300 communities spread among 24 parishes that border the two parks. These two protected areas are rare examples of afromontane habitat, noted for high biodiversity and in particular as a last refuge for over half of the world's surviving population of mountain gorillas (estimated to be about 600 in total).

The DTC project started in 1988 and has been operating for ten years. During this period, the project has worked on the following:

1. A range of activities designed to build the capacity for protected area management, in particular through the active participation of local communities.

2. Institutional development initiatives to support the development of community-based and local government institutions that can effectively plan for sustainable management and utilization of natural resources in the region.

3. Agricultural/agroforestry extension work which trains farmers in a range of agricultural and agroforestry interventions, notably tree planting, improved banana management, improved potato management, vegetable production, production of improved varieties of beans, soya bean and potatoes, and soil conservation techniques for soil fertility improvement.

FARMER PARTICIPATORY RESEARCH (FPR) PROGRAM

Why It Was Established

The FPR program was established in 1995 in response to the realization that:

1. Some agricultural problems were being addressed inadequately or not at all in our extension activities. This was partly the result of the project area being very diverse in terms of farming and cropping systems; yet the project interventions tended to concentrate on those things for which we could offer direct, ready recommendations, such as tree planting for solving the problem of lack of firewood. Some problems, which were area specific, were ignored or received little attention, and we realized that some of the interventions needed to be modified to fit different situations. Moreover, there were certain problems for which the project had no well-established technologies or messages to transfer to farmers, such that a more adaptive approach was called for.

2. Some of the interventions promoted by the project at the time enjoyed very limited adoption, which raised questions about their appropriateness. PRA workshops attempted to involve local communities in problem identification and analysis and in action planning so that the final project interventions were need-driven. However, this was often done bearing in mind only those solutions already on a list of interventions. Thus, if decreasing yields were identified as a priority problem and analyzed, it was almost inevitable that the action plan arising would include agroforestry, composting and bund construction; the feasibility of the proposed solutions was not analyzed. One project initiative, community-based environmental

management (CBEM), went a little further in analysis but again fell back on the current interventions, even if their appropriateness was uncertain, because no other mechanisms were available within DTC to address these issues. This was particularly the case with regard to soil management.

Thus the FPR program was set up with three main objectives:

1. to help the project gain a better understanding of the local farming system with which we were working
2. to facilitate the development of new technologies that would address critical constraints that had been identified through community needs assessment
3. to build farmers' capacity to conduct small-scale experimentation

From the start we agreed that the FPR initiative should evolve into an agricultural development process that would outlive the project. We aimed to foster the growth of a community-based process that could produce its own innovations based on indigenous knowledge to supplement innovations that might originate from external sources.

FPR Activities

The major activities in the FPR program included the following:

- Organizing and facilitating meetings with farmers' groups to discuss the basic principles of experimentation.
- Assisting group members to design, implement and monitor experiments.
- Carrying out follow-up visits to group members' experiments.
- Facilitating cross visits between experimenting groups to share experimental experiences.
- Organizing meetings for participatory evaluation of trials.
- Planning and conducting trials for initial screening of technologies at community training centers and researcher-managed trials on farmers' fields.

The areas of experimentation have included:

- Evaluation of new varieties of climbing beans, soya beans, maize and sweet potatoes.
- Integrated management for control of bacterial wilt in Irish potatoes.
- Cultural control of cassava mosaic virus involving use of resistant varieties.
- Evaluation of bean varieties for tolerance to bean root rot complexes (in the last two seasons).
- Evaluation of alnus trees for agroforestry potential.
- Improved fallow with Tephrosia and Sesbania as means of improving soil fertility.

Target farmers for experimentation activities

Initially FPR activities centered on women's groups rather than mixed community groups, firstly because women traditionally do most of the agricultural work and secondly because mixed groups tend to be dominated by men who have little interest in subsistence crops (on which FPR activity was focused). Working with groups rather than individuals had three major advantages: it allowed for a greater exchange of experiences within a group, it provided researchers with easier access to large numbers of farmers, and it gave the farmers themselves more "weight" in dealing with researchers. The ultimate aim was to establish a self-supporting network of groups involved in experimentation which could meet to share experiences, designs further experiments and, as needed, coordinate with researchers and government extension agents. Groups were identified from communities that had gone through a process of participatory needs assessment and planning, where we felt that some issues were not being addressed.

Process

Getting started

With each new group, the FPR process started with discussing the idea of experimentation and choosing topics for experimentation, e.g., pest and disease control, new varieties of crops or soil fertility management. At this initial stage, there was little attempt to diagnose problems for the following reasons:

1. All the groups had already been involved in project PRA meetings and we did not want to involve them in another series of meetings at this stage. Moreover, on the basis of these PRAs some topics had already been identified such as bean weevil control. However, on the whole it was difficult to rely entirely on the PRAs to identify experimental options since the analysis was often not sufficient and was geared towards implementing one of the current activities.

2. Most literature reviewed (e.g., Bunch, 1985) states that, when starting experimental work with farmers, it is important to begin with something short-term and likely to achieve recognizable success. We therefore chose to start on new crop varieties because we felt they fulfilled these criteria. Variety trials have the additional advantage of being the type of experimentation most commonly carried out by farmers. So we met with researchers at the national programs to see if there were any interesting new varieties that could be tried. We thought it was necessary to use something simple to introduce basic ways for improving farmers' experimentation skills.

As anticipated, as we worked with farmers, they soon started raising more complex issues. We then started more detailed participatory diagnosis and characterization studies. We conducted diagnostic studies in three communities where the priority problem raised was declining soil fertility.

Implementation

Having agreed on an intervention, whether through diagnosis or through menu-driven exercises that involved no diagnosis, the next step was to conceptualize and design the experiments. In each case this started with discussions to ascertain what farmers already knew about the topic (e.g., bacterial wilt) which provided the facilitator with an opportunity to fill any critical "knowledge gaps." That achieved, the discussion would then move to possible solutions with both sides contributing suggestions, based on traditional knowledge plus new possibilities suggested by what participants had just learnt. Having agreed on what the groups would experiment with, farmers designed their experiments with the bare minimum of guidance from facilitators (i.e., no blueprints). Principles of good experimentation were discussed--for example, reducing variability, using a control plot and making simple measurements. Farmers agreed on what was to be monitored and on the criteria for evaluation and established a time frame for various activities. No attempt was made to ensure that these ideas were implemented. During the course of the trials, field staff made follow-up visits to experimenting farmers. This provided an opportunity for the farmers to ask any questions they might have about the trial and raise any difficulties or problems unforeseen at the time of planning. During the visits, staff offered scientific explanations for observations on the trial, and also learned from the farmers' trials.

In some cases, we organized trials for initial screening of new technologies. We took responsibility for designing and managing such trials. However, farmers participated in monitoring and evaluation. These trials were conducted at the project's community training centers or in communities on land rented by the project, and the project incurred all the costs of the trials. This was considered necessary for cases where we received very many varieties of a crop in small quantities and about which we had little information. For instance, at one time we had 18 varieties of soya beans to evaluate, and at another, we had 42 accessions of *Lupinus metabilis*, and other cover crops, like *Dolichos lablab* and *Mucuna pruriens*. Here we deemed it necessary to do some preliminary screening. Also, when we started work on improved fallow with Tephrosia and Sesbania species, we were unsure about many factors, and so had very many variables to consider. For instance, we were not sure whether to use seedlings or seed, what planting density was appropriate, what weeding regimen to follow and so on, so we decided to establish some researcher-designed and -managed trials in which we could handle many variables at once (many more than we would expect in an individual farmer's trial).

At the end of every season, participatory evaluation meetings were organized for farmers to discuss the results of their trials and make new plans for the following season.

By the end of the 5th season, we had introduced the process to 22 groups. The rest of this paper presents and discusses some of the most interesting and, in our view, significant learning points that arose from this experience.

LESSONS LEARNED

Targeting for Experimentation and Selection of Farmers to Conduct Trials

Working with women's groups had the advantage that we were addressing real practicing farmers. We avoided domination by men, who often had other priorities. We found an additional advantage in the fact that, because women move to their husbands' houses on marrying, a group of women may bring together indigenous technical knowledge and cultural practices from a wide geographical area. However, there are also advantages of working with a mixed group as was done in four areas where the entry point was a traditional community institution (stretcher group). More people are involved, and men, who make decisions (e.g., on land use) and often control the resources that are vital in experimentation, are given the chance to participate in the process.

It was easier to work with already-existing groups than groups formed around an experimentation activity. This is because existing women's groups have some sense of cohesion and members have something in common since they have chosen to work together.

There were problems in communities where we went directly to groups already chosen by our field-based staff. Other community members complained of being marginalized. Bitter divisions were created in some communities by envy and jealousy that arose when one group or just a few individual farmers received experimental materials and others did not. Satisfaction was greater where our entry point was at the community level because more people were involved and a majority in the community knew what was going on even if they were not participating themselves. However, some problems did arise, for example when facilitation was not good enough to explain clearly how experimental work done by a few people would benefit the community as a whole, and how difficult it was to get enough experimental materials for everyone who wanted them. We found it very important to let community members decide who would conduct the trial, agree on the activities in which others would be involved and determine the mechanism for enabling others to share the results. All these have to be followed up.

More often than not, it was difficult to separate genuinely interested and committed farmers from those interested mainly in the "handouts" of free seed and seedlings. We have now come to believe that constructive participation is learned and is therefore achieved gradually. Comparison of groups that we have worked with for different lengths of time indicates that there is more trust, mutual respect and a better working relationship, freed from expectations, in groups with whom we have worked for more seasons. Nevertheless, when entering a new community, any farmers' groups or individuals that show an interest in conducting experiments should be included.

We faced a very big challenge in the effort to target the poorer people in communities we work with. Those who are better off often tend to dominate. When working with crop varieties this was not a big problem, but when it came to more complex trials that required more time and resources, imbalances became apparent. These imbalances seem inevitable in some cases because the wealthier farmers have more freedom to experiment and can afford some risk while still carrying out their farming activities.

Our experience has led us to believe that the most appropriate way to address these issues is to allow the community to select the experimenters themselves, in a democratic manner. This selection process, however, must be open to review at regular intervals.

Nature of Initial Experimental Activities

At the start it is very important to begin with a simple trial or experiment that will yield quick results. The early recognizable success that was achieved in conducting trials on new varieties of climbing beans and sweet potato clones stimulated a lot of enthusiasm. Farmers involved in these trials were more willing to take up more challenging work on improved fallow experiments where success was less certain. On the other hand, some women's groups that had worked for several seasons on bean weevil control without achieving recognizable success developed some doubt about the possibility of solving the problem through the experimentation process. Some members began to doubt our competence and changed their minds only when we introduced new soya bean varieties that performed better than those they had. At the start it may not be important to dwell too much on diagnosis; diagnosis became much easier once farmers had a better idea of what the new approach was all about and their expectations had been scaled back.

While it is important to have some success in a given group, failures can also be a very good learning experience, given careful facilitation to analyze the problem. Whenever we work with a new group for the first season many experiments are "badly" designed, making it hard to draw conclusions. Many of the errors are corrected gradually by progressively and consistently working with the same group over several seasons. In the process, a lot is learned about the technologies and principles of experimentation. Once a good understanding of the approach has been developed with experimenting farmers, experiments do not have to "work" (yield positive results) to be useful. A case in point was trials on bacterial wilt in potatoes. The researchers' "package" actually failed but farmers learned a great deal because they had dissected the package into components and added in a few ideas of their own, some of which did produce positive results.

Complementing Farmer Trials with Researcher-Designed and Researcher-Managed Trials: Dealing with Many Variables

When farmers are carrying out experiments, it is neither practicable nor realistic to expect a single farmer to experiment with very many variables at once. For instance, when designing trials on improved fallow, a number of possibilities for establishing fallow with two species were suggested, but each of the farmers took up only one or two options for experimentation. Table 76 shows the different designs that were involved:

Table 76. Complementary researcher- and farmer-managed trials

Treatments in one researcher-managed trial with four replications	**The different options selected by farmers for experimentation (*each option represents a trial conducted by one or more farmers*)**
• Sesbania seed direct sown • Tephrosia seed direct sown • Sesbania seedlings • Tephrosia seedlings • Continuous cropping (sweet potato rotation) • Control (natural fallow)	• Sesbania seed + natural fallow • Sesbania seedlings + natural fallow • Mixed Tephrosia & Sesbania seed + natural fallow • Tephrosia seed only • Tephrosia seedlings • Tephrosia seed intercropped with sweet potatoes • Sesbania seed intercropped with sweet potatoes
Uniform spacing was used in the first set of trials and proved ineffective.	There was a lot of variation in spacing in different farmers' trials and some farmers did not include a control.

There were a lot of variations in farmers' trial designs. Some of the variations were decided on by farmers after the initial design meeting (e.g., intercropping the fallow species in sweet potato gardens, and mixing the two fallow species of Sesbania and Tephrosia seed, which were not discussed in the planning meeting).

Whereas the variations in different farmers' trials helped us to narrow down the number of options very quickly, some farmers who chose the less promising options (such as using Tephrosia seedlings to establish fallow) were disappointed and some dropped out.

It is useful, in some cases, to design and establish our own trials in which many treatments and replications can be tested to avoid fruitless efforts on the part of farmers. Moreover, it is mainly through these that we can get data that can easily be statistically analyzed. Also, these researcher-designed and -managed trails serve as result demonstrations to those farmers who are involved. Having researcher-designed and researcher-managed trials is the only way to avoid the tendency on the side of researchers to impose their ideas about what should be experimented with and how the experiments should be conducted.

Expectations and "Hidden" Social Dynamics as Barriers to Effective Participation

Based on experience with the way extension work has traditionally been done, most farmers view extension in terms of provision of farm inputs, such as certified seed, hoes, wheelbarrows, watering cans and fertilizers as well as technical information or credit. The idea that a project comes to work with farmers on an ongoing basis, for gradual improvement of their farming system through participatory research, is generally alien to the average farmer. Some farmers will promise to work just for the few grams of free seed that come with a variety trial. For the same reasons, participatory diagnosis and design activities may be difficult to conduct. Most farmers played tricks and tried their best to divert discussions to meet their expectations.

Social dynamics, few of which are transparent to outsiders, can be a real problem. In two communities just adjacent to the park we almost abandoned our FPR efforts because of social problems and suspicions that took us some time to understand. Experimental plots grew up in weeds, only a few community members showed up for meetings, some farmers took agroforestry tree species seedlings but planted only one or two and diplomatically told us that some malicious members were uprooting them. Through informal interactions it emerged that several factors were involved. Prior to the beginning of FPR activities our project had started a pilot "catchment" approach to land management in which we hoped to develop a model area with various soil conservation structures in place for contour bunds well laid and stabilized with agroforestry trees, shrubs and grasses. People had become suspicious that this work on land management was geared towards park expansion. At the back of their minds they thought that if trees were left to grow, animals from the park would have an expanded habitat and they would be evicted from their land as they were earlier on when the forest was gazetted. After gaining insight into these issues, we organized meetings in the two communities and invited representatives from park authorities, the district forest department and a local chief. These people took the lead in explaining the park boundary and the rights of farmers to their land. With time the number of participants has increased but we had to reduce activities such as promoting agroforestry trees for two seasons. We temporarily concentrated on crop varieties and, later, on improved fallow. It is only during the last two seasons that farmers have requested assistance to experiment with agroforestry tree species.

Good Facilitation Skills a Prerequisite for Success

Success requires very good facilitation skills, taking great care to avoid the "expert" role. Most researchers, government extensionists and project staff whom we have tried to involve find this difficult if not impossible.

There are always problems, related to attitudes, among both the farmers and the outsiders. At the beginning, farmers will expect you to come with all the information and tell them what to do to solve their problems. Where good facilitation is lacking, farmers will do most of the listening and silently judge what the "expert" is suggesting against their experience and indigenous technical knowledge. They will say thank you for teaching them and walk away only to implement nothing. On the other hand, when we ask farmers to explain to us what they have done so far to solve a given problem, they frequently say that they do not know anything. Sometimes farmers reply to questions of that nature saying they expected the facilitator to have come with ready answers. This is a real challenge and has several times frustrated our inexperienced field staff.

Whereas there is general agreement among most practitioners about the value of indigenous technical knowledge, some researchers and extension workers whom we have tried to involve in some of our activities do not value time spent eliciting farmers' knowledge and assisting them in making insightful and useful contributions to problem-solving research. Most of them are used to the traditional way of teaching farmers and tend to rush to provide technical knowledge and suggest solutions and methods for farmers to conduct their trials without taking care to solicit their input, thus short-circuiting the whole process.

There are several cases (one is described below) which have suggested the following as salient features of good facilitation:

- Begin by exploring with farmers what they know, what they do and the resources available to them.
- Explore the feasibility of all options suggested for experimentation, taking into consideration the social, economic and cultural conditions facing the target group. Bear in mind the fact that what you are suggesting may not necessarily be the appropriate thing for farmers.
- Go with an open mind and maintain flexibility. With good facilitation, you never know what is going to happen.

An anecdotal case illustrates the value of these principles.

One community prioritized couch grass weed as a big constraint in farming. After a review of the literature, project staff suggested trials with various cover crops including *Dolichos lablab* and *Mucuna pruriens* to suppress the weed. Some farmers planted these but when we went back after a season they said that all of the cover crops had been out-competed by couch grass. Then we thought of Round-Up (glyphosphate) as an option to try with farmers. We were quite confident that this would suppress the couch grass but we thought we needed to assist farmers to establish small-scale trials to assess the economic feasibility of using it on their farms. Project management was ready to buy the chemical to use in this trial. However, when we went to hold detailed discussions on the problem with an intention to introduce our "new" option, we found that farmers knew much about Round-Up as it had earlier been supplied by a tea company. In this meeting they told us that all along they had expected the project to buy the chemical for them. We explained our policy on provision of inputs. On further probing we found that some farmers were already trying some other locally-available plant species and one of them (*Lantana camara*, which the government extension service was condemning as a terrible weed) was very promising. We gave up with the idea of introducing the trial, encouraged farmers to continue trying indigenous plant species and promised that we would also keep searching for plant species that may be in used in other places.

If we had not taken time to find out what the farmers know, they would definitely have agreed to carry out the trial as it fitted with their expectations, but it would have been time and money wasted.

FPR as an Extension Tool - Advantages We Have Derived from the FPR Approach

- The FPR process described above has resulted in adoption and diffusion of new technologies, most notably new varieties of climbing beans and sweet potatoes. In three communities, farmers' groups started with 2.5 kg of five varieties (0.5kg of each variety per community). After three seasons, two of the varieties had spread to at least 15 households in communities of around 50 households.

- There is better understanding of the integrated management for bacterial wilt control in communities where we used the FPR process compared to those communities where the management package was introduced using the traditional technology transfer model employed by our general extension.

- The lessons learned from the FPR experience have contributed to the improvement of the community-based needs assessment and planning process that forms the core of our extension program. Two of the challenges we have had to address in our general extension work involve enthusiasm and community participation. Taking development to mean a process whereby people learn to take charge of their lives and solve their own problems, we have for some time been trying to develop the capacity of communities to identify and find solutions to their problems. With this approach we try to avoid both providing materials (inputs) that farmers can obtain for themselves, and doing for them what they can do for themselves. We place emphasis on avoiding the "expert" role/attitude. Unfortunately, our experience with implementation of this approach has been mixed. Whereas it was difficult for some staff to facilitate communities to participate constructively without "give-aways," others swung to the opposite extreme of providing almost nothing. In some cases PRA meetings were organized in which communities were facilitated to identify, prioritize and analyze their problems. When it came to suggesting solutions, the process tended to be one-sided, with little staff input. This limited community participation.

- The FPR process involves providing small quantities of materials for small-scale experimentation and encouraging farmers to make decisions and judgments and to express their own ideas freely, in a two-way communication process that enhances information sharing. In our experience, these conditions, coupled with the practical learning, which the FPR process provides, have led to more enthusiasm and better participation in some communities.

Unlike most of our collaborators, the experimenting farmers make no clear distinction between FPR work and the rest of our extension program. From their viewpoint FPR is simply a better way of doing extension, and there are now a few examples of FPR farmers becoming "local consultants," introducing new technologies to their neighbors. Thus we no longer think of FPR as separate process from extension but rather as a powerful extension tool.

CHALLENGES AHEAD

To some leading partners, use of FPR (or Farmer Experimentation, as we call it) as an extension approach seems a radical concept. In our agricultural extension program we work closely with national and international research centers, notably the National Agricultural Research Organization (NARO), ICRAF and CIAT. The project also works in partnership with the government extension program. Among these partners, there is enormous variation in perspectives on how extension should be done. Most researchers and extension workers in the government system still have their hopes pinned to the traditional approaches based on the Technology Transfer Model of extension. Only a few people understand, let alone believe in, the new approach that project is trying to promote. Changing these attitudes is part of the challenge.

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The ideas expressed here were developed through the experience of various staff members in the organization's development section. Philip Franks and Vanessa Bainbridge initiated the FPR Program and were inspirational teachers for the rest of our staff in the new approach. Ongoing review of activities with zone field officers and field assistants in two extension zones of Rubanda and Rubuguri have played a significant role in the development of the Farmer Experimentation Model.

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DISCUSSION SESSION

Question 49.
How do you ensure that something decided democratically will be implemented by most of the farmers on the site where you work?
Response
a) Once a trial has been agreed on (by a whole community), then the whole group/community is facilitated to make a decision on who is actually going to conduct the trial. We have to ensure everybody or at least the majority is involved in the decision to avoid feelings of alienation (being left out).
b) The number of implementing farmers depends on farmer interest and availability of the required inputs e.g. amount of experimental seed.

Question 50.
As an NGO leading FPR project, how did the project source information or technologies or farmer problems?
Response
The project depended on contacts and good relations with the national research system and international research organizations such as CIAT.

FARMER PARTICIPATION IN RESEARCH FOR IMPROVED SOIL MANAGEMENT

C.S. Wortmann[1] and C. K. Kaizzi[2]

INTRODUCTION

Soils in eastern and central Africa are diverse, even within the typically small farm units. The current low nutrient status (due to inherent low nutrient supply and/or negative nutrient balances that have prevailed for many years) constrains productivity. Resources for soil fertility management available to farmers working with such soils are varied but are generally scarce and inadequate to achieve positive nutrient balances at the farm and field levels (Wortmann and Kaizzi, in press). Farming systems are often agronomically diverse with some components of the systems responding better than others to improved soil management. Fertilizer use is very low and in several countries has declined with the removal of subsidies. Increasing efficient use of scarce organic and inorganic resources for greater profitability and productivity is a challenge to researchers, extensionists and farmers.

Many farmers are aware of differences in their soils and of crop-soil interactions, which are important for their farms. Such farmers often know a good deal about the use of alternative resources in soil management. This paper explores potential roles for farmers in research on improved soil management and addresses several relevant strategies:

- integrating farmers' knowledge of soil-crop interactions with researchers' knowledge to make research more efficient
- integrating more and less participatory approaches to make research more cost-effective
- defining farmer experimentation and its role in systems research
- using a decision guide approach to adaptive and verification soils research to enable farmers to make better decisions.

FARMERS' KNOWLEDGE OF SOIL-CROP MANAGEMENT

The following cases, involving farmers in Ethiopia and Uganda, demonstrate the detailed knowledge farmers possess about the soil-crop interactions on their farms. The relevance of their knowledge to research is discussed.

Response Farming in the Central Rift Valley of Ethiopia

Farming systems of the Central Rift Valley are characterized by low and erratic rainfall, high variability of soils, landscape types and year-to-year rainfall over small distances, and lack of resources for farmers (Fujisaka et al., 1997). Farmers employ substantial technical knowledge in responding to 30 possible rainfall scenarios, and matching seven important crops, with varieties of different duration, to soil types, topographic position and resource availability (Figure 13; CIAT, 1995). Farmyard manure and fertilizers are used but are scarce. Farmers prioritize their soils and crops for fertilizer use and apply it in response to water availability. Farmers' decisions regarding choices of crops and varieties, timing of operations and use of fertilizer and manure are

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sophisticated to the extent that research planning is not feasible unless it is done in collaboration with farmers.

Classification of Soils by Farmers in Uganda

Farmers' recognition and characterization of soils has been studied in five locations in Uganda. The number of soils identified by farmers within a community varied from 6 to 14. Farmers used soil color and texture, topographic position, tilth and productivity in differentiating between soils. They could discuss soil properties with regard to suitability for different crops and the implications for management, and describe the soils in terms of water infiltration and availability, drainage, readability, compaction and ease of tillage (Table 77; Wortmann et al., 1998). Soil analyses confirmed significant differences between the more common soils in texture and chemical properties (Table 78).

Researchers cannot ignore the heterogeneity of the soils and its importance to crop management. Farmers' knowledge of their soil offers an opportunity to improve planning of research, siting of trials, interpretation of results and dissemination of information.

Farmers' Knowledge in Research and Technology Dissemination

Systems research and technology dissemination might be enhanced through good use of farmers' knowledge.

- Researchers can use farmers' knowledge in an extractive manner to better understand their situations and their priority problems, and to predict which technical options are likely to offer appropriate solutions. Researchers can use this information to develop research plans.
- Farmers' knowledge may be integrated with researchers' knowledge and applied in planning and implementing research collaboratively.
- Researchers may accept that farmers are knowledgeable about a topic and that this knowledge can be the most important asset for solving some problems. Researchers may decide not to try to learn from farmers, but simply to provide farmers with additional information and possibly inputs and encourage them to experiment on their own.

In the Ethiopia case, improved understanding of farmers' responses to varying conditions aided in prioritization of problems and possible solutions by farmers and researchers, and in development of a research plan. Priority problems and research priorities differed from those previously identified using more conventional farming systems research approaches (Fujisaka et al., 1997). Farming systems characterized by much environmental and cropping system diversity coupled with erratic rainfall are not easily improved with reductionist research approaches. Farmer participation is expected to be especially beneficial in these cases (Nielsen et al., 1997).

Information on farmers' perceptions of different soil types in Uganda has been applied to a limited extent in prioritizing and designing research. Some soil types were judged to be inappropriate for testing of some solutions. In one community, a trial was designed to address problems with a specific soil type, *lunyu*. The soils information is being used to target information for technology dissemination.

Generally, however, farmers' knowledge is under-utilized, in both research and technology dissemination. Although the Ethiopia farmers consider water availability in making decisions about fertilizer application, researchers rarely fully interpret research results and formulate recommendations in consideration of rainfall variability. Likewise, variation in soils is rarely considered in siting trials, interpreting results and formulating recommendations.

Research is often limited by the knowledge elicitation stage. Learning from farmers--often through interpreters--can require a great deal of effort. Farmers are not usually fully aware of their knowledge or able to express it easily. In some cases, farmers give poor quality or misleading information, although this may not be intentional. Researchers may lack the resources or the patience needed to gather and sift through information of varying quality.

INTEGRATION OF ALTERNATIVE RESEARCH APPROACHES

Farmer and Researcher Roles

The nature and degree of farmers' participation in research can vary depending on topics and approaches (Table 79). Farmers' participation in research is not a panacea, and cannot hope to address all research problems (Nielsen et al., 1997). Farmers' contribution may be negligible in some research projects while in other cases the farmer is the major actor with researchers participating in the evaluation of results only.

Farmers play a minor role in research

All strategic, adaptive and verification research should be based on information, to which farmers have contributed, of farming systems' characteristics and problems. Beyond this, farmers' direct contribution is negligible in some of our on-station research. Examples of some current research, which has no direct farmer involvement, include studies on:

- genotypes for efficiency of nutrient use
- water use and nitrogen fixing by green manure crops
- nutrient dynamics in climbing bean systems
- utilization of different organic materials in soil management.

The research is targeted to well or poorly-defined farming systems with the expectation that the information gained will facilitate other research in which farmers will play a greater role.

Both farmers and researchers play major roles in research

In other research, farmers and researchers collaborate. In addition to assisting with characterizing systems and prioritizing problems, farmers may participate in designing research, managing trials and evaluating and interpreting results (Table 79).

In variety trials, researchers generally identify the entries from breeding programs (participatory plant breeding approaches offer alternatives to this) while the farmers identify local controls. Farmers may participate in trial design and manage the trials on their own land. Farmers and researchers jointly evaluate the results, deciding which varieties will be rejected, tested further or disseminated.

In these cases, farmers and researchers collaborated closely during intermediate stages of research to determine the potential of different green manure species for the farming systems. Researchers identified the species and provided the seed. Farmers and researchers together designed trials, implemented by farmers and evaluated jointly.

With other trials, such as those aimed at improving nitrogen fixing, farmers did not participate in the design of the trials but managed the trials and participated in the evaluation of the results. In the exploration of using alternative organic materials in soil management, farmers contributed valuable information on potential materials, researchers designed the trials, farmers implemented them, and farmers and researchers jointly evaluated the results.

Farmers in Uganda have little or no experience with fertilizer use. They are knowledgeable about their soils, but otherwise can contribute little knowledge to fertilizer research.

In all cases, farmers could have contributed to the design of trials if they were provided with enough information. Scarcity of time and operating funds may prevent researchers from adequately informing farmers so that they can effectively collaborate in trial design. Does the exclusion of farmers from the design of some trials, which they then implement, threaten the collaborative process, in either the short or the long term? Although this apparent inconsistency in collaborative approaches has not been raised as an issue of concern by participating farmers, we need to be concerned that it could lead to problems.

Farmers play the primary role in some research

An interesting outcome of the collaborative research has been the increase in independent experimentation by farmers. Several cases of farmer experimentation are detailed in Table 79.

Following the initiation of collaborative research on green manures, many farmers explored options for integrating these species into their farming systems. Researchers' direct involvement in this farmer experimentation was limited to our participation in evaluating and interpreting the results.

Following the identification of root (mole) rats (*Tachyoretes splendens*) as a priority problem, researchers provided farmers with information on the potential of a local plant species (*Tephrosia vogellii*) for root rat management. Farmers found the plant, harvested the seed, and planted the Tephrosia either throughout their fields or in barriers around fields infested with root rats. After several seasons, researchers participated in the evaluation through open-ended interviews with the experimenting farmers. The technology was found to be effective and dissemination to other farmers was already occurring.

In Kabale, CARE staff learned of the potential of Sesbania (*Sesbania sesban)* and Tephrosia for improving medium-term fallows. They took this information to farmers, discussed it with them and encouraged them to try the species. Much was learned about planting methods, sowing rate, weed suppression and adaptation to different soil types. Improvement of fallows with Tephrosia is now considered a very promising soil management option (Mwebasa, pers. comm., 1998).

Soil erosion was a major concern in Iganga District. Researchers provided information about living barriers and also provided planting material for vetiver grass, which farmers planted on their farms. Researchers later visited the participating farmers and evaluated the results. Some had planted barriers along the slope for the full width of their fields. Others had planted the grass strategically, only in places where erosion was severe. Good erosion control was achieved when the barriers were well managed, but dissemination of the technology was hindered by difficulties in cutting the coarse grass and digging up the crowns to obtain planting material.

Each of these cases of farmer experimentation yielded a good deal of information. The farmers' efforts were apparently stimulated by researchers' provision of additional information and planting material. Often the experimentation led to technological innovation, and the costs to the researchers were small.

Diverse research approaches and farmer empowerment

Use of diverse research approaches, which vary in the degree of farmer involvement, is cost-effective in the generation of information needed to improve technology to solve farmers' problems or to better exploit opportunities. It can be argued that using some approaches which are researcher-dominated will send confusing messages to farmers and inhibit the empowerment of farmers for the improvement of their own systems and livelihoods. Confusion resulting from the use of a variety of approaches may threaten the participatory process.

We have not established indicators of progress, nor instituted monitoring and evaluation measures, to chart the progress of farmer empowerment. Therefore, we cannot fully assess the effects of different aspects of participatory research on progress to farmer empowerment. However, we have not detected from discussions with farmers, nor from observation, that the diverse approaches described here inhibit empowerment or threaten the participatory process. In the case of Ikulwe in Uganda, the work has continued well for 11 seasons while using diverse research approaches. Farmers appear to appreciate the value of using alternative approaches and of researchers' leading efforts where farmers realize their knowledge is weak. We acknowledge, however, that with researcher-dominated approaches, efforts to fully inform farmers may often be inadequate, and there is opportunity for, and potential value in, greater farmer involvement.

Farmer Experimentation: Stimulation of Experimentation and Evaluation of the Results

The cost-effectiveness of systems research using participatory approaches is improved when farmers do a lot of experimentation independently. Farmer experimentation (FE) in Ikulwe occurred on several technical options, especially the integration of green manure species into their cropping systems (Wortmann et al., 1999). FE on green manures was of an adaptive nature, while FE on Tephrosia for root rat control and on vetiver grass as a living barrier to curb erosion took a problem-solving approach (Rhoades and Bebbington, 1991); all could be considered hypothesis testing (Stolzenbach, 1994). FE methods varied: sometimes the innovation was superimposed on a field otherwise managed according to the normal practice, but sometimes the innovation was applied to a whole field (e.g. intercropping Crotolaria with coffee and Canavalia as a cover crop in banana); treatments were seldom replicated; yields were generally not measured; plot size varied (small to moderate-sized test plots were commonly used, but only a few farmers measured the plots to ensure that they were of similar size).

Stimulation of farmer experimentation

Farmer experimentation in Ikulwe was apparently stimulated through: farmers' recognition of the role they had to play in a collaborative research process; farmers' access to new information about technical alternatives; farmers' access to an initial supply of planting material; and farmers' interactions with other PR farmers who provided encouragement and ideas (Wortmann et al., 1999).

Supplementing farmers' knowledge with additional information may often be the key to farmer experimentation (D. de Waal, 1997, *pers. comm.*). We mentioned above the success of farmer experimentation in verifying the value of Tephrosia in root rat control; researchers assisted with information after which farmers did their own experimentation.

Information may be provided to farmers in different ways. It can be done informally while in the field with farmers as was the case with Tephrosia and root rat controls. Visits by farmers' groups to an area with a tradition of climbing bean production resulted in a high rate of adoption of climbing beans but also in FE to solve problems which arose while adapting the cropping system to another environment. The farmer field school approach has been applied in Asia to enable farmers to find ways to improve management of their soils (van de Pol and Miagostovish, 1997); farmers meet regularly with resource people over a period of several months to learn more about the basics of soils and their management. CARE-Kabale met with farmers' groups to discuss the potential of Sesbania and Tephrosia as improved fallows and to encourage FE; farmers took the information and seed and experimented on their own fields. Less effective were farmers' visits to see the rural development activities of an NGO and to an agricultural research station: farmers were excited about the potential of some of what they saw, but little farmer experimentation resulted.

Evaluation of the results of farmer experimentation

Farmer experimentation can result in a seemingly "haphazard offering of innovations and ideas" (Tripp, 1991) from which it is difficult to extract and interpret information. Four methods were applied by participating researchers and farmers to gain information from FE about green manures in Ikulwe. These methods are listed here but are discussed in more detail elsewhere (Wortmann et al., 1999).

1. Researchers and interested farmers visited FE sites during the growing season and discussed their observations with implementing farmers. This approach probably yielded the best information on agronomic matters.
2. Farmers practicing FE on green manures met in small groups to list the main benefits, opportunities and problems associated with each species.
3. Farmers individually assessed four green manure species against eight criteria using a counter method of matrix ranking.
4. Farmers were interviewed using an open-ended approach on their FE experiences and results. These interviews yielded information that was well grounded in experience gained through FE.

Some of the information obtained was similar for two or more methods but generally the methods offered information of differing types and quality.

Development of Decision Guides for Integrated Nutrient Management

Research for soil fertility management has often focused on the use of one or two nutrient sources. Resource-poor farmers, however, often have access to diverse but scarce resources, which might be used in soil management. Few such farmers have sufficient money to apply fertilizer to all their fields at the currently recommended rates. Organic materials that might be used in soil fertility management are generally insufficient to maintain productivity of the whole farm.

Farmers' challenge

Farmers who wish to maximize returns on their investments must decide on the best use of available money, credit and organic resources. Questions farmers might consider are:

1. Which of their diverse crops or crop associations will give the greatest returns to investment in use of organic or inorganic resources for soil fertility management (e.g., banana, maize, bean, cotton, coffee, maize-bean intercrop)?
2. Should a scarce resource be applied to a small area at a high rate or more widely at a low rate? Which rate gives the best benefit: cost ratio?
3. How can organic and inorganic resources most efficiently be integrated? Are there potential synergisms that should be exploited?
4. How should fertilizers be applied: broadcast, band or spot applied; at sowing or top-dressing? Which formulation should be used?
5. If rains begin late, what does this imply for the short-term profitability of fertilizer use?
6. What is the value of alternative organic resources, e.g., commonly occurring plants (*Lantana camara, Tithonia diversifolia, Cassia* spp.) in management of soil fertility, and how should these be used?
7. How does cropping history (e.g., rotation from fallow, banana or cassava) affect response to nutrient application?
8. What is the effect of crop performance in the previous season?
9. How does soil type affect response?

Challenge for researchers and extensionists

Adequate information is often available to enable those capable in soil management to make reasonable decisions for diverse crop production systems, i.e., to estimate application rates and to see opportunities for integrating alternative resources for soil fertility management. The estimates, however, need to be improved and verified for agronomic and economic efficiency and compatibility with the farming system. The information then needs to be readily available to farmers and extensionists.

A decision guide approach can give direction to the research while putting information into a form, which allows efficient decision making.

- Tentative decision guides for production areas and major soil types might first be developed using available information, including ample local knowledge. Development of such a guide is expected to explicate research needs: the priorities for adaptive and verification research, and needs for additional information about the management of soil-crop interaction.
- Researchers and farmers collaborate in the research needed to verify and improve the guide, making it appropriate for farmers' use.
- Eventually farmers and extensionists promote the guides for use.

Tables 80 and 81 provide examples of two such guides.

CONCLUSIONS

The effectiveness of research for improved soil management can be enhanced through farmer participation, although there is a need to integrate more and less participatory approaches.

- Farmers have substantial knowledge about their farming systems, including the soil-crop interaction, that is potentially useful in soil fertility research; this knowledge may be the major asset for some problem-solving research.
- Farmers' knowledge is generally under-utilized, even by practitioners of participatory research.
- Different research topics require different approaches, not all of which lend themselves to high levels of farmer participation.
- Potential contributions of farmers are often not exploited by researchers, because of short-term expediency and cost considerations.
- Farmer experimentation can improve the cost-effectiveness of participatory research.
- Farmer experimentation is stimulated by the provision of information, exposure to other participatory research activities and recognition by neighbors of the importance of the research.

Farmer experimentation offers an opportunity to gain access to a lot of information, especially of a qualitative nature.

Resource-poor farmers have diverse but scarce resources, which can be used in soil fertility management; research and extension efforts should be oriented toward integrated nutrient management.

A decision guide approach can give direction to research and make information available to extensionists and farmers in a form that facilitates good decision-making for integrated nutrient management.

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Figure 13. Farmers' planting decision tree, Nazareth, Ethiopia, (Source: CIAT, 1995)

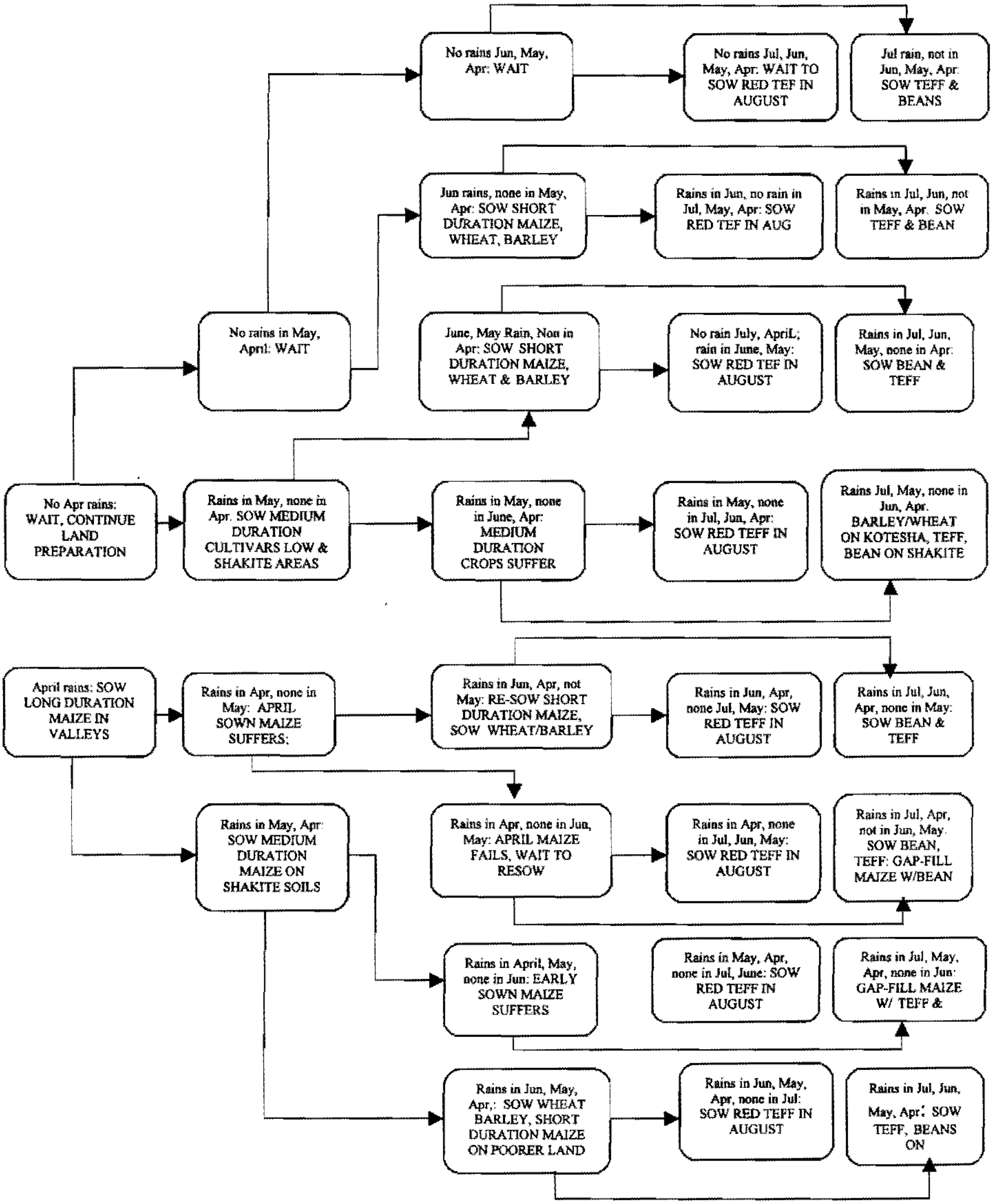

Table 77. Positive and negative soil characteristics cited for one or more soils by 35 farmers interviewed in Ikulwe

Soil characteristics	% of farmers Positive	Negative
Water-holding capacity	59	38
Tilth	49	--
Nutrient supply	46	37
Infiltration rate	44	--
Aggregate stability	23	--
Internal drainage	18	--
Soil depth	15	6
Stickiness (to hoe)	--	22
Erodibility	--	16
Gravel/stones	--	15
Compaction	--	11

Table 78. Soil pH, organic matter, and available P, K and Ca for major soil types at Ikulwe

Soil type	OM (%)	P (ppm)	Ca (mg)
Elyolubalebale	2.9 a	1.4 c	49.0 ab
Lusenyhosenyho	2.3 a	4.5 bc	30.3 b
Emyufu	2.5 a	4.1 bc	43.3 ab
Eliirugavu	3.4 a	20.2 a	70.6 a
Elyekibali	5.0 b	17.0 ab	72.8 a
Lyamutala	2.6 a	7.2 abc	52.2 ab
Mean	3.12	9.06	53.03

Table 79. Research topics in which farmers and researchers had roles of varying importance (F=Farmers played an important role; R=Researchers played an important role)

Trial	Problem recognition	Information source	Trials design	Trials management	Evaluation of results
Mouse birds in climbing beans	F	F,R	F	F	F
Tephrosia for mole rat control	F	R,F	F	F	F,R
Vetiver grass in barriers	F	R	F	F	F,R
Integration of green manures	F,R	R,F	F	F	F,R
Tephrosia fallows	F,R	R	F,R	F	R,F
Variety trials	F.R	R	R,F	F	F,R
Green manures	F,R	R	R,F	F	R,F
N fixing in beans	F,R	R	R	F	R,F
Organic x inorganic resources	F,R	F,R	R	F	R,F
Development of decision guides	R	R,F, other	R	F	R,F

Table 80. Tentative guide to fertilizer use for maize or bean in sole crop, and for the maize-bean intercrop on deep sandy clay loams in Iganga District (For determination of research and extension needs and a guide for extensionists and more literate farmers; an example.)

(Unless stated otherwise, the following applies if annual crops were grown the previous two seasons.)

Conditions	Maize, sole crop	Bean, sole crop	Maize-bean intercrop
1. Adequate money or credit is available	Apply 50 kg ha^{-1} TSP and 25 kg ha^{-1} urea at sowing; apply 50 kg ha^{-1} urea at 2nd weeding[1]	Apply 100 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing	Apply 100 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing; apply 50 kg ha^{-1} urea at 2nd weeding
2. Money or credit is inadequate	Apply 50 kg ha^{-1} urea at first weeding	Apply 50 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing	Apply 50 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing; apply 50 kg ha^{-1} urea at 2nd weeding
3. Green manure was produced the previous season	Do not apply inorganic fertilizer	Do not apply inorganic fertilizer	Do not apply inorganic fertilizer
4. Lantana, etc. is available	Reduce application of urea at 2nd weeding by 30% for each ton of fresh leafy material applied	Do not apply fertilizer	Reduce application of urea at 2nd weeding by 30% for each ton of fresh leafy material applied
5. Sowing is delayed until after 15 March or 15 September	Reduce fertilizer rate by 50%	Do not reduce fertilizer rate	Reduce fertilizer rate by 50%
6. Sowing is delayed until after 30 March or 30 September	Do not use fertilizer at sowing; top-dress urea at 50% rate if conditions are promising	Do not reduce fertilizer rate	Apply 50% of TSP at sowing; top-dress urea at 50% rate if conditions are promising
7. Farmyard manure is available	Reduce fertilizer by 25% for each ton/ha of dry FYM applied	Reduce fertilizer by 40% for each ton/ha of dry FYM applied	Reduce fertilizer by 20% for each ton/ha of dry FYM applied
8. Farmyard manure was applied last season	Reduce fertilizer by 15% for each ton/ha of dry FYM applied	Reduce fertilizer by 30% for each ton/ha of dry FYM applied	Reduce fertilizer by 10% for each ton/ha of dry FYM applied
9. Land was rotated from banana or fallow within last one year	Apply N at 2nd weeding, but only if maize is yellowish.	Do not apply fertilizer	Apply N at 2nd weeding, but only f maize is yellowish

[1] Top-dress with urea only if the crop is well established, the season appears promising, and especially if the lower leaves are yellowish-green in color.

Alternative fertilizers can be used. Use CAN as the N source for low pH soils. Approximate substitution equivalents are: DAP = 1 TSP and 0.5 urea; CAN = 0.7 urea; SSP = 0.5 TSP.

Optimal rates depend on fertilizer: commodity price ratios. The above assumes farmgate values such that 200-250 and 250-300 kg of maize are required to purchase one 50 kg bag of urea and TSP, respectively. If more maize is required to make the purchase, reduce fertilizer rates by 50%. If less maize is required to make the purchase, increase N application by 50%.

Table 81. Tentative guide to fertilizer use for maize or bean in sole crop, and for the maize-bean intercrop on deep sandy clay loams in Iganga District

(For use by farmers; an example. To be updated regularly to account for price changes, fertilizer availability, etc.)

Conditions	Maize, sole crop	Bean, sole crop	Maize-bean intercrop
1. Adequate money or credit is available	Apply 50 kg ha^{-1} TSP and 25 kg ha^{-1} urea at sowing; apply 50 kg ha^{-1} urea at 2nd weeding[1]	Apply 100 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing.	Apply 100 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing; apply 50 kg ha^{-1} urea at 2nd weeding
2. Money or credit is inadequate	Apply 50 kg ha^{-1} urea at 1st weeding	Apply 50 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing	Apply 50 kg ha^{-1} TSP and 20 kg ha^{-1} urea at sowing; apply 50 kg ha^{-1} urea at 2nd weeding
3. Green manure was produced the previous season	Do not apply inorganic fertilizer	Do not apply inorganic fertilizer	Do not apply inorganic fertilizer
4. Lantana, etc. is available	Reduce top-dress of urea by 30% for each ton of fresh leafy material applied	Do not apply inorganic fertilizer	Reduce top-dress application of urea by 30% for each ton of fresh leafy material applied
5. Sowing is delayed until after 15 March or 15 September	Reduce fertilizer rate by 50%	Do not reduce fertilizer rate	Reduce fertilizer rate by 50%

[1] Apply urea at second weeding only if the crop is well established, the season appears promising, and especially if the lower leaves are yellowish-green in color.

PARTICIPATORY IPM DEVELOPMENT AND EXTENSION IN NORTHERN TANZANIA

J.K.O. Ampofo and S.M.S. Massomo[1]

INTRODUCTION

Technologically sound and effective integrated pest management (IPM) strategies are often not adopted because farmers' production circumstances are frequently not well understood or are neglected in the generation and packaging of technologies. This is largely due to the fact that smallholder agriculture has often been considered primitive on the assumption that yields could be improved by supplying deficiencies through the introduction of external inputs. Smallholder farmers, however, operate in more complex, diverse and risk-prone environments than these assumption grants. Fixed prescriptions such as IPM packages do not work in such circumstances, since site-specific agroecological and socioeconomic conditions often determine what is best for a particular place (Van Huis, 1997). To enhance the relevance of technological innovations, several approaches to farmer involvement in technology generation and diffusion have been proposed and tested. IPM technology generation is moving from an approach that emphasizes research station trials and subsequent transfer of results to farmers by the extension system to an approach that emphasizes varying levels of farmer participation to ensure greater suitability of the technology to farmers' circumstances and to increase the likelihood of its adoption.

This paper describes some participatory approaches to the management of bean stem maggots (*Ophiomyia* spp., Diptera: Agromyzidae) and bean foliage beetles (*Ootheca* spp., Coleoptera: Chrysomelidae) with two farming communities in the Arumeru and Hai districts in northern Tanzania. The projects were initiated at the invitation of the District Extension Offices of Arumeru and Hai to assist the village communities in addressing some of their production constraints.

AGROECOSYSTEM CHARACTERIZATION

The research site in Arumeru district was Mbuguni division in the southeastern lowlands of Mt. Meru (Figure 14). The mountain (at 4562 m asl) exerts a profound influence on the district's climate, soil and physical infrastructure such as roads and on the availability of irrigation water. These influences account for much of the district's agricultural diversity. The general area has a gentle slope and lies between 850 and 1000 m asl. It is served by the Kikuletwa and Nduruma rivers and other small streams whose waters are used for irrigation of crops in many of the villages. The soils are relatively young volcanic ash from Mt. Meru eruptions; they have high porosity and low bulk density (Lundgren, 1978). Rainfall records from nearby Kilimanjaro airport suggest a bimodal pattern with peaks in April-May (140 mm) and November-December (40 mm), but agriculture thrives throughout the year because of irrigation. The area was under sisal cultivation by several estates during the colonial era. Immigrant laborers from various parts of Tanzania remained as settlers even after the collapse of the sisal plantations. The main ethnic groups within the heterogeneous population are the Waarusha, Wachagga, Wamaasai, Wameru, Wanyiramba and a number of other tribes.

A participatory rural appraisal (PRA) conducted by Baral et al. (1993) suggests that the main occupation of the people is agriculture involving three farming systems: agro-pastoralism, crop

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cultivation and mixed farming. The main crops are maize and beans which are either grown as monocrops or are intercropped together. Other important crops include cabbage, chilies, sweet peppers and tomatoes. Beans are preferred, according to the farmers, because they are easy to produce and are also more profitable, yielding a greater return for inputs compared with crops such as maize. These crops are grown for nearby markets in Kikatiti, Tengeru and the mining settlements of Mbuguni and Merarani.

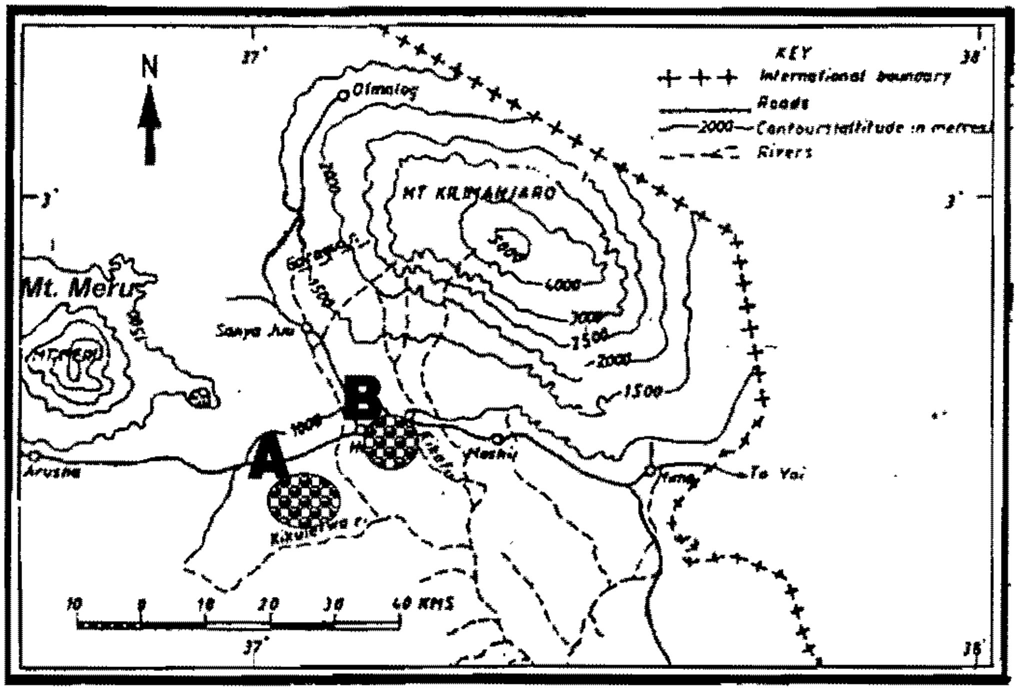

Figure 14. Sketch map showing the topographic features of Arumeru and Hai Districts and highlighting the research sites at Mbuguni (A) and Masama (B) Divisions

The research site in the Hai district was the Masama division in the Sanya Plain (ca. 950 m asl) which lies between Mt. Meru and Mt. Kilimanjaro. The division is contiguous with the Mbuguni division of the Arumeru district and shares similar rainfall characteristics with it. The soils however are shallow, stony and weakly developed (Lithosols) (JKADP, 1977) and irrigation water is limited to a few areas only. A mixture of tribes dominated by the Wachagga populates the area. The population density is currently low--ca. 50 persons/km^2--but is increasing with immigrants from the uplands. The main occupation is agriculture and livestock, with maize, beans and horticultural crops such as tomatoes, carrots, cabbages and sunflower as the main crops. The principal growing season is March-June.

RESEARCH ACTIVITIES

Project Organization

The research approach adopted was participatory and included the following activities:

- Identification of production priorities and constraints.
- Participatory discussion of constraints and possible solutions.

- Formation of farmer research groups to plan and execute on-farm evaluations of possible solutions.
- Field demonstrations by lead farmers or farmer research groups.
- Farmer-to-farmer technology diffusion.

There were several sessions of group discussions at each stage to appraise progress and set new directions.

Production Constraints at Mbuguni Division (Arumeru District)

Baral et al. (1993) identified pests and diseases as the major production constraint to bean productivity in the area. They did not, however, specify the pest or disease species. During our initial visit we highlighted farmers' specific production problems through group discussions and farmers' ranking of priorities among production constraints. This was followed by a verification survey conducted by researchers. Among their general problems was insufficient land availability for farming. This appeared to be more of a problem in Kikuletwa village, while insufficient water for irrigation was a problem in Valesca village. The main agricultural production constraints in the area were pests and diseases as highlighted by Baral et al. (1993), low soil fertility and lack of access to markets. Farmers described beans as one of the main crops in the area, the other being maize. With regard to beans they described their constraints as:

- lack of improved production technology, including improved varieties
- low crop yield, which was attributed to low soil fertility, inappropriate varieties as well as pests and diseases
- pests (bean stem maggots, aphids and spider mites) especially during the second cropping season (October-January); diseases such as rust and "root diseases" (a vague description of several anomalies associated with the soil and roots).

The farmers did not attribute BSM damage to an insect. However, they described the symptoms very well: "The young plants yellow, wilt and die. Older plants develop swollen and cracked stems." They attributed some of these symptoms to moisture stress, but they observed that if such plants were irrigated they died within a day.

Following the identification and prioritization of production constraints the farmers selected BSM as the first priority to address. This was partly because the pest was in season and damage was severe as a result of drought, and also because they identified us as crop protectionists. After participatory problem analysis and brainstorming on possible control measures we agreed on:

- evaluation of improved varieties and BSM tolerant varieties, and
- cultural methods including the potential of soil moisture conservation and enhanced soil fertility for the management of the BSM problem.

Our focus was on sound crop management practices and not just BSM management *per se*. The Patanumbe village community organized themselves in a farmer research group and offered community land as well as individual farmers' fields for research.

Farmer Evaluation of BSM Tolerant Cultivars

The farmers evaluated nine BSM-tolerant bean varieties after they had grown them in comparison with Bwana Shamba (farmers' own variety) under farmer management for one season. They appreciated the value of tolerance but desired marketability as well. Subsequent appraisal was based on seed type, yield and consumption characteristics. Two varieties, G 11746 and PAD 3, were ranked high for all the criteria used in the assessment by the farmers. Other varieties were selected for other characteristics (Table 82). Initially, the farmers were apprehensive about the market potential of these varieties and did not grow them on a large scale, but when other farmers expressed their appreciation for the varieties during a Farmers' Field Day, they multiplied seed and sold it to them.

Evaluation of cultural control methods with farmers

The purpose of the trials was to expose farmers to new technology and use farmers' knowledge and experience to adapt such technology to improve their production practices. This then could be used to refine the methodology for extension elsewhere in similar circumstances. The treatments used were:

- seed dressing with endosulfan to protect against BSM infestation
- application of inorganic fertilizer/DAP to enhance plant vigor and tolerance
- application of farmyard manure to enhance plant vigor and tolerance
- application of grass mulches for soil moisture conservation and promotion of adventitious root formation
- earthing up (piling of soil at the base of plants during weeding to promote adventitious root formation)
- various compatible combinations of the above.

Farmer selection of control strategies was related to crop vigor and pod load (which were the more obvious characteristics of the treatments selected by them) as well as the availability of inputs and ease of application of the control method. Farmers did not like applying inorganic fertilizer to their fields as it is commonly believed in the area that such fertilizers have detrimental effects on the land ("If you used it once you will have to use it all the time or your land will be destroyed"). The farmers generally ranked the use of farmyard manure above all the other components and began to use it also on high-value crops such as maize. (Before this collaboration, farmers viewed manure as a nuisance that they had to remove from their cattle kraal and burn.) They also appreciated the value of mulching but observed a competition between using it for animal feed and using it for crop mulch. The use of mulching has, however, spread into the neighboring Usa River area where rice straw is plentiful and the practice of growing beans after rice is being promoted through a sub-project.

Participatory analysis of performance

At the end of the season we did a performance analysis in which all the different activities conducted during the season were evaluated. The result of the analysis is summarized in Table 83 below:

Table 82. Farmers' evaluation of BSM tolerant varieties, Patanumbe village, 1997

Variety	Yield in Kg/plot	% Clean seed	Farmer ranking	Frequency ranked among the:		Merits	Disadvantages
				Best 3	Worst 3		
G 11746	26.2	84.8	1	25	0	Earliness High yield Drought tolerance Marketability	None
PAD 3	48.7	94.4	2	7	0	High yield Marketability	None
Mlama 49	27.9	80.9	3	10	4	High yield Seed color	Marketability
G 13856	18.3	38.2	4	8	6	Disease resistance Yield Seed color	Marketability
ZPv 292	35.2	53.8	5	8	8	Yield Marketability	Rat damage
G 22501	31.2	79.2	6	7	9	Yield	Seed color Lateness Marketability
ZAA 12	23.9	77.8	7	4	6	Yield	Seed color Empty pods
Ex Lushoto 290	17.3	61.5	8	5	8	Disease resistance Marketability	Low yield Lateness
Mlama 127	28.6	93.0	9	2	9	Yield	Seed color

Table 83. Participatory evaluation of production performance

Aspect	Performance	Follow-up actions
Crop growth	Crop growth was vigorous and productive. This was due to good management practices (timely weeding and irrigation).	Need information on fertility management for stable production.
Pests	BSM tolerance was better than in the local controls (Bwana Shamba and Lyamungu 85). Other pests, e.g., pod-sucking bugs, were not controlled. This affected the quality of the harvest (seeds had sunken scars and blemishes). Rat damage was more severe than expected and affected some varieties more than others.	Need information on pests: pest identification, damage and management, especially pod-sucking bugs, BSM.
Diseases	The crop was generally disease-free but some varieties suffered from white mold attack; this was attributed to dense crop canopies in the affected varieties. BCMV attack was high in some of the personal fields.	Needs information on diseases: disease identification, damage and management, esp. BCMV. Rogue out all BCMV infected plants.
Yield	Yields were increased beyond expectation but could have been better if pests and diseases had been adequately controlled.	Take actions to improve yield and seed quality.
Sale of produce	Could have been better. Quality of seed was poor. Lots of seed was sold for less money (500 TSh) immediately after the harvest. Offers for 1000 TSh /kg were received later in the season but little seed was sold at this price. Nearly all seed of G 11746 was sold in response to demand, not a good practice.	Improve seed quality and manage sale of seed efficiently. Do not sell seed from BCMV-infected plots. Always separate seed for next season's planting from seed for sale.

Bean Foliage Beetle (Ootheca Spp) Management Strategies at Hai

Identification of production constraints in Masama division, Hai district

In a PRA conducted by Aminu-Kano et al. (1992), farmers did not cite any problems associated with bean production. At that time beans constituted a minor crop in their production system. In recent years, however, farmers have come to consider beans a more profitable crop and to grow them as a monocrop season after season. Crop rotation is poorly practiced. Several problems associated with continuous cropping of the same species have emerged as a result.

During the "masika" of 1997, the Hai district administration requested help from the Tanzania Bean Program to address a problem that was affecting bean crops in smallholder fields. After a preliminary survey by researchers and the district extension officers, farmers were invited to participate in a wider survey and monitoring exercise to identify the cause of the problem and its spread. A follow-up group discussion increased understanding of the history of the problem and helped to identify research and development needs, as summarized in Table 84.

Development of strategies for bean foliage beetle management

There were three phases of participatory discussion and research activities as summarized in Table 84. Periodic meetings were held with the farmers and extension officers and with other bean researchers to plan research activities, monitor field trials and discuss and make inferences from the results. Experiments conducted were developed mostly through discussion with farmers and extension officers. Some farmers performed individual research based on the available information and shared the results with the larger group. Further experiments were based on the results of the previous ones. Control strategies were developed collectively as listed in Table 84.

Pest identification and studies of its biology and ecology

The problem was diagnosed as larvae attacking roots of bean plants. This was done through a sequential sampling of affected plots and mapping out the distribution in the area as well as distribution at different soil depths. Changes in the life stages of the pest were also monitored in the process until adults were formed. This helped farmers to understand the biology and ecology of the pest and subsequently to develop management strategies. The pest was widely distributed in the area. Its biology is described in Table 85 and Figure 15. Over 80% of the subterranean forms were within the top 20 cm of the soil and the mean population was ca. 100 insects/m^2. Farmers were initially only aware of the damage caused by the adult BFB (i.e. foliar damage) but assumed heavy rain effectively drowned them. They were unaware of the larval damage to roots and did not relate stunted plants and premature senescence to BFB. The study helped them understand the BFB life cycle and ecology better and this enabled them to identify potential control methods (see Table 86) and participate actively in the generation of strategies for BFB management. Such strategies included: post-harvest tillage, crop rotation, delayed sowing of beans, and the application of pesticides such as neem, etc., as listed in Table 84. These were experimented with and the results are summarized in Figures 16 - 18 below.

Table 84. Summary group discussion points, research activities and research needs as identified by farmers

Phase	Discussion points	Activities	Research & development needs
1	Discussion on cropping history of sampling sites	Problem identification and analysis Field sampling of plants, roots and soil for the cause of above-ground symptoms	• Pest identification • Life cycle and ecology • Pest distribution
2	Results from research in Phase 1 Potential control strategies	Field visits to monitor on-going research activities	Evaluation of potential control strategies • Post-harvest tillage • Crop rotation • Host plant resistance • Insecticide application Post-harvest flooding
			• Delayed sowing of beans • Insecticide (neem) application
3	General research results Strategies for area-wide management	Request that local administration enforce community adoption of area-wide management strategies	Extension of management strategies with posters, bulletins and farmer-to-farmer activities

Table 85. Summary of *Ootheca* life cycle in relation to bean planting cycle at Hai, northern Tanzania (see also Figure 15)

Period	Developmental activity
March-April	Adult emergence in synchrony with rains and planting of beans. They cause defoliation to bean seedlings. Adults mate and oviposit in soil near bean plants. Emerging larvae feed on bean roots removing secondary roots and causing injury to the primary roots. They also poach nodules.
May-June	Larval damage to rooting system disturbs nutrient flow from the soil and causes plants to senesce prematurely and bear few pods, each with few seeds.
July	Beans are harvested but *Ootheca* is left in the soil in different stages of development; populations may exceed 100/m^2. Land is left to fallow and *Ootheca* population development continues.
August	Pupation starts in the soil.
September	Adults are formed but remain in soil and undergo diapause.
October to March-April	Adults remain in diapause until the beginning of the rains when they emerge to attack newly-emerged beans

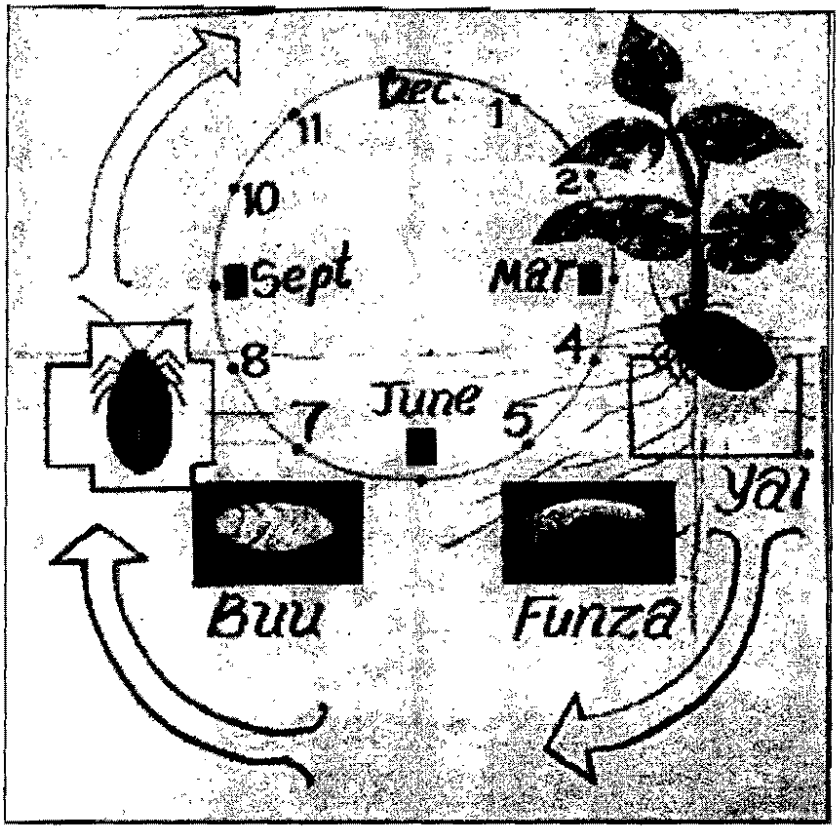

Figure 15. Bean foliage beetle life cycle: Yai = eggs (adult laying eggs in soil); Funza = larva (feeding on roots in soil); Buu = pupa (developing in soil)

Table 86. Summary of farmers' group discussion on possible control strategies

Strategy	Views in favor	Views against
Post-harvest tillage	BFB is not a problem in commercial production system where this is practiced	Hai soils are rocky and post-harvest tillage may be difficult
Insecticide application	• Requires research on use of neem • Requires research on insecticides that can be applied at planting Use of insecticides will require a collective approach so all farms will be sprayed simultaneously to avoid migration to other fields.	
Delayed planting	May be useful in monocrop beans	Rainfall distribution may not allow crop to grow to full maturity
Crop rotation	A potentially good strategy	May not be practical where fields are small
Biological control	No knowledge available: requires research to identify possible natural enemies	

Evaluation of potential control strategies

Zero tillage and post harvest tillage

Both practices reduced pest emergence from the soil and subsequent crop damage. Farmers and researchers deduced that post-harvest tillage exposed the subterranean form of the insect to the elements and to predators and reduced the residual population of the pest. Tillage just before planting facilitated the emergence of the pest from the soil as compared to zero tillage (Figure 16). The following recommendation was made: because of the pest's ability to fly to other plots, these treatments were ineffective when practiced in isolation. There was a general consensus that these should be adopted communally, as the pest's ability to fly will render the treatments ineffective if applied in isolation.

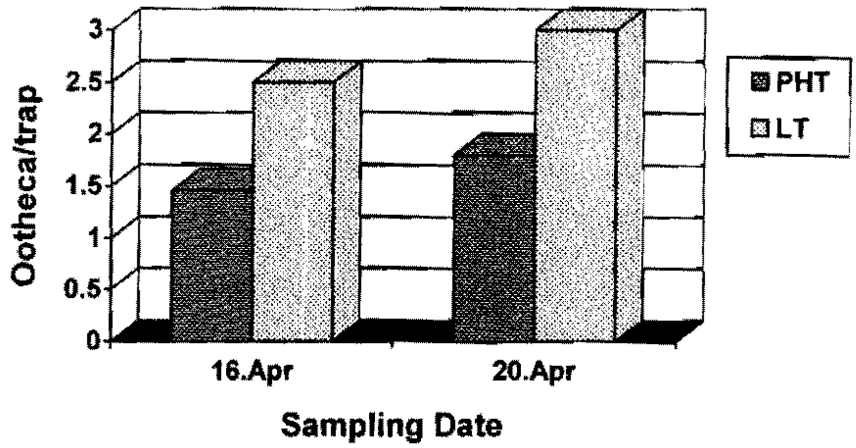

Figure 16. Effect of post-harvest tillage (PHT) and late tillage (LT) on BFB populations in farmers' fields at Hai

Crop rotation

Maize, beans, cowpeas and soybeans were planted after beans in a plot known to have a high level of residual BFB infestation. There was BFB emergence in response to the germinating beans and cowpeas but not to the maize and soybeans (non-hosts) (Figure 17). This was a clear indication that growing beans after beans in the same plot permitted the continuous development of BFB and that rotation with non-hosts will interrupt the cycle.

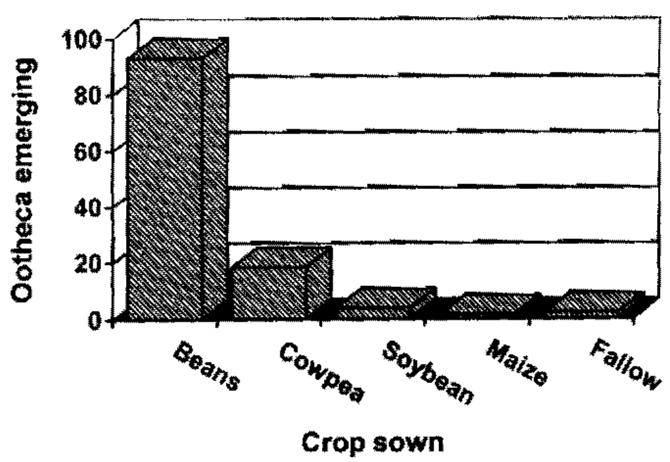

Figure 17. Effect of crop rotation on BFB emergence patterns in farmers' fields

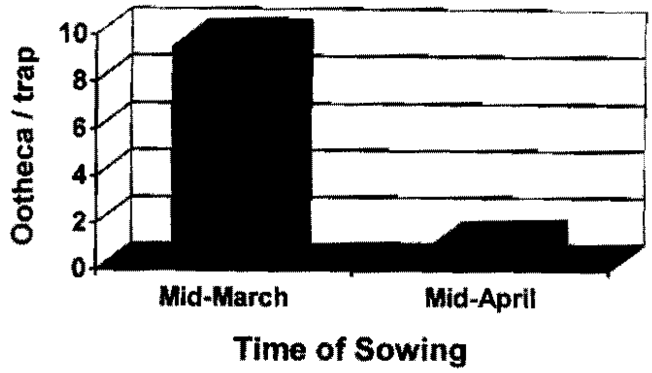

Figure 18. Effect of timing of sowing on BFB infestation patterns

Delayed sowing of beans

Late (mid-April)-sown beans missed the peak infestations of BFB and were attacked less compared to the March-sown crop (Figure 18).

Neem sprays

Foliar application of neem seed oil and neem seed powder protected the bean plants from adult infestation for periods of more than five days per application (Figure 19).

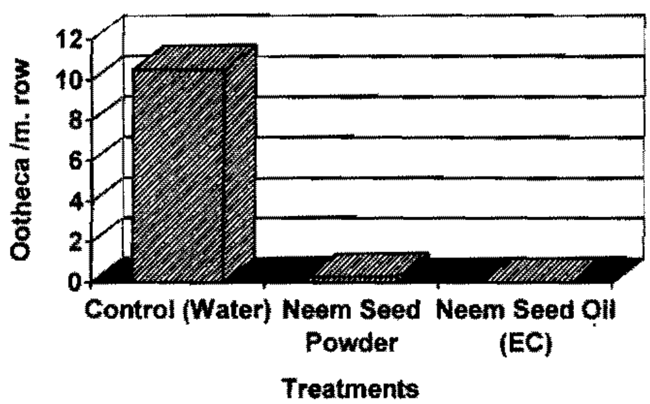

Figure 19. Effect of foliar sprays of various neem products on BFB adult infestation

RESEARCH RESULTS

The aim of this research was to enable the farmers to understand some of the problems that affect productivity in their farming systems and help them to develop solutions through research. This approach stimulated farmers' initiative and confidence in themselves and initiated further activities in which they can share their experiences with other farmers.

Farmer-to-Farmer Extension

The Patanumbe-TFG held a field day to demonstrate their newly acquired technology to other farmers' groups. This was attended by the Arumeru and Hai District extension staff, researchers and an NGO (FAIDA--Small Enterprise Promotion). The visiting farmers were invited to score the varieties for various characters including yield, marketability and tolerance to various constraints to productivity. Table 83 shows farmers' ranking of the test varieties. The visiting farmers requested seed for some the selected varieties and the Patanumbe-TFG multiplied and sold seed to them accordingly. In addition, the Patanumbe-TFG offered practical training in bean production to the groups that bought seed from them (This was to ensure that they obtained the advertised yields). In the process 12 farmers' groups including three schools were formed and received training.

Radio Broadcasts

The Information and Communication Section of the extension service put out radio broadcasts about the Patanumbe-TFG, the field day and the new bean varieties. This created public awareness of the availability of new bean varieties and led to a demand for seed. It also boosted the confidence and morale of the Patanumbe-TFG.

Farmer Exchange Visit

In response to farmers' desire to acquire knowledge on fertility management strategies two farmers were sponsored for a week-long visit with farmers participating in the Organic Matter Management Network in Kakamega, Kenya. In addition to cultural strategies for fertility management, they also acquired technology for solar drying of fruits and vegetables, which they plan to use in drying mangoes (an abundant commodity in their environment), for export with assistance from FAIDA-SEP.

Village Information Centers

These activities have generated a demand from the general farming community for information and technology. Farmers frequently visit the research station in search of information on crop production and other activities including market channels. In collaboration with researchers and the extension service, they have set up a Village Information Center (a depository of literature including extension bulletins, posters, books and other informational materials) in the local school for use by all. They have appointed one individual who is relatively better educated (in addition to the school teachers) to lead them through the available information when needed. They have also collaborated with the researchers and extension staff to develop posters capturing their experiences and understanding of the management of bean foliage beetles.

Benefits to Other Commodities

The experience gained from these participatory activities is being applied to other commodities such as vegetable seed production.

LESSONS LEARNED

When farmers are able to grow a crop more profitably they tend to invest time and resources in the production system. Initially farmers in Patanumbe assumed *"this is how beans grow here"*;

however, when they realized they could grow more profitably and sell surpluses, they were eager to achieve even higher yields. They began to notice pests and diseases as constraints in their system and sought to control them. One farmer observed that "these days people are taking care of their beans," possibly because beans could grow better in their village. They were also willing to share their newly acquired technology with others. When other farmers observed that their colleagues "could do it" they became more convinced of the technology and were willing to try it themselves.

Farmers adopt components within packages rather than whole packages. The farmers observed the potential of chemical seed dressing, inorganic fertilizers and farmyard manure. They also realized that chemicals were often beyond their reach and farmyard manure was difficult to cart. They opted for the more convenient component—BSM-tolerant varieties--more readily. They also prioritized the distribution of their resources and applied farmyard manure to their maize crops rather than beans.

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DISCUSSION SESSION

Question 51.

a) Have you ever tested post harvest tillage combined with no tillage at planting?

b) What sort of implements did you use for tillage and planting?

Response

a) We have tested them separately but as a combination, we have not tested them in a formal trial.

b) A standard ox-drawn plough.

Question 52.

Would you please exactly indicate the actual participation made by the farmer on the IPM development and extension?

Response

Farmer participation was right from problem identification through the selection and design of trials. They discussed and evaluated the results at each stage and recommended what follow up trials or action needed to be taken.

Question 53.

How do you find your approach to the community from IPM point only, where farmers' problem may not be IPM only but other problems also? Doesn't this affect the integrated development aspects?

Response

I have only discussed the IPM work here but the activities were more holistic than that. For instance, we invited an NGO to help in identification of market channels for them. Also through visits with other farmer groups the learned how to process of mangoes (solar drying) for the local and export market

Question 54.

a) Number of participating farmers in Arumeru & Hai

b) Role of ITK in developing potential solutions for ootheca beetle.

Response

a) We started with about 20 farmers but these have helped form farmer research groups in 11 other villages each comprising approximately 15-20 members so in total we have over 200 farmers now.

b) We tried to bring in ITK in all we did. For ootheca the farmers did not come up with any ITK grant from time of sowing to avoid periods of high pest population. For bruchids however they had lots of ITK.

Question 55.

How long did it take to the formation of farmer research groups?

Response

A period of four years for farmers to reach where they are.

Question 56.

You have mentioned about opportunistic seed companies, how do we go about convincing them against their profit motives, that we are helping the community, bearing in mind that we want to attract the private sector into participation?

Response

This has been difficult for us. The seed company's primary motive is profit and not community development. What we would like to see is farmers getting into seed multiplication of local market varieties rather than seed for the export market.

SECTION IV
OVERVIEW

PRIAM PROJECT: ACHIEVEMENTS, LESSONS LEARNED AND CHALLENGES AHEAD

Cary Farley

OVERVIEW

Presented below is a concise synthesis of the achievements to date of the PRIAM Project, as reported by PRIAM Sub-Project partners and workshop participants. The synthesis includes a review of some of the lessons learned during the course of the PRIAM Project, and identifies some of the challenges ahead for the PRIAM Project, but also for participatory research programs in general. Further observations and recommendations (i.e., outputs from the PRIAM Synthesis Workshop's Working Groups' activities) concerning the current and future needs and opportunities for the PRIAM Project, and similar participatory research programs, are presented in Addendum I.

PRIAM Project's Four Cornerstones

Partners in the PRIAM Sub-Projects have been working in communities with farmers for two or more years, working in a way that emphasizes shared, experiential and iterative learning processes. Based on the diverse experiences of multiple partners and community members working across diverse sub-project sites in Eastern Africa over the last two years, the PRIAM Project has identified four basic components important to the development and successful implementation of community-based, "participatory agroecosystem management" programs. The four components have been developed into the PRIAM Project's Four Cornerstones. These are: 1. Multi-Disciplinary and Multi-Partner Teams, 2. Participatory Methods, 3. Agroecosystem Approach, and 4. Integrated Community Action Plans. The Four Cornerstones can be woven together into one succinct statement that exemplifies the broad conceptual and methodological framework, and the overall goal of the PRIAM Project.

"To work within an *Agroecosystem Approach* in *Multi-Disciplinary and Multi-Partner Teams* using *Participatory Methods* to develop and implement *Integrated Community Action Plans*, with the aim to improve agricultural production and agroecosystem management in a sustainable manner, and ultimately to improve rural livelihoods."

The basic objectives and some of more salient characteristics of the Four Cornerstones are detailed here:

A. Agroecosystem Approach

- Utilize an agroecosystem approach that underscores the need importance of the dynamic interactions between the various component sub-systems. There is a focus placed on four basic sub-systems: 1. Crops, 2. Livestock, 3. Soils and land, and 4. Social and economic. (The four sub-systems are delineated for the purposes of facilitating the characterization and diagnosis of the larger agroecosystem, and the development and implementation of sub-project activities; the inter-related nature of many of the problems and potential solutions should be underscored and further reflected in the Integrated Community Action Plans.)
- Seek to better understand the dynamic (i.e., changes over time), diverse (i.e., differences across space) and interrelated nature of the components, i.e., organic) of the agroecosystem,

rather than to simplify its complexity and reduce it to component parts, singular technical problems and mechanical solutions.

- Examine and address not only the bio-physical aspects of the agroecosystem (i.e., subsystems #'s 1-3), but the social, economic and political aspects as well.
- Examine and address the agroecological (e.g., land holding size, soil type, livestock number) ***and*** social and economic differentiation (e.g., gender, wealth, organization membership, land tenure) within participating communities.
- Use the "community" as the point of entry for the activity program (versus individual-farmer or organizations, etc.), and strive to address not only household or farm-level problems, but community-level and larger scale issues.

B. Multi-Partner and Multi-Disciplinary Teams

- Develop teams comprised of multiple partners (or "stakeholders"), including farmers and other community members (e.g., local leaders) and staff from NARIs, MoAs, Extension, and NGOs, amongst others.
- Include partners from varied disciplines and specializations, and seek to ensure that social scientists are also well represented on the teams.
- Emphasize the complementary--as opposed to the competitive--aspects of multiple partners and team approaches (i.e., strive to cultivate team synergies, where the outputs of the "whole team" are greater than those of the individual partners.)
- Facilitate and support multiple and evolving modes of organization among, and interactions between, the various partners (i.e., allow for site-specific variations or interpretations of the basic "guidelines".)
- Work with local leaders and community-based organizations, as well as district and regional level organizations.
- Develop Farmer Research Committees to oversee ICAPs, and to liase between "outside" partners (e.g., researchers, extension agents, NGO staff, etc.) and farmers and other community members.

C. Participatory Methods

- Shift control of the research and development process from the domain of researchers, extension agents and development practitioners, to that of a larger "shared" domain that includes all partners, and particularly farmers.
- Provide farmers the opportunity to participate in all aspects of decision-making throughout all stages of the research and development process.
- Focus on the needs and problems of, and the differences between, small-scale, resource-poor farmers, and address farmers--as opposed to "outsider"-identified and prioritized research problems.
- Address the agroecological and socio-economic differences within communities, and the changing needs of community members over time by providing "Baskets of Options" that allow farmers to make choices according to their diverse and ever-changing needs, instead of singular technical solutions or prescriptive recommendations (i.e., promote "menus" of technology and management options rather than specific "recipes").
- Promote technical solutions that have multiple potential benefits or uses (e.g., agroforestry).
- Characterize and utilize indigenous (i.e., local, farmer) technical knowledge, and draw on local innovative capacity and experimental ("research") experiences.
- Support farmer experimentation and innovation.

D. Integrated Community Action Plans

- Develop Integrated Community Actions Plans (ICAPs) characterized by:
  - Farmer identified and prioritized problems.
  - Flexible methodological framework, and a basket of skills and tools.
  - Integrated research and development activities implemented by teams of partners.
- Create an "open" working environment that supports increased awareness of, access to and sharing of:
  - Information (e.g., technical knowledge; sources of expertise, materials, funds).
  - Skills (e.g., agronomic techniques, research methods, management options).
  - Resources (e.g., financial, material inputs, (e.g., new crop varieties, fertilizers)).
- Emphasize ***products*** (i.e., generation, and/or adoption and dissemination, of technologies), as well as ***process*** (i.e., an iterative, experiential ("learning by doing"), group-learning approach to research and development.)
- Assist to **empower** farmers, i.e., facilitate farmers to better understand and exercise their rights to make demands on, and benefit from, the formal research and development systems.
- Assist to **enable** farmers, i.e., facilitate farmers to make better and more informed decisions, learn new skills, access new resources, and ultimately--*to improve farmers' problem-solving capacities.*

ACHIEVEMENTS

Objective One: To Implement Community-based, Participatory Research Projects in Collaboration With National Agricultural Research Institutes (NARIs), Ministries of Agriculture (MoAs) and Departments of Extension (Extension), and Non-Governmental Organizations (NGOs).

- PRIAM sub-projects implemented in nine communities in Eastern Africa. The sub-projects are located in: Ethiopia (3): Awassa, Nazreth and Alemaya; Kenya (2): Kisii and Kitale; Uganda (2): Kabale and Ikulwe; Madagascar (1): Antsirabe; and the Democratic Republic of Congo (1): Bukavu. (Please see Table 1 and Figure 1 for further details.)
- Sub-project teams comprised of farmers and "outside" partners established and functioning.
- Farmer Research Committees established and functioning.
- Farmers' and other partners' confidence in, and commitment to, one another and the larger sub-projects increased with time.
- Number of participating farmers has, on average, increased at each sub-project.
- Partners increasingly shared information, skills and resources amongst one another.
- Researchers increasingly recognized the potential value of, and also used or built on, indigenous (i.e., local, farmer) technical knowledge and local experience.
- Farmers adopted new crop varieties, (e.g., bush beans, wheat, maize) and technologies (e.g., agricultural implements).
- Farmers provided valuable evaluation "feedback" regarding crop varieties and other technologies to research partners.
- Farmers assisted with the dissemination of new technologies (e.g., green manure, bean varieties.)
- Farmers demonstrated a variety of independent initiatives. Examples include: 1. Establishment of independent agronomic research, seed multiplication, and related activities, 2. Developed cost-sharing schemes with partners to defray research expenses, and 3. Formed and registered self-help groups or income generating "cooperatives".

Objective Two: To Facilitate the Institutionalization of Participatory Research Approaches within Collaborating NARIs, MoAs, Extension and NGOs.

- More than one hundred and fifty farmers actively participating in PRIAM sub-projects, with more than 300 other farmers loosely affiliated to the sub-projects.
- More than one hundred CGIAR and NARI researchers, extension agents and NGO staff participated in PRIAM and related PR training and implementation workshops.
- PR Lectures were provided to over 600 students and staff at Alemaya University of Agriculture (Ethiopia).
- Participatory research (PR) literature and training materials distributed to PRIAM sub-project partners.
- Funds provided to extension agent to enroll in a "mid-career" B.Sc. program at Alemaya University of Agriculture (Ethiopia), to study potential role of participatory methods in MoA and Extension programs in Ethiopia.
- One NARI researcher facilitated to work as PR resource person for ECABREN, and to assume the position of Coordinator of the PRIAM Project in 1999.
- In 1999, the PRIAM Project formally incorporated into ECABREN, which will provide future funding and coordination-support to the PRIAM Project.

Objective Three: To Refine and Develop Methods for the Different Stages of the Participatory Research Process.

A methodological framework for the PRIAM Project was developed. The framework is comprised of five distinct, yet overlapping stages: 1. Participatory Agroecosystem Characterization and Diagnosis (PAC&D), 2. Participatory Planning and Experimentation (PP&E), 3. Participatory Monitoring and Evaluation (PM&E), 4. Participatory Information and Technology Dissemination (PI&TD), and 5. Participatory Analysis of Experience (PAE). A concise description of each stage is provided below:

1. Participatory Agroecosystem Characterization and Diagnosis (PAC&D)

Participatory exercises are utilized to characterize the agroecosystem (e.g., compiling inventories of resources, social organizations, information sources, support agencies, and mapping their location and distribution), and to diagnose the problems, needs and constraints to improved production of the subsystems. (The PAC&D exercises include assessments of both the biophysical AND socio-economic components of the agroecosystem.) Participatory exercises are also used to conduct cause and effect analyses, and to prioritize the problems to be addressed and the potential solutions to be tested and evaluated in the Integrated Community Action Plan (ICAP).

2. Participatory Planning and Experimentation (PP&E)

Building on the information gathered in Stage One (PAC&D), farmers, researchers and other partners collectively develop an Integrated Community Action Plan (ICAP) for the upcoming season/year. In addition to standard on-farm trial designs, and crop variety and technology demonstration methods, partners are encouraged to test new field research methods, modify conventional experimental designs, and expand "conventional" research activities to include indigenous technical knowledge (ITK) components and farmers' traditional experimental approaches. A strong emphasis is also placed on examining interrelationships between problems, and between solutions, and seeking technical or management solutions that can address multiple problems simultaneously.

In the development of the first season's or year's ICAP, partners are encouraged to undertake relatively simple, clearly defined and short-cycle activities (e.g., adaptive crop variety trials). It is important that at least some of the initial activities provide farmers with readily visible and analyzeable/understandable results over a short time period, and that the results demonstrate some potential benefit or "return" for farmers investment of labor, land, etc. This type of straightforward, short-term activity can help cultivate in farmers a belief that their participation may yield tangible benefits. It also provides the "outside" partners an opportunity to work closely with farmers, for partners to work out operational modalities at the field- and community-levels, and for all partners to develop mutual trust and confidence, commitment to the program, and to build effective teams.

During the either the PAC&D or PP&E stages, Farmer Research Committees (FRCs) are formed to facilitate farmers to assume greater responsibility for implementing the ICAP, to assist "outside" partners to liase with other farmers and community-members, and to help with overall coordination of the team of partners.

3. Participatory Monitoring and Evaluation (PM&E)

During the development of the ICAP, partners are also encouraged to develop both formal and informal participatory monitoring and evaluation (PM&E) plans. A strong effort is made to insure that the monitoring and evaluation methods and criteria of all partners are included--and particularly those of farmers. It is generally feasible to either integrate or utilize independently the diverse criteria and methods of different partners, within one broad and flexible PM&E framework. While it is important to monitor and evaluate the progress of the technical or ***product*** aspects of the ICAP (i.e., aspects related to technology generation, testing, adoption and dissemination), this is often relatively straightforward. What often proves to be a greater challenge is to assess the progress of the ***process*** aspects of the sub-project (i.e., changes in degree of participation or types of participants, or changes in empowerment, enablement, problem-solving capacity, etc.)

4. Participatory Information and Technology Dissemination (PI&TD)

The fourth stage (PI&TD) is initiated when specific technologies or approaches/methods have been developed, tested, evaluated, and deemed suitable for wider distribution. The PI&TD stage usually begins in the third or fourth year of a sub-project, once ICAP activities have been implemented, tested and evaluated for two or more seasons by participating partners. However, the fourth stage may commence earlier in the sub-project if initial ICAP activities included the testing and evaluation of previously generated and tested technologies--for example, the testing and evaluation of officially "released" crop varieties that had been successfully distributed in similar environments elsewhere. While formal extension models and networks are utilized in the PI&TD stage (e.g., working with the MoA and extension agents), efforts are also made to facilitate more active farmer participation in extension efforts, to develop and/or support alternative channels of dissemination and to better understand informal diffusion networks. Examples of the "informal" approaches include "farmer-led" or "farmer-to-farmer" extension, cross-site or "farmer exchange" visits, and dissemination through informal rural networks (e.g., via local cultural events, social organizations, rural markets, etc.)

5. Participatory Analysis of Experience (PAE)

This stage is initiated in the fifth year or later of the sub-project, at the time when "outside" partners plan to significantly reduce their roles and responsibilities in sub-project activities, and ultimately hand-over overall management of the sub-project to the FRC. The aim of the PAE stage is to review activities implemented over the course of the sub-project and assess whether sub-project objectives were met, and to assess the overall successes and shortcomings of the sub-project. The PAE should also address both the ***product*** and the ***process*** aspects of the project. At the end of the PAE, the primary responsibility for the management and coordination of the sub-project is "handed-over" to the community, and the "outside" partners move to implement another sub-project in a new community. (It should be noted that the formal withdrawal of the "outsider" support does not thereby imply the end of the sub-project, and technical support to the sub-project continues to be provided by the "outside" partners where needed or requested.)

LESSONS LEARNED

Agroecosystem Approach

- Many partners don't have experience working in an integrated systems project--surprising given the long history of FSR/E in the region.
- Many partners tend to overlook or even ignore the socio-cultural and economic aspects of the agroecosystem, and their relevance to solving agronomic and related biophysical problems.
- Local social, cultural and historical conflicts can effect the diversity of farmer participation and even overall community commitment to a PR project. These types of conflicts can be "politically charged" and thus complicated and time-consuming to address, and ultimately difficult to resolve.
- Gender analysis and wealth ranking can be complicated exercises to undertake given cultural-based sensitivities in the community. The objectives of these exercises must be clearly communicated in advance, and the methods and results made transparent to all.
- Some problems can be addressed at the farm-level, but many problems need to be addressed at the community, watershed, district and greater-scale levels.

Multi-Partner and Multi-Disciplinary Teams

- Consistent and adequate institutional and logistical support (e.g., transportation) must be provided to facilitate the participation of team-partners.
- Multiple partners (stakeholders) can be difficult to organize into teams given their varying motivations for participating, institutional approaches to participatory research, modes of operation in the field, and financial support.
- Most partners have other responsibilities and commitments, and collaboration in a PR project is not necessarily the highest priority for many.
- Inconsistency of partner involvement can undermine the dynamics and function of the team, and affect the type of expertise and quality of service potentially available to the larger team and community.
- Many partners don't have experience working in multi-disciplinary or multi-partner teams, despite the long history of Farming Systems Research and Extension (FSR/E) programs in many parts of Eastern Africa.
- Team-building skills are also lacking among many partners, and the development of actual functioning "teams" that work as a unit in the field is difficult. While many partners can demonstrate an ability to work in a "team-mode" during workshops, many also revert to their "independent-mode" of operation immediately afterwards.

- Partners tend to have different levels of field research experience, and skills and capacities to conduct participatory research. Methods training and additional opportunities to gain in-depth field experience must be provided to partners.
- There persists a common belief among many biological scientists that the social science aspects of agricultural research, and even participatory research, can be readily addressed without the contribution of social scientists. Conversely, many biological scientists also assume that social scientists do not have the field experience or proper training to make contributions to the agronomic research aspects of participatory research.
- There is a shortage of social scientists in the formal research and development system in Eastern Africa, and there is a lack of even one social scientist on many PR teams.
- Farmers can be initially wary or apprehensive when it comes to participating in sub-projects. The suspicions are often a result of prior experiences with other research projects, but can also be affected by the interactions with partners in the early stages of the sub-project.
- Farmer Research Committees (FRCs) can effectively liase between farmers and "outside" partners, and also assist to manage the ICAP.
- The FRCs generally comprise six to ten members representing different gender, social and wealth groups, but their actual composition and formation should reflect local cultural and organizational norms and practices.
- The development of social relationships is important in any team or community-based project, but facilitation and related social skills are lacking among many partners.
- Participatory research requires a considerable investment of time, and real commitment on the part of all partners, particularly in early stages of a PR project.

Participatory Methods and Integrated Community Action Plans

- PR is not simply about generating new technologies and improving adoption--it's also about changing professional mentalities, and ways of working together. It is also important to address issues of empowerment and enablement.
- There is often initial resistance to the PR approach by many partners, as they don't fully understand how PR differs from FSR/E or the value of yet another research approach.
- There often exists a large "social" distance between farmers and outsider-partners that can be difficult to overcome, and many partners don't know how to address the issue.
- Farmers' expectations are often high, particularly concerning the possibility of free inputs and other resources or technologies. These expectations can hamper levels of participation and commitment on the part of farmers, and must be addressed directly at the commencement of the sub-project.
- Most partners expect a methodological blueprint and step by step guidelines detailing how to conduct PR. While many participatory methods are yet to be fully developed, refined or verified, few partners are interested or willing to undertake these tasks, and the demand for a PR "manual" is high.
- Few partners are willing to innovate, and develop new or modify existing research methods. This is partly due to a "conventional research culture" that seeks to standardize methods and means of analysis rather than innovate.
- The Participatory Characterization and Diagnostic stage (or Participatory Rural Appraisals--PRAs) is not undertaken simply to collect information, but also to identify technical *and* social entry points into communities. It is the starting point for developing social relationships.

- Experience with Participatory Rural Appraisals (PRA) is now common in many research and development organizations, but many partners need to learn to utilize PR methods not only in the diagnostic and characterization stage, but *throughout* the participatory research process.
- It is common for partners to over-commit to implementing multiple and complex activities in the ICAPs. It is important not to make promises (e.g., implementation of specific activities, provision of inputs) that can't be assured. (Think big, but start small.)
- Start projects with simple, clearly defined and short-term activities, e.g., adaptive crop variety trials.
- Provide farmers with multiple options (i.e., potential solutions) to address any given need or problem.
- After implementing adaptive crop variety trials and similar simple activities in the first and second years of a sub-project, many partners have difficulty to begin to address more complex and/or long-term problems (e.g., soil fertility management).
- Farmers often experiment, monitor and evaluate, and disseminate technologies in entirely different ways from researchers and other partners.
- Many partners want to train farmers within a "conventional framework" in how to implement participatory research activities.
- Indigenous technical knowledge (ITK) and farmer-research experience is increasingly recognized as being valuable, and is increasingly utilized in the ICAPs.
- Cross-visits and exchange visits are effective ways to cultivate new ideas and disseminate technologies among farmers.
- Farmers feel greater "ownership" of sub-project activities and results when they have fully participated in decision-making throughout the sub-projects development.
- Implementing sub-projects involve multiple constraints and addressing the diversity of needs and problems of a community involve multiple limitations, regardless of the degree of participation, planning and preparation.
- Be flexible and prepare to adapt to local, site-specific conditions and constraints.
- Participatory research requires a long-term commitment on the part of all partners.

Institutionalization of Participatory Research

- Not all institutions are at the same point in their institutional evolution, or equally receptive to participatory research projects, and thus different institutions require different "approaches" to facilitate the institutionalization of PR.
- Many partners are unwilling or hesitant to suggest or initiate changes in research approaches or methods to other partners for fear of the "political repercussions" and damaging their inter-institutional relationships, regardless of whether or not the "end-users" (farmers) benefit. Too often the "status quo" within the research and development community is maintained for the sake of preserving inter-institutional relationships and guarding fiefdoms, and for fear of disturbing the "old guard" of researchers and administrators.
- Projects are to often deemed successful for meeting reporting standards laid out by donors, rather than for any tangible results that might benefit end-users (farmers) and improve rural livelihoods in general. Different means of assessing projects' strengths and weaknesses need to be developed in collaboration with the "end-users"--farmers in particular, and community members or rural peoples in general.

CHALLENGES AHEAD

Further Refine, Develop and Utilize Agroecosytem Approaches, Participatory Methods and Integrated Community Action Plans

- Further refine and develop participatory research methods, particularly in the latter stages of the PRIAM framework.
- Encourage and support all partners to innovate and develop new, or refine existing, participatory research methods.
- Develop not only a "basket of options" for farmers to select from (i.e., multiple technical or management solutions for any given need or problem), but also a box of methodological tools and management skills for partners to utilize (e.g., a "methodological toolkit" that provides analytical tools, team building exercises, etc.)
- There remain sizeable gaps between the PR rhetoric that many partners and projects use, and reality of PR in the field. In other words, few projects move beyond the PRA or PAC&D stage in a collegial manner using participatory methods.
- Participatory research jargon is now common in many research and development proposals. There is a growing risk that PR becomes the new research orthodoxy, and many of the innovative and democratic principles upon which it is based are compromised or lost.
- Address the following questions:
  - Can partner-prioritized problems be addressed if farmers haven't prioritized them? If so--how?
  - How are farmers selected to participate in activities? By identifying expert farmers, special-interest groups, stratify according to wealth or gender, etc.?
  - Should farmers be provided with free inputs or technologies?
  - Can conventional on-farm trial methods be made more "participatory"? If so, how?
  - Can results generated in on-farm trials in a PR project be analyzed? If so, how and with what tools or techniques?
  - How can participation be measured? Or the variance in participation amongst different participants or groups?
  - How can changes in farmers' problem solving capacity, empowerment and enablement be monitored and evaluated?
  - How far "upstream" can farmers be efficiently and effectively involved in the research process? (Adaptive, Applied, Strategic or Basic research programs?)
  - How can effective "exit strategies" be developed?
  - How can PR projects be effectively and efficiently scaled up?
  - Can community-based projects ultimately become sustainable?
  - How can their progress be monitored and evaluated? According to what criteria?

Develop Effective Multi-Partner and Multi-Disciplinary Teams, and Institutionalize Participatory Research Approaches

- Invite new partners (i.e., "outside" experts) to address needs or problems beyond the ability or expertise of core team partners. For example, to address health, education, market or infrastructure problems normally considered outside of the mandate area of agricultural researchers.
- The majority of partners have multiple responsibilities and obligations, and participating in a PR project is not always the highest priority for many of them or their organizations. There is need to support and facilitate greater partner commitment to the PR projects.

- Competent partners who are innovative and interested in community-based field work or PR, often find their skills in high-demand, (i.e., "Competition for Competence".) The sustained participation of these partners must also be facilitated.
- The majority of partners, and particularly researchers, who are interested and/or involved in PR projects, are younger or "junior-level" staff. Many of the participating organizations also maintain traditional and hierarchical cultures where the expertise or viewpoints of junior-level staff are not solicited, or often ignored. Correspondingly, within many organizations these same staff are also often accorded the lowest priority when it comes to the allocation of resources (e.g., funds, materials, vehicles) and institutional support.
- Few researchers are rewarded for conducting participatory research activities. On the contrary, when they do undertake such activities they tend to be penalized for producing reports or results that are "unfamiliar" to most conventional research and development programs, i.e., results that are readily analyzeable with conventional statistical packages and suitable for publication in professional journals. The traditional reward system is set up to benefit those who produce conventional "scientific" results, regardless of their actual relevance to the presumed end-users (farmers). Alternative or expanded reward systems need to be developed that appropriately value participatory research projects, and alternative forums to report and publish participatory research experiences need to be formed.
- Provide, and fully support, facilitators to "backstop" PRIAM sub-projects and related participatory research projects. Such backstopping should provide technical and methodological support to the PR projects, provide a link between projects, and encourage partners to persevere in what are often non-supportive work environments, and thus help to validate or legitimize their efforts.
- Provide training and field experience in community-based, participatory research and agroecosystem approaches to senior researchers and administrators.
- Support development of national policies to formally integrate Participatory Research (PR) methods and approaches into NARIs and NARS. PR is generally conducted within projects within NARIs or NGOs, but has not yet been fully integrated or streamlined into the institutes or national systems.

CONCLUSION

The PRIAM Sub-Projects and the Partner Projects have made considerable progress in developing more "farmer-friendly", participatory research programs in the last two years. The many partners involved in these projects have worked hard and determinedly to modify, refine and expand their modes of interaction with farmers, and to build larger and more diverse methodological and technical tool boxes. The results have been impressive, and rewarding for partners, yet considerable work remains to further develop participatory methods, and to further institutionalize participatory research approaches so as to ensure that these efforts are sustained.

Community-based participatory research programs are neither easy nor quick to implement--but with time and perseverance, the rewards can be substantial and enduring. It is hoped that the experiences related in these proceedings provide readers not only with a few conceptual insights, though-provoking ideas, and useful methodological tools, but also the encouragement and motivation to undertake similarly involved and challenging endeavors to improve the rural livelihoods of farmers and fellow community members throughout Eastern Africa.

"Quisque suos patimur manes." (We make our destinies by our choice of gods.) Virgil

FUTURE NEEDS IN FARMER PARTICIPATORY RESEARCH

John Lynam[1]

The method and practice that underlies farmer participatory research has evolved significantly over the past fifteen years. Adoption and application of FPR techniques within agricultural research and extension systems now has a relatively broad base of experience throughout the tropics, much of being supported by donor funding. However, FPR with a few exceptions still operates very much at the fringes of national research and extension systems in developing countries, and many authors have remarked on the adoption of the participation vernacular without the incorporation of the substance. This paper will argue that this lack of more systematic institutionalization of FPR is due in part to a certain stasis over the past few years in the evolution of FPR methodology and, therefore, the need for a second generation of methods and practice to ensure efficient and more broadly based application. The paper will thus present a brief overview of current practice in FPR and then identify areas where further work is needed in order to move FPR into the mainstream of research and extension activities in tropical agriculture.

THE FPR AGENDA AND THE STATE OF CURRENT PRACTICE

The Agenda

Farmer participatory research has its origins in the farming systems research agenda of the 1970's and early 1980's, and developed in response to a recognized need for greater farmer involvement in on-farm, adaptive research. This introduced what Farrington (1998) terms functionality in the development of FPR practice, namely more efficient methods for the testing and adaptation of agricultural technologies, particularly allowing more scope for farmer choice and building on indigenous farmer capacity for experimentation. This evolution is apparent in part 3 of Farmer First (1989), probably the most influential of the first series of books systematizing FPR.

Between Farmer First (1989) and Beyond Farmer First (1994) other sources of innovation and thinking were incorporated into FPR. The most important element here was the post-modernist challenge to positivism within academia, building on the social theories of Foucault and Habermas. This agenda is well represented by part 1 of Beyond Farmer First and concentrates on different knowledge systems between farmers and researchers and the importance of power relationships in influencing—and biasing-- technological outcomes and the interaction between researchers and farmers. Many authors argued that methodological origins of FPR in farming systems research and what was termed the traditional transfer-of-technology model of agricultural R&D (Drinkwater, 1994) could not counter the inherent biases in knowledge systems and power relationships in currently structured agricultural research and extension systems. This led to what Farrington (1998) terms empowering types of FPR methods and objectives. These focus on better elucidation of farmer knowledge and analytical skills and development of community structures to interface with external change agencies. This agenda has been advanced especially by the NGO community.

The other principal factor driving the FPR agenda has been renewed emphasis on poverty alleviation by the international aid community. The focus of the 1980's and early 1990's on

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structural adjustment and policy reform, as well as an increased emphasis on environmental concerns, has in the latter part of the 1990's been replaced by a principal focus on poverty. The FPR methodology provides a very effective vehicle for both empowering low-income farmers and developing technologies appropriate to resource poor farmers, particularly in more marginal agricultural areas. This particular objective integrates both the empowering and functional types of FPR, but as well puts particular emphasis on appropriate targeting of FPR activities to marginal regions and resource poor farmers. However, national agricultural research and extension systems have a broader range of objectives than just poverty alleviation, and in practice while FPR methods attempt to ensure the participation of the poor, they do not necessarily do this to the exclusion of higher potential agricultural regions or farmers with a better resource base. While FPR within adaptive research units has been a principal vehicle for donors to achieve impact on rural poverty alleviation, in fact this objective must be integrated in research planning, resource allocation, and research organization decisions within national agricultural R&D institutions to be effective. This is in fact a larger agenda but has the potential of leading to future disillusion with FPR programs on the part of donors (Gubbles, 1994, provides a good case study of this problem).

The agenda driving the development of FPR methods and their application in technology development may be summarized as follows: (1) empowerment of rural communities, especially the poor, leading to more sustainable livelihoods, (2) development of more appropriate technologies in line with farmer priorities, (3) enhanced farmer experimentation and integration of indigenous technical knowledge in technology development, and (4) making agricultural R&D institutions more responsive to farmer demand, particularly from resource poor farmers. This is a broad agenda, and as was noted above, has evolved from a number of quite different intellectual influences. This, in turn, has led to some differentiation in methodology and practices, nicely categorized by Farrington into functional and empowerment types, and to pointed—verging on ideological-- debate on what forms the necessary corpus of FPR practice and objectives.

Current Practice

FPR methods and practice has evolved primarily within NGOs and international and national agricultural research systems. NGO practice is varied, extending from work focusing on broad-based community development to narrower foci just on agriculture, usually organic or sustainable agriculture. As Farrington (1998) notes the former involving empowerment approaches "is pursued by supporting the formation of groups capable of assessing their own needs and addressing them either directly or creating demands on government." But, "NGOs claimed strengths in empowerment may, in some circumstances, be more a reflection of the ability of middle-class agencies to protect the poor and give them space to innovate, than of any substantive changes in the latter's own levels of awareness or power in the society." Methods arising from this work include participatory rural appraisal methods for farmer needs assessment and group building techniques (Chambers, 1996).

NGOs work on actual technology development using FPR is much more limited. Few NGOs have a substantive research capacity and where it exists, it focuses on a few techniques, such as the Mucuna cover crop technology in Central America, composting and double digging in East Africa, agroforestry in many parts of Africa, or improved seed introduction. Needs assessment is usually very strong, but it is not matched by the ability to respond to those needs—often resulting in bias in the PRA toward those technologies in which the NGO has some expertise. Moreover, there is often little experimentation, rather relying on demonstration plots, farmer training, for example in composting, or provision of a range of genetic material, whether trees, crop varieties, or forages, which the farmer then utilizes as he or she sees fit. NGOs ability to develop more robust FPR practice around agricultural technologies has depended on linkage with more formal research systems, an often uneasy relationship, as NGOs do not want to be unnecessarily drawn into doing only research at the expense of more developmental activities (Farrington et al., 1993).

The adoption of FPR methods by agricultural research systems has been motivated by the desire to improve the efficiency of technology adaptation, adoption and diffusion, that is on the functional aspects of FPR methods and practice. Sutherland, et al, (1998) term this focus participatory technology development (PTD), as a subset of FPR practice. To date FPR is still very much experimental technique within national agricultural research systems and has found no clear role within agricultural extension systems. Within the IARC's, there has been significant work on methodology development and centers such as CIP and ICLARM have employed it more systematically in research programs (Fujisaka, 1994). However, with the move to more upstream research and project-based funding, most of the FPR work is done through collaborative work with NARS. FPR is primarily employed within a project mode, as opposed to being integrated into research practice within the institute, (see for example, Sutherland, et. al, 1998). A project mode usually puts location, content, and time constraints on the application of FPR techniques and in many ways is responsible for the current plateau in the development of FPR methods; in that, time constraints and lack of institutionalization move the work only to the point of identifying a few techniques in a limited number of sites. The second generation questions usually relate to how the work then moves to the next stage, which few projects based on FPR methods get to.

Functional FPR or PTD is primarily applied at the adaptive research stage in the technology development cycle. This work is usually done within a highly selected number of villages or benchmark sites, and a significant amount of institutional resources are focused on those sites. The methods thus tend to be based on activities organized at a village or community level, and can be divided into four basic steps, namely (1) Site characterization and farmer targeting, (2) Problem diagnosis and needs assessment, (3) Experimentation and technology adaptation, and (4) Technology assessment and evaluation. These largely form the corpus of current PTD methods and these will be briefly reviewed.

Characterization and targeting

There are a range of PRA techniques that have been developed which allow mutual learning by farmers and researchers in understanding diversity in production conditions within the village. Characterization methods, e.g. transects, agroecosystem analysis, and mapping, are most effectively employed when they are utilized for joint resource planning, e.g. watershed management, technology differentiation on the basis of, for example, soil type, location on the catena, or access to water, or understanding system interactions in the landscape, e.g. agroforestry. Employment of these characterization techniques are driven by purpose, usually determined by the sub-system being researched or the technology being tested.

Analyzing socio-economic profiles are useful in ensuring access to appropriate technology by different socio-economic strata in the village. The intent here is to ensure participation by poorer strata in the village economy. Wealth ranking (Grandin 1988) and focus group discussions to identify socio-economic categories, for example, with and without access to oxen or paddy land, are methods designed to understand this diversity. However, moving from such analysis to actual selection of farmers to participate in the technology development process is a more difficult exercise, balancing participation and local decision-making with the inherent biases due to power relationships in the community. In practice, technological options are often not sufficiently robust to allow such differentiation and the result is usually an understanding of the socio-economic factors that distinguish adopters from non-adoptors.

Problem diagnosis and needs assessment

This area forms the core of current FPR practice and relies on a range of PRA techniques that allow farmers and researchers to jointly diagnose problems, put problem prioritization in the hands of the farmers, and maximize the potential for farmer assessment and choice in the selection of interventions. Chambers (1994) and Cornwall, et al, (1994) provide a survey of such techniques and they will not be reviewed here. The methods are not robust and continue to be developed. Many quantitative methods utilized by scientists can be adapted for use in FPR sites--e.g. the adaptation of De Jager, et al (1998) nutrient flows and balances methods by Defoer (1998) in Mali to evaluate soil fertility management options within the overall agroecosystem. However, various factors in field practice usually constrain the full realization of the potential inherent in these methods.

Many PTD projects are technology driven, focussing on particular problems such as soil erosion, pest control, pesticide reduction or a particular technology. Such projects obviously reduce the scope of farmer priority setting and choice from his overall farming system to particular sub-systems. Many would see this approach as merely reinforcing traditional transfer of technology models. However, many research systems are structured along commodity lines and any adaptive research is done within commodity research teams with a narrow focus on that commodity. FPR methods can be as effective in such circumstances as when employed in more systems research or adaptive technology programs. Moreover, internalization of participation in institutions must start with researcher learning within all contexts requiring interaction with farmers. In practice appropriate site selection figures more critically in technology-led projects, so that there is a high probability that the problem or technology is high priority in villages where the project chooses to work. Even where broader choice is allowed, technology availability will inevitably constrain what problems are researched.

In field practice with PTD the largest hurdle is usually the transition from diagnosis to experimentation. The farmer is obviously interested in solutions to his problems and thus betters technology and practice than what he currently has access to. At this critical point in the PTD process, initiative and decision-making largely shifts to the researcher, and farmer choice will in fact be dependent on the creativity, knowledge and experience of the research team. This problem is solved if the project leads with technology—which probably characterizes most PTD programs and experience. If the research team is required to source techniques across a range of sub-systems, where the program focuses on the overall agroecosystem, the effective transition from diagnosis to experimentation significantly increases the technical capabilities required in the team or tests their ability to access such expertise at low transition costs from sources within the larger research institute.

The diagnosis and needs assessment leads inherently to the development of a relationship and commitment between the research team and the community—this is one of the driving elements of participation. Yet, there is a strong presumption in PTD either that techniques are available that can significantly improve the welfare of the community and/or the research institution is making a longer term commitment to do the research necessary to solve the major problems facing farmers, so called benchmark sites. Most FPR projects have not thought through the implications of this commitment. In the first instance, researchers will in almost all cases move forward to experimentation, assuming that techniques are available for priority problems in this particular site and that these welfare gains will justify the institutional resources expended in the site. The diagnosis rarely, if ever, leads to the conclusion that continuation to the experimentation stage will not be cost effective, and that there are constraints on what research can do with the techniques or knowledge currently available. In the second place, the alternative is that more strategic or applied research is required on the problem to develop technological solutions. However, in this case the institute must make some assessment on either how representative this site is of agricultural systems in the mandate area or how extensive the problem is. In either case, the research team should withdraw from the site, but this rarely happens. Neither exit strategies nor cost effectiveness are features of current FPR practice.

Experimentation and technology adaptation

Experimentation within FPR focuses on learning by the farmer rather than the scientist. This is probably the most radical shift from farming systems research to FPR. In general, the shift results in a loss of information on learning—or reduced efficiency in the process – for the scientist. The objective is to increase farmer understanding of the technology, allowing greater capacity for adaptation and innovation for his or her circumstances. As technologies have moved from inputs such as varieties or fertilizers, where the knowledge underlying enhanced productivity is embodied in the seed or nutrient formulation, to sources of productivity increases based on innovative management practices and more efficient resource utilization, the need for enhanced farmer knowledge and experimental capacity has increased in order to effectively deploy and diffuse the techniques. FPR offers a method to adapt such knowledge-intensive technologies as integrated pest management, integrated nutrient management, agroforestry, crop-livestock integration, and multiple cropping. At the same time, FPR attempts to build on indigenous technical knowledge and farmers inherent capacity for experimentation.

That is the ideal or promise; the practice has required a significant amount of simplification and can be categorized in three principal approaches. The least formal or structured approach essentially introduces a range of usually genetic options for the farmer to evaluate, experiment with, and adapt to particular conditions. This technique is especially useful where the plant component is deployed in different niches in the agroecosystem, and is particularly applicable for trees, forages, or low value crops.

The second approach enhances farmer knowledge and understanding of components of the farming system, so that he or she has a better basis for change in management of the sub-system. The most well known example of this approach is the farmer field schools for rice integrated pest management in Asia. The training focussed on farmer identification and understanding of biocontrol agents, the impact of pesticides, and pest monitoring and economic threshold spraying. However, extending this approach to conditions where pesticides are not used, where there are multiple pests, and where farmers must manage varietal resistance, biocontrol agents, and cultural practices will be the true test of how complex information can be transformed into improved farmer practice.

The third approach utilizes experimental trials to test hypotheses and as such is the dominant approach utilized in PTD. This approach borrows heavily from farming systems research being based on small plot, simple factorial trail designs. The innovation has come in allowing farmers more control over treatment selection and definition. This varies from researchers selecting some treatments and farmers some treatments to complete farmer control over trial design. In the latter, farmers often reject the necessity for a control and often bundle components so that it is not possible to separate the effect of individual factors—this can be important, as in Kenya if compost is removed from organic technology packages, double digging which is very labour intensive has no impact on yield in many soil types. Getting a firmer understanding of both farmer methods of experimentation and more formal experimental methods on farmer learning is a key priority in expanding the range of PTD experimental methods. For many PTD should give primary attention to farmer knowledge (see part one of Beyond Farmer First, 1993). However, as Farrangton notes, referencing Sumberg and Okali (1997), "recent research in Africa suggests that farmers' experimentation is not much different from types of adaptive research that the public sector does, and farmers need more new materials to experiment with, not more attention to their "socially constructed knowledge."

To improve farmer learning from experimental trials, there has been some move to integrate sub-system research, experimental design and training. This is most advanced in participatory breeding (Eyzaguirre, 1995), and has developed experimental methods, evaluation methods, and some farmer training around the specific area of varietal evaluation and selection. In integrated pest management, training and evaluation have been emphasized, with less work on experimental design, although once IPM moves away from a focus on pesticide reduction, this component will have to be addressed. Integrated nutrient management has not been as systematized and has started with experimental design, but needs work with evaluation and training. There has been some work on post-harvest systems and agroforestry, but nothing systematized. This is the right direction for development of participatory experimental methods but there has yet been little evaluation of how to maximize farmer learning in the interaction between new knowledge about the system, e.g., the relative roles and management of N, P, and K in plant nutrition, testing performance through appropriate experimental design, and evaluation of the results.

Technology assessment and evaluation

This area follows directly on and is integrated with experimentation and is a significant part of farmer learning from experimentation. PRA tools such as preference ranking and matrix scoring are used in this area, together with focus group discussions with scientists on how to interpret the results. Farmer criteria for evaluation are elucidated with the matrix scoring and these multiple criteria are in a sense weighted in the evaluation of technology options through the preference ranking. Evaluations by farmers almost always include criteria other than just yield and relative importance between criteria often differs by gender and sometimes by socioeconomic status. Allowing scope for elucidating such differences and then incorporating them into planning for the next season's set of trials requires significant attention to group dynamics. Developing more participatory methods for economic evaluation is an area of needed work. There is scope for improvement in evaluation methods focusing more on farmer learning rather than just technology screening, and advances here will be linked to the increased specificity in type of trial and information content in areas of varietal evaluation, IPM, INM, etc.

FUTURE NEEDS FOR PARTICIPATORY TECHNOLOGY DEVELOPMENT

Farmer participatory research and its narrower relative, participatory technology development, now have over a decade of practice and experience. Participation is now a standard term in development discourse and is being increasingly integrated into donor and foreign aid programming. FPR has found a natural home within the NGO community but still operates at the margins of agricultural research and extension systems. There is still a huge gulf between the vision of leading advocates of FPR and its application in the field through public sector agencies, and there is no clear roadmap on how to move current practice toward this ideal.

PTD to date rests on a limited number of disparate and widely spread sites and villages, where a limited number of technologies have been developed and adopted. Moreover, PTD is relatively resource intensive, requiring vehicles, research personnel and significant operational funds, more time in the field by researchers, and longer project periods in a site. To date it is probably fair to say that PTD has not been cost effective, but that the enhanced efficacy of PTD over traditional adaptive research or extension methods is relatively well established. The potential of PTD rests on taking it to scale, searching for cost efficiencies, and exploring institutional linkages to applied and strategic research, or as Farrington (1998) puts it, "a major unresolved issue is the need to complement depth of participation with breadth of coverage."

Scaling up of PTD can be done in two principal dimensions, namely as process or as technology. A process approach would focus on how to expand PTD to as many sites as possible. Such an approach would require internalization of PTD within the agricultural R&D system. There is a presumption in such an approach that agricultural technologies require significant adaptation or information to be adoptable by farmers. Farmer field schools are based on this premise, since the IPM techniques are knowledge intensive. Where farming systems are complex, where they depend on efficiencies in resource management as opposed to the use of inputs, where they are intensive in the use of land and labor, and where there is significant heterogeneity in agroclimatic conditions, a process based approach is probably called for. This would apply to such areas as the highlands of East Africa, the uplands of Java, or the Andean highlands. In such cases, productivity enhancement tends to focus on the whole agroecosystem rather than a single sub-system, techniques tend to be knowledge intensive, and technologies work within an interacting set of components, such as integrated nutrient management. This would apply particularly to the newer research area of natural resource management. Of course, the question still remains of how to make such process transfer as efficient as possible given the limited resources available to national agricultural research systems and the large areas and number of farmers that need to be covered.

Alternatively, scaling up can be done by modifying more traditional (TOT) methods of technology transfer. In this case technologies identified within PTD sites are transferred to farmers with similar farming systems and agroclimatic conditions, that is the recommendation domains of farming systems research. Transfer methods, however, will have to move away from those developed for product-based technologies. Farmer-to-farmer have been employed in some cases, but these can be resource intensive and require some understanding by staff of where such exchange would be productive. In other cases transfer might involve genetic material, community-based multiplication systems, and establishment procedures, as in the case of vetiver technology for erosion control. In all cases technology transfer is built around the PTD site, with some possible costs to farmers in those sites in assisting in such transfer activities.

In either case, scaling up will require a deeper integration of PTD into public sector agricultural research and extension systems. Some of this may be done by forging better links between research systems and NGOs. Although there are some successful examples of this (Farrington et al., 1993), the potential for widespread linkages and the development of a division of labor still remains questionable. Much of it, however, will be done by developing operational and organizational structures within agricultural research institutes. Associated with institutionalization will be another level of methodology development, which will build scaling-up strategies into the PTD process and will focus on less resource intensive approaches within PTD.

INSTITUTIONALIZATION

FPR has operated at the margins of formal agricultural research and extension systems, as FPR practice has evolved either in dedicated FPR projects or in NGOs. In that process there has been a tendency to lose sight of the original role and purpose of FPR, whether functional or empowerment types of FPR. That purpose was to increase the effectiveness and efficiency of public sector agricultural research and technology delivery systems, particularly ensuring access to that system by resource poor farmers. Agricultural technology and productivity enhancing methods were felt to have primacy over other development interventions. However, given a focus on the rural poor and marginal areas, together with the evolution of development thinking within the sustainable livelihood framework, agricultural production for this socio-economic stratum was often complemented by or superceded by other sources of income, especially wage labor and income transmittances, and health and education were often more important determinants of household welfare. This provided a strong rationale for the focus on empowerment types of FPR, where the objective was developing community structures to improve access to and demand for such social services. There are no obvious mechanisms for scaling up such FPR projects beyond village by village replication, that is where the target is only the poor—no public institution has this as an objective, except possibly in India--, and the objective is to access a broad range of services from a multiplicity of public institutions.

Moreover, investment of public funds in agricultural research and extension systems has as its objective the development and transfer of technologies and knowledge that will lead to sustained increases in agricultural productivity in the economy—that is, the basis for increased farmer income, increased food production, and lower consumer food prices. These are critical objectives, especially in Africa where per capita food production has actually been declining. FPR practice, where the purpose is to improve the effectiveness of national agricultural research systems and the domain of application is restricted to agricultural production—as opposed to the quite different objective of improvement in the welfare of the poor, although not neglecting the poor who depend on agricultural production--, has three principal objectives, (1) improve the efficacy of adaptive research and in turn the potential for technology adoption, (2) promote more demand-led, and therefore more efficient, research institutions, and (3) ensure that resource poor farmers participate in the process of technical change. There is significant potential for scaling up FPR through focus on improved agricultural productivity—that is in fact the focus of much of the existing practice in FPR—and going to scale relies on institutionalization of FPR within public sector agricultural research systems.

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SECTION V
ADDENDA

ADDENDUM I: WORKING GROUPS' RESULTS

A. ACHIEVEMENTS

PRIAM/Participatory Research: Where Are We Now?			
ACHIEVEMENTS			
Farmers more confident (e.g) independent experimentation	Site specific technologies developed	Thirteen pilot sub-projects implemented across eastern Africa	Identified specific target groups
Involvement of an increased diversity of farmers	Appropriateness of technology improved	Identification of local institutions	Researcher skill improved in FPR
FRGs and FRCs established	Increased level of adoption	More and useful feedback relayed (RF)	Farmers' experimentation on capacity improved
More demand from farmers for knowledge and technology	Crop/genetic diversity increased	Some researchers sensitized	Improved farmers' problem solving capacities
Facilitate intra community communication	ITK potential recognized	Sensitized senior managers in research and extension	Better use of PR tools
Indigenous/local social organizations identified	ITK better utilized	Attitude changes of farmers, researchers and extensionists/NGOs	Increased participation of women in PR process
Resource poor farmers benefited from FPR generated technology	Enhanced dissemination of technology from farmer-farmer	Training of other organizations on FPR methods	FPR approach accepted
Confidence of stakeholders as equal partners improved	Farmers provided earlier/more rapid access to information and technology	Research process to generate appropriate technology reduced in time	Increased appreciation and understanding of complex systems (socio-economical and biophysical) by stakeholders
Intensification of agriculture (inter-cropping) Conservation of soil (tie ridging) Better utilization of fertilizer	Problem areas that entail cooperation identified prioritized and investigated	Both research and extension made efficient and effective	Inter disciplinary team work to solve project site problems
Welfare of farmers improved Reduced cost of production (inputs) Reduced drudgery increased yield Reduced drugdgery Increased yield	Better collaboration b/n institutions (NGOs, EXT. IARCs, GOV) achieved (regionally and area specific and sites) Improved linkage and collaboration between farmers and researchers		

B. LIMITATIONS

PRIAM / Participatory Research: Where are we now?			
Limitations and "Under"-Achievements			
FRC dis not perform as expected	Problems in institutional linkage	Technology diffusion rate not quantified	Achievements not assessed and quantified
FPR limited by high expectations of farmers	Role of extension not clearly understood	Training of farmers on topics to be researched poor	Limited learning between PRIAM FPR sites
Holistic approach not effectively implemented	Unable to sensitize policy makers	Little emphasis on measuring / assessing farmer empowerment	Approaches for institutionalization not yet developed
In some instances, bottom–up approach not effectively implemented	Lack of competencies in the team	Impact indicators not identified	Slow scaling up process
Initial logistical support expensive	FPR not fully appreciated at the research center level	FPR approach not streamlined	Implementation tools not clearly defined
In consistent participation of actors	Logistics (poor institutional support)	Conflicts in experimentation strategies between conventional research and FPR	Some FPR methodologies not defined and evaluated
Limited number of researchers involved in the PR	Requires much time, patience, devotion and commitment	Farmers experimentation methods not adequately integrated in FPR	Complex issues not experimented
Difference between FPR and FSR / adaptive research not defined "misunderstandings"	Only one regional network involved in the FPR	Stratification of farmers not done	

C. POTENTIAL OPPORTUNITIES

PRIAM / Participatory Research: What might we achieve?		
Potential Opportunities		
FPR approaches evaluated in at least 10 new communities in every country region represented	FPR approach and research on station are "complimentary"	Researchers and extension workers equipped-trained in PRA tools effectively using them in PR
Refine FPR methodologies	A "community based" innovative process, supported with an institutionalized linkage to research organizations	Policy assisting in adoption of technologies
Farmers constituting an effective pressure group on research / development through strong	At least 60% of small holder farmers able to effectively solve their problems	Inclusion of FPR in all aspects of research and extension
Local social organization formalized and recognized	Methods for quantifying achievements/impact	FPR institutionalized in the research system
Roles of FRC clearly stated leading to increased farmer experimentation	Institutions involved in agricultural research and development sensitized on FPR approach	Over 60% of applied research will be client oriented
Effective dissemination of generated technologies beyond the project site boundaries to benefit as many farmers as possible	Principles and tools of FPR developed more	Steps and mechanisms of scaling up developed
More diversity of genetic materials to be developed by innovative farmers	Holistic approach more implemented	Farmer (community) property (technology) right developed
Increased interest of researchers to work with farmers	ITK of farmers recognized and formalized	Facilitate coordination and cooperation amongst stakeholders
Research becomes more cost and time effective	Motivation for community participation in place	
Success rate of research increased		
There will be wider use of research results		
Farmers (communities) fund research (cost sharing)		
Doubling farm productivity while maintaining farm diversity and complexity		

D. METHODOLOGICAL NEEDS

PRIAM / Participatory Research: Assessment of Methodological Needs					
Methodological Needs					
Need	**Outcome**	**Constraints**	**Strategy**	**Time**	**Resources**
Practical field training on problem diagnosis & character	Better understanding of problem identification	• Limited time for persons • Availability of farmers time • Short notice for farmers for workshop • Farmer awareness	• Resource person(s) allocates more time • Resource person trains other trainers (Totrole) • Consult farmers in planning • Put diagnosis work in phases • Farmer awareness meeting prior workshop	10 days for field exercise	• More resource persons (2) • Training materials • Logistics (transport)
Methods for exploitation with farmers	• Better understanding of trials by farmers • Formulation of farmer experimentation methods • Researchers understanding of farmer exploitation methods	• Risks in experimentation • Lack of facilitation skills for researchers to enable farmers participate in design & monitoring	• Start with small plots to big ones • Decision on plot sizes by farmers • Have a number of farmers doing same trial, each farmer = replication • Training researchers in facilitation skills	On-going (continuous)	Resource persons
Planning for implementation	• Better management of trials by farmers • Better quantification of participatory experiments(?)		• Farmers select trial participants • Periodic review (seasonal) of trials • Program – participants performance - scalings up- plan • Formation of research committees not at the start – wait for at least a season. • Periodic review of committee performance & membership • "Experiment minded"/innovative members join the committee	On-going (continuous)	Time – resource - farmers
Site Selection	Representative site	• Accessibility • Bio-physical differences and socio-economic • Lack of data	• Consulting farmers (ITK), local extentionists • 2^0 data (reports) in identification • use GIS for predicting constraints & options	Continuous	Time for field observation, data Review maps & skilled personnel (for GIS)
Research team development	• Holistic approach • Better solving farmers problems (biases avoided) • Integrated agricultural development	• lack of commitment • lack of multidisciplinary team & institutions (sometimes)	• multidisciplinary/multiinstitutional approach • create opportunities to share xperiences (recognition)		Trained & rewarded man power Institutions availability Funds

E. INSTITUTIONALIZATION OF PARTICIPATORY RESEARCH: REVIEW OF THE CURRENT STATUS AND NEEDS

PRIAM / Participatory Research: Facilitating Institutionalization of Participatory Research Programs					
Needs	**Product**	**Constraints**	**Strategy**	**Time**	**Resource Requirements**
Sustainability of local organizations	Material FRC in place	Lack of suitable collaborators e.g. NGO's extension etc	• Workshops for development insitutions on assisting /training FRC's on income generating activities	3 years	Funding
Organization /formation of FRC	Efficient FRC increased participation in FRC	Lack of information on indigenous social organizations	• Case studies of FRC experiences in other E. African countries • Development of program to strengthen FRC's	1 year	Intern of consultant
Umbrella organizations of FRC/ Social organizations at zonal levels. To represent farming community in negotiating with formal research sector & policy makers	Imported linkages with all stake holders more effective influence on research and policy	Harmonizing diverse agenda's/interests of stakeholders Logistics Lack of coordinating agency	• Identify coordinating agency • Planning workshops	2 years	Consultants Extension agents Specialized projects
Representative testing site	Representative testing sites established	Lack of skill in subzonation	• Training to upgrade skills • Effective zonation	1 year 1 year	Funding
Dissemination of technologies	Farmer rural information center established Schools as centers of dissemination Commercial ventures e.g. stockists, farm seed enterprises Farmer visits	Lack of extension materials Lack of trained teachers Lack of resources (training materials , training etc and organizational structures	• Develop project for training materials • Develop project for supporting commercial ventures	1 year 2-3 years	Funding Funding
Lack of exit strategy	Appropriate exit strategy	Lack of experience	• Workshops of stake holders on exit strategy • Gradual handover of responsibilities to extension agents + FRC • Assist FRC to look for funds for research activities • Regional research + developmental organization take over support of project • Ensure a motivated FRC in place	2 years	Workshop facilitator (s)

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ADDENDUM III: PARTICIPATORY RESEARCH RESOURCE LIST

ORGANIZATIONS

1. PELUM Association (Participatory Ecological Land Use Management)

P.O. Box MP 1059, Mt. Pleasant, Harare, Zimbabwe
Tel: 263-4-744470/744117,
Fax: 263-4-744470
Email: pelum@mail.pci.co.zw

This association provides an excellent opportunity to network with other individuals and organizations interested or involved in participatory research. They also sell difficult to obtain literature related to participatory research, and conduct a variety of multidisciplinary training courses. Associate membership is $50/year, while full membership is $100/year; one can join through the main office in Harare, or through the country desk offices:

PELUM Association, c/o SACDEP-Kenya
Box 1134, Thika, Kenya
Tel: (0151) 30541, Fax: 3005

PELUM Association, c/o INADES-Formation Tanzania
P.O. Box 203, Dodoma, Tanzania
Tel: (061) 354230, Fax: 354722, Email: INADES-FO@MAF.Org

PELUM Association, c/o Integrated Rural Development Initiatives (IRDI)
P.O. Box 10596, Kampala, Uganda
Tel: 256 (41) 266492, Fax: 256 (41) 533574

2. Resource Centre for Participatory Learning and Action

IIED, 3 Endsleigh Street, London WC1H ODD, U.K.
Tel: +44 (0) 171 3882117,Fax: +44 (0) 171 3882826
Email: resource.centre@iied.org

Provides information and resources concerning participatory approaches to development. Contact: Laura Greenwood, Information and Editorial Assistant.

3. Sustainable Agriculture and Rural Livelihoods Programme

IIED, 3 Endsleigh Street, London WC1H ODD, UK
Tel: +44 (0) 171 388 2117, Fax: +44 (0) 171 388 2826
Email: sustag@iied.org

For information about publications and PLA Notes subscriptions, contact: Hilary Pickford, Programme Administrator.

4. **Agricultural Research & Extension Network (AgREN)**

Overseas Development Institute (ODI)
Portland House, Stag Place, London, SW1E 5DP, UK
Tel: +44 (0) 171 393 1600, Fax: +44 (0) 171 393 1699
Email: agren@odi.org.uk

Provides information on ODI and AgREN publications, which include a variety of publications related to agricultural development and participatory research, and the AgREN Newsletter and Network Papers.

PUBLICATIONS

1. **LEISA (ILEIA Newsletter For Low External Input and Sustainable Agriculture)**

P.O. Box 64, 3830 AB Leusden,
The Netherlands
Tel: +31 (0) 33 494 30 86,
Fax: +31 (0) 33 495 17 79
Email: ilea@ilea.nl

Subscriptions:
Students, individuals and organizations in the Developing World: US $17 per year. Others: US $34 per year. Third World organizations may request the newsletter free of charge.

Emphasizes participatory research, low-input agriculture, grassroots & farmers' organizations. Good review of new literature and forthcoming conferences, etc.

2. **Indigenous Knowledge and Development Monitor**

CIRAN/Nuffic, P.O. Box 29777, 2502 LT The Hague, The Netherlands
Tel: +31-70-4260324,
Fax: +31-70-4260329/4260399
Email: ikdm@nuffics.nl
WWW: http://www.nuffics.nl/ciran/ikdm

Subscriptions: Free to everyone except for persons living in the USA, Canada, New Zealand, Australia, Japan & Europe. For residents of these countries: US $27/year.

Emphasizes ITK and related development issues. Excellent reviews of new research findings and literature, related networks and organizations, and forthcoming conferences and workshops.

3. **Participation Page (Newsletter)**

Institute of Development Studies
University of Sussex at Falmer
Brighton BN1 9RE, U.K.
Tel: 00-44-1273-606261
Fax: 00-44-1273-621202
Email: J.Vaghadia@ids.ac.uk

Free newsletter emphasizing rural development and participatory research.

4. Common Property Resources Digest

Quarterly IASCP publication. Contact the IASCP office at the addresses below for additional information or visit our Web site.

The International Association for the Study of Common Property
Indiana University, Workshop in Political Theory and Policy Analysis
513 North Park Avenue, Bloomington, IN 47408-3829
Phone: 812 855 8082
Fax: 812 855 3150
Email: iascp@indiana.edu
Web URL: http://www.indiana.edu/~iascp

5. PLA Notes (Participatory Learning and Action)

Tri-annual publication: They aim to supply copies free to as many people as possible in the South.

Subscriptions
PLA Notes
Sustainable Agriculture Programme
IIED, 3 Endsleigh Street
London WC1H ODD, U.K.
Fax: +44 171 388 2826
Email: sustag@iied.org

ADDENDUM IV: ACRONYMS

AETRI	-	Agricultural Engineering and Appropriate Technology Research Institute
AIRIC	-	Agricultural Implements Research and Improvement Center
CBO	-	community-based organization
CIAT	-	International Center for Tropical Agriculture
DRD	-	Department of Research and Development (Tanzania)
ECABREN	-	Eastern and Central Africa Bean Research Network
EARO	-	Ethiopian Agricultural Research Organization
FOFIFA	-	Centre National de la Recherche Appliqueé au Développement Rural
FPR	-	Farmer Participatory Research
FRC	-	Farmers' Research Committee
FYM	-	farmyard manure
GTZ	-	Deutsche Gesellschaft für Technische Zusammenarbeit
ICRAF	-	International Center for Research in Agroforestry
IPM	-	integrated pest management
KARI	-	Kenya Agricultural Research Institute
KARI	-	Kawanda Agricultural Research Institute (Uganda)
MoA	-	Ministry of Agriculture
MOALD	-	Ministry of Agriculture and Livestock Development
NAARI	-	Namulonge Annual Crops and Animal Production Research Institute
NARC	-	National Agricultural Research Center, Kitale, Kenya
NARO	-	National Agricultural Research Organization (Uganda)
NGO	-	non-governmental organization
PRA	-	Participatory Rural Appraisal
PRIAM	-	Participatory Research in Agroecosystem Management
PR	-	Participatory Research

ADDENDUM V:
PUBLICATIONS OF THE NETWORK ON BEAN RESEARCH IN AFRICA

Workshop Series

No. 1. Proceeding of the Bean Fly Workshop, Arusha, Tanzania, 16-20 November 1986.

No. 2. Proceeding of a Workshop on Bean Research in Eastern Africa, Mukono, Uganda, 22-25 June 1986.

No. 3. Proceeding of a Workshop on Soil Fertility Research for Bean Cropping Systems in Africa, Addis Ababa, Ethiopia, 5-9 September 1988.

No. 4. Proceeding of a Workshop on Bean Varietal Improvement in Africa, Maseru, Lesotho, 30 January-2 February 1989.

No. 5. Actes du Troisieme Seminaire Regional sur L'Amelioration du Haricot dans la Region des Grands Lacs, Kigali, Rwanda, 18-21 Novembre 1987.

No. 6. Proceedings of First SADCC Regional Bean Research Workshop, Mbabane, Swaziland, 4-7 October 1989.

No. 7. Proceedings of Second Workshop on Bean Research in Eastern Africa, Nairobi, 5-8 March 1990.

No. 8. Actes de l'Atelier sur la Fixation Biologique d'Azote du Haricot en Afrique, Rubona, Rwanda, 27-29 October 1988.

No. 9. Actes du Quatrieme Seminaire Regional sur L'Amelioration du Haricot dans la Region des Grands Lacs, Bukavu, Zaire, 21-25 Novembre 1988.

No. 10. Proceeding of a Workshop on National Research Planning for Bean Production in Uganda, Kampala, Uganda, 28 January-1 February 1991.

No. 11. Proceeding of the First Meeting of the Pan-African Working Group on Bean Entomology, Nairobi, Kenya, 6-9 August, 1989.

No. 12. Progress in Improvement of Common Bean in Eastern and Southern Africa. Proceedings of the Ninth SUA/CRSP and Second SADCC/CIAT Bean Research Workshop, Morogoro, Tanzania, 17-22 September, 1990.

No. 13. Proceeding of a Working Group Meeting on Virus Diseases of Beans and Cowpea in Africa, Kampala, Uganda, January 17-21, 1990.

No. 14. Proceeding of the First Meeting of the SADCC/CIAT Working Group on Drought in Beans, Harare, Zimbabwe, May 9-11, 1988.

No. 15. Proceeding of the First Pan-African Working Group Meeting on Anthracnose of Beans, Ambo, Ethiopia, February 17-23, 1991.

No. 16. Actes du Cinquieme Seminaire Regional sur l'Amelioration du Haricot dans la Region des Grands Lacs, Bujumbura, Burundi, 13-18 Novembre, 1989.

No. 17. Actes du Sixieme Seminaire Regional sur l'Amelioration du Haricot dans la Region des Grands lacs, 21-25 Janvier 1991.

No. 18. Actes de la Conference sur le Lancement des Varietes, la Production et la Distribution de Semaines de Haricot dans la Region des Grands Lacs, Goma, Zaire, 2-4 Novembre 1989.

No. 19. Recommendations of Working Groups on Cropping Systems and Soil Fertility Research for Bean Production Systems, Nairobi, Kenya, 12-14 February 1990.

No. 20. Proceeding of First African Bean Pathology Workshop, Kigali, Rwanda, 14-16 November, 1987.

No. 21. Soil Fertility Research for Maize and Bean Production Systems of the Eastern Africa Highlands: Proceedings of a Working Group Meeting, Thika, Kenya, 1-4 September 1992.

No. 22. Actes de l'Atelier sur les Strategies de Selection Varietale dans la Region des Grands Lacs, Kigali, Rwanda, 17-20 Janvier 1991.

No. 23. Proceeding of the Pan-African Pathology Working Group Meeting, Thika, Kenya, 26-30 May 1992.

No. 24. Proceeding of a Bean Research Planning in Tanzania: Uyole Research Centre, 18-24 May 1992.

No. 25. Second Meeting of the Pan-African Working Group on Bean Entomology, Harare, 19-22 September 1993.

No. 26. Bean Improvement for Low Fertility Soils in Africa: Proceedings of a Working Group Meeting, Kampala, Uganda, 23-26 May 1994.

No. 27. Third SADC/CIAT Bean Research Workshop, Mbabane, Swaziland, 5-7 October 1992.

No. 28. Proceedings of Third Multidisciplinary Workshop on Bean Research in Eastern Africa, Thika, Kenya, 19-22 April 1993.

No. 29. SADC Working Group Meeting of Bean Breeders, Lilongwe, Malawi, 26-29 September 1994.

No. 30. Regional Planning of the Bean Research Network in Southern Africa, Mangochi, Malawi, 6-8 March, 1991.

No. 31. Fourth SADC Regional Bean Research Workshop, Potchefstroom, South Africa, 2-4 October 1995.

No. 32. Alternative Approaches to Bean Seed Production and Distribution in Eastern and Southern Africa: Proceedings of a Working Group Meeting, Kampala, Uganda, 10–13 October 1994.

No. 33. Eastern Africa Working Group Meeting on Bean Breeding, Kampala, Uganda, 30 May 1994.

No. 34. Pan-Africa Working Group on Bacterial and Viral Diseases of Bean, Kampala, Uganda, 13-16 June 1994.

No. 35. Seminaire Regional Restreint du RESAPAC tenu a Bukavu du 25 au 27 Janvier 1995.

No. 36. VIII^{e} Seminaire Regional du RESAPAC tenu a Mukono, Uganda, du 5 au 8 Novembre 1995.

No. 37. Second Pan-Africa Working Group on Fungal Diseases of Bean, Kakamega, Kenya, 5-8 June 1995.

No. 38. Participatory Research for Improved Agroecosystem Management: Proceedings of a Synthesis Workshop, Nazreth, Ethiopia, 17-21 August 1998.

Occasional Publications Series

No. 1. Agromyzid Pests of Tropical Food Legumes: a Bibliography. N.S. Talekar. 1988.

No. 2. CIAT Training in Africa. R.A. Kirkby, J.B. Smithson, D.J. Allen and G.E. Habich. 1989.

No. 3A. First African Bean Yield and Adaptation Nursery (AFBYAN I): Part I. Performance in Individual Environments. J.B. Smithson. 1990.

No. 3B. First African Bean Yield and Adaptation Nursery (AFBYAN I): Part II. Performance across Environments. J.B. Smithson and W. Grisley. 1992.

No. 4. Assessment of Yield Loss caused by Biotic Stress on Beans in Africa. C.S. Wortmann. 1992.

No. 5. Interpretation of Foliar Nutrient Analysis in Bean - the Diagnosis and Recommendation Integrated System. C.S. Wortmann. 1993.

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