Paper for Theme 3: Enhancing integrated management of natural resources

How can smallholder farmer-market linkages increase adoption of improved technology options and natural resource management strategies?

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Abstract

The paradigm of involving farmers in research is based on strong evidence that enhancing farmers technical skills and research capabilities, and involving them as decision-makers in the technology development process results in innovations that are more responsive to their priorities, needs and constraints. Linking the technology development process to market opportunities has the potential to promote links between investment in natural resources, markets, and adoption of technologies. Market orientated agriculture for reducing poverty and environmental degradation needs to centre on three related paradigms; strengthening biological processes in agriculture (to optimise nutrient cycling, minimise external inputs and maximise the efficiency of their use); building farmer's capacities (to learn and innovate focused on improving livelihoods through market opportunity identification and the management of natural resources); and developing forward and backward linkages (between natural resources, production and markets). In a multi-stakeholder coalition, CIAT and its partners are working in Malawi, Mozambique, Tanzania and Uganda to explore and

understand how market orientation leads to improved NRM at the farm level. This paper uses case studies from Uganda to highlight and discuss examples where identifying potential markets for existing and new products has led to increased investment in NRM.

Key words participatory methods, FPR, enabling rural innovation, Africa, markets

Introduction

Much of sub-Sahara Africa faces the inter-related challenges of rural poverty and environmental degradation. The most vulnerable are the poor, especially women, as they depend on agriculture-related activities for their livelihoods. The increasing interest in market orientation and special programs to support this, e.g. African Growth and Opportunity Act (AGOA), New Partnership for Africa Development (NEPAD), offers new opportunities for smallholder farmers in developing countries to alleviate poverty by increasing their income opportunities. However, despite the growing enthusiasm about market orientation for increasing domestic food security and improving income, the transition towards producing for markets is not only complex but constrained by a range of bio-physical, economic and social factors at the household and community level (Kaaria and Ashby, 2001). Therefore, we propose that increased farmer-market linkages needs to be centred on three related paradigms that have emerged from several decades of development related experience and scientific analysis:

- **Strengthen biological processes** to optimise nutrient cycling, minimise external inputs and maximise their use efficiency. The greater effectiveness of this paradigm for Africa is clearly described by Sanchez (2001). Biological soil management and crop husbandry practices form an inherent component of organic agriculture.

- **Build farmer's capacities to learn** about biological and ecological complexity, using participatory approaches and involving farmers in experimentation and learning (for example, see Pretty and Hine, 2001). Agriculture demands a sustained, collective capacity of farmers for generating site-adapted natural resource management strategies and social innovations focusing on improving livelihoods.

- **Embed rural innovations in the resource-to-consumption system** and develop forward and backward linkages between natural resource management and agriculture production (Kaaria and Ashby, 2000). Technical innovation in organic agriculture must address both pre-harvest and post-harvest (including agro-processing activities) together, because poor people have to allocate scarce resources across this continuum. Opportunities and challenges of organic agriculture therefore need to be seen along the resource-to-consumption continuum.

Enabling Rural Innovation

Increasing household food production is often a necessary condition for improving food security, and usually a pre-condition to farmers' increasing their income generation, as farmers can sell their surplus production. Increased income can act, in turn, as an incentive for farmers to invest in their natural resource base. Sustainably improved rural livelihoods at the household level depend upon much more than improved access to technology and markets. Farmers' financial benefits from agriculture are often reduced by their limited opportunities and skills for adding value to their agricultural produce, and by low bargaining power with such rural service providers as market middlemen, agricultural extension agents and researchers.

The resource-to-consumption (R-to-C) concept

The R-to-C concept extends the commodity chain to include investment in natural resource management, and specifically links natural resource management (NRM) to market opportunities. This is a new approach, which focuses on increasing household food security and producing crops that have an identified market opportunity. This differs from the conventional approach of trying to find markets for excess production at harvest time when commodity prices are at their lowest. More specifically, it links farmer participatory research, market opportunity identification, and development of technologies for integrated soil and nutrient management, with a focus on women and the poor.

To address these issues CIAT and its partners are working in Malawi, Mozambique, Tanzania and Uganda to test the concept that market orientation leads to improved NRM at the farm level. This partnership aims to alleviate poverty in rural communities in pilot areas by taking a holistic approach with communities to their empowerment, development of rural agro-enterprises and management of natural resources, while systematically gaining detailed insights and lessons that should be useful to many similar actors elsewhere.

This approach has been implemented in all three countries for the last two years and a framework developed (Figure 1). This has necessitated training of partners to gain new skills, e.g. in identification of agro-enterprises, facilitation skills to work with communities and in gender awareness. The steps in the R-to-C framework are:

1. Participatory diagnosis with the community, with strong emphasis on gender and stakeholder analysis to identify differentiation of roles and perceptions
2. Formation of farmer research group and market research group, and building their capacity to participate actively in selecting, testing and evaluating marketing strategies and technology options
3. Participatory market analysis to identify market opportunities for competitive products that will increase farm income and employment
4. Prioritisation of options for addressing household food consumption and agroenterprise options through feasibility studies and cost benefit analysis

5. Planning and implementation of experimentation and marketing strategies with farmer research and market research groups
6. Development of community enterprise development and strengthening community agroenterprise development
7. Feedback of results to the community and R&D research, and identification of further research questions
8. Participatory, monitoring and evaluation, and learning to derive lessons and impacts, and scaling-up and out of participatory research results and of community enterprise development process

The following three case studies show that using the R-to-C concept as an entry point can lead to increased incomes and increased investment in NRM.

Case Study Results

<u>Kabale – Pyrethrum for income and asset management</u>

In south west Uganda the highly degraded hilltops have long been abandoned for crop production and now are used for grazing of livestock. During the prioritisation of agroenterprises the community visited the local town to see which crops and products there was a market for. The town has a pyrethrum extraction factory and the farmers became very interested in this as the crop would provide a monthly cash income. More importantly pyrethrum produces the best flowers at altitudes above 1800 m.a.s.l. just where the farmers had available and under-utilised land.

As pyrethrum was a new crop to the farmers they were interested to find out more about its production potential and possible problems, so exchange visits to farmer groups that were already growing the crop were arranged. This allowed a cost-benefit analysis to be conducted for the enterprise, following this the farmers agreed to select this for further investigation. The issue of crop production was the next area of consideration. How does the crop grow? how do we manage fertilisation? and pest control?

The local factory had extension staff, so there were involved to train the farmers in pyrethrum production but the issue of fertilisation remained. What is the best fertiliser approach for growing pyrethrum. Following farmer meetings, several different treatments were agreed on for experimentation and evaluation, these were, control, lime, farmyard manure (FYM), wood ash, compost and inorganic fertiliser. The soils were acidic (pH 4.8) and extractable P (5.8 mg kg^{-1}) was the most limiting nutrient.

A research committee of five farmers was selected by the community to monitor the experiments and conduct participatory evaluation to identify farmers' preferences for promising management options. Plants grown under compost and NPK treated soils had highest yields of 350 and 400 kg ha^{-1} though flower diameter was not significant with other treatments (Figure 2).

The community ranked soil amendment options in the order of NPK>compost>FYM>wood ash>lime. FYM and compost were not preferred in the community as it required intensive labour in preparation and ferrying them uphill.   Inorganic NPK was most preferred because it is accessible by most farmers and it was not bulky to carry to the tops of the hills. Also, because it was available and most members could afford the small amounts for their pyrethrum plots.

Although inorganic fertiliser had a high impact on pyrethrum yields it is not possible for all households to purchase it. Comparison of different options allowed for different wealth categories of farmers to see which soil fertility technology was most appropriate for them.

Tororo – Developing seed systems as an agroenterprise

In eastern Uganda the soils are some of the poorest in the country, they have a high sand content and low levels of organic matter and nutrients. Food insecurity is a feature of this area as yields are low and the seasons unpredictable. The R-to-C process identified beans and groundnuts as two potential crops that would address the joint concerns of food security and income generation. There was an active cross border trade in these crops and if the community was unable to sell the produce they could always eat it. Market studies and cost benefit analysis identified a further potential of selling these two crops as hybrid seed rather than as food to satisfy the demand for new varieties from many farmers.

As hybrid seed production requires skills new to the group, the NARO Bean Program from Namulonge were brought in to support them in aspects of production, postharvest sorting and grading of seeds. The research committee initiated farmer designed and managed, on-farm field trials comparing, different varieties of beans and groundnuts, pest control (with and without using Dimethoate for insect control) and different soil fertility options (TSP, compost, manure) in the long rains 2003.

Unfortunately a bad hail storm at flowering destroyed much of the bean and groundnut crop and low yields were achieved. The small bean harvest was kept for planting in the following season but eight bags of unshelled groundnuts were harvested. Some of this was kept for replanting, two bags was distributed to members of the community for planting and four bags were sold to other farmers. This sale of some of the groundnut seed proved a great successful for the group and they agreed to repeat the experimentation in 2004 to see how good their returns would be in a, hopefully, good season. From the UShs400,000 (USD200) this raised, half was used to rent land for the bean and groundnut seed enterprise (oxen ploughing, purchase of inputs, hiring labour for weeding) and half was used to open a group bank account. The group is now planting larger areas to the agroenterprise, investigating buying a spray pump and other implements to ensure more timely management operations.

Kabale – Forages for improved livestock feeding and soil and water conservation

South western Uganda is characterised by steep sided hills rising from around 1600 m.a.s.l. in the valley bottoms to over 2200m at the hilltops. Terracing has been historically the intervention used to control erosion but over the last few decades these have been poorly maintained and have started to collapse. The resulting increase soil erosion has led to severe production problems in many areas.

One of the communities had started working on soil erosion control through digging trenches across the hillsides where erosion was a problem. Ditches were seen as a less labour intensive method compared with terracing. Unfortunately the trenches filled up with eroded soil and were soon not able to prevent soil erosion, leading to a loss of interest in continuing this intervention. The participatory diagnosis conducted with the community had identified lack of livestock feed and lack of income generation as constraints to their ability to achieve food security and income generation. Further discussions with the group ranked as priorities for research, Sugarcane, C*alliandra, Setaria* and *Pannesitum* as options for stabilising the trenches and to prevent soil washing into the trenches (Table 1).

Using the R-to-C approach the community selected research committee are experimenting with these options to measure biomass production, palatability to livestock, ability to prevent soil erosion and potential for selling. Due to the longer-term nature of this work it is not possible to give results for differences between treatments for soil erosion control but farmer evaluations conducted over the last 12 months do show an increased investment in the labour of trench digging accompanied by stabilisation with one or more of these species.

Feedback to research from farmer experimentation

For future work the area of focus is how does the partnership continue to address the research needs of the communities, for example, in Kabale, the development of pyrethrum as an agro-enterprise raised many questions and this led to the identification of research questions that need to be addressed through strategic on-station research; adaptive research conducted by National partners and adaptive research conducted by farmers (Table 2).

Conclusions

The examples given in this paper are initial results from implementing the 'Enabling Rural Innovation' project in Africa and they show that farmers are developing new approaches to linking market orientation with investment in natural resource management, to ensure the sustainability of increasing production and of market orientation, to achieve food security and to avoid nutrient mining and increasing land degradation. Increased investment in NRM and purchase of external inputs is occurring as farmers and communities see the returns to their investment in agroenterprise development that addresses an identified market demand.

By focusing on the entire resource to consumption system, technical innovations to improve poor people's agricultural productivity can link the goals of improving small farm productivity and increasing income generation to the sustainable management of, and investment in, the natural resource base.

Further work is continuing on collect and synthesis information on the, competitiveness of these agroenterprises; whether this approach can increase assets; improve nutrition of households and very importantly, what is the equity in the distribution of the benefits from agroenterprise development using the R-to-C approach.

References

Pretty, J., and R. Hine. 2001. Reducing food poverty with sustainable agriculture: a summary of new evidence; final report from the SAFE-World Research Project. University of Essex, Colchester, UK

Kaaria, S.K. and J.A. Ashby. 2001. An approach to technological innovation that benefits rural women: the resource-to-consumption system. Working Document No. 13. PRGA Program. Cali, Colombia.

Sanchez, P. 2001. Tropical Soils, Climate and Agriculture: an Ecological Divide? Harvard Conference on Raising Agricultural Productivity in the Tropics: Biophysical Challenges for Technology and Policy. October 19, 2000.

Table 1: Farmer ranking of the different multi-purpose live barriers

Treatment	**Farmers perceptions about**	
	Advantages	**Disadvantages**
Calliandra	❖ Provision of firewood ❖ Provision of stakes for climbing beans ❖ Fodder for small ruminants ❖ Control of surface runoff ❖ Improves soil fertility ❖ Provides building material	❖ Seedlings not readily available ❖ High labour requirement ❖ Takes long to establish ❖ Highly affected by dry weather when young ❖ Not very effective in erosion control
Sugar cane	❖ Edible ❖ Readily available planting material ❖ Establishes so fast ❖ Stabilizes the soils ❖ High	❖ Harbours pests ❖ Leaves not good for fodder ❖ Attracts children in gardens in search for edible stems
Napier	❖ Provision of stakes for climbing beans ❖ Material for craft ❖ Provision of material building materials ❖ Stabilizes the soil ❖ Controls erosion ❖ Improves soil fertility ❖ Provision of firewood ❖ Provision of fodder ❖ Establishes so fast	❖ Planting material not readily available ❖ Evasive tendencies ❖ High competition with other crops ❖ Habitat for rodents and pests
Setaria	❖ Provision of fodder ❖ Thatching material ❖ Stabilizes the soil ❖ Rapid growth ❖ Improves soil fertility ❖ Easy to establish and maintain	❖ Attract livestock in the gardens ❖ Planting material not readily available

Table 2: Examples of Research Questions identified and type of experimentation required

Research Questions identified through interactions with the community:	**Type of experimentation required**
Production aspects • Which hybrids are appropriate for the region (testing germplasm from Kenya and Tanzania) • Does existing germplasm meet farmers current and projected needs? Are new varieties or crops needed? • Where on the slope to grow the crop • Propagation of pyrethrum	On-station variety testing and farmer experimentation On-farm trials NAREs and farmer experimentation
Management options • Management options better suited to local conditions • Appropriate niches for legumes cover crops for soil fertility improvement • The potential for legume crops and trees (cover crops; improved fallows) in improving soil in pyrethrum production systems • Guidelines for appropriate use of organic/inorganic materials for soil fertility improvement	Experimentation at different levels: • Farmer experimentation • On-station experiments by NAREs and CIAT scientists
Nutrient cycling and nutrient flow balances • Management options aiming at optimal use of the legume-N in combination with strategic applications of mineral fertilisers to maximise nutrient cycling and soil organic matter replenishment • Analysis of different organic/inorganic nutrient interactions in pyrethrum farming systems	On-station experiments by NAREs and CIAT scientists

Figure 1. Key steps in Farmer Participatory Research and links to Community Enterprise Development

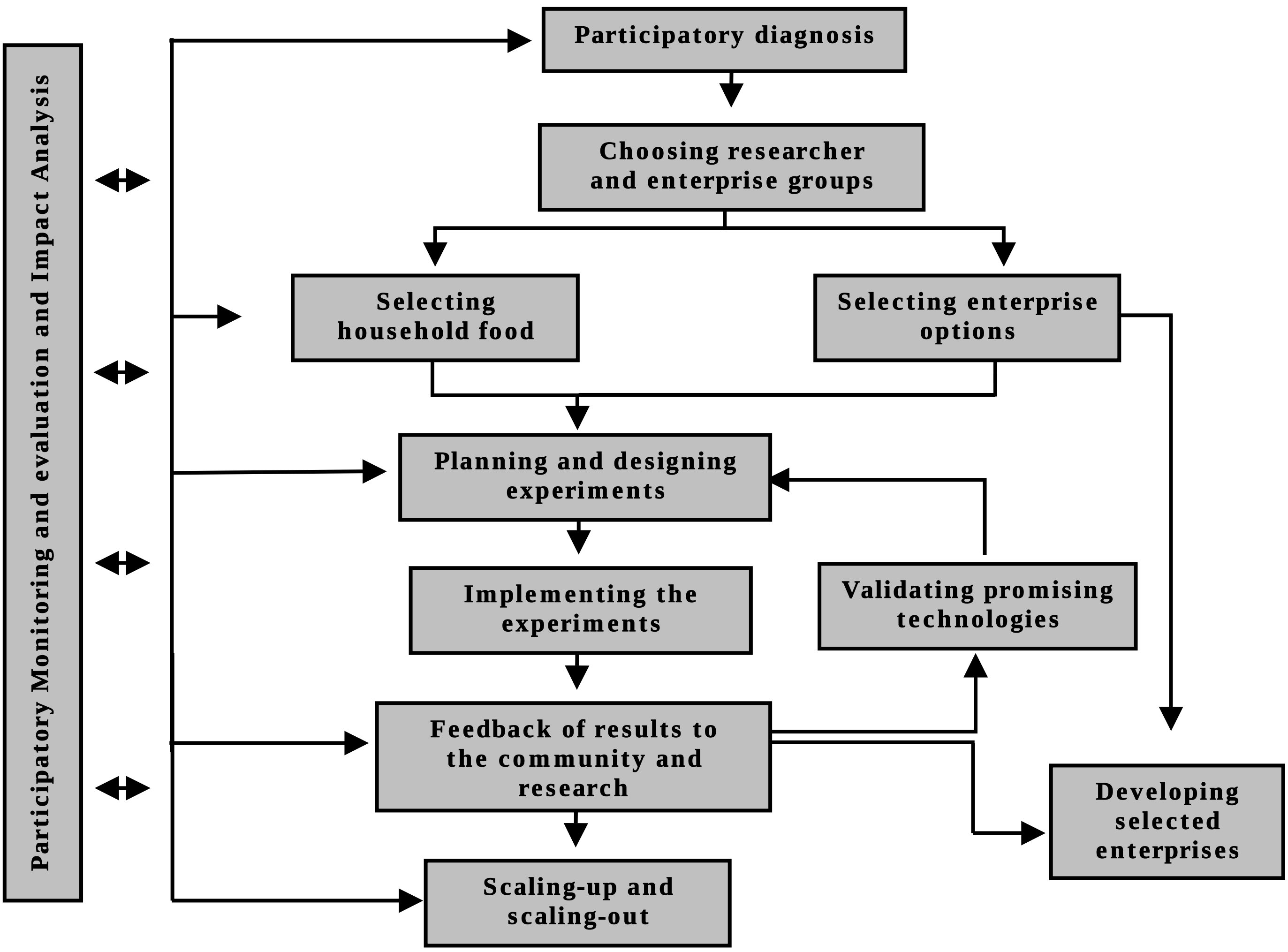

Figure 2. Pyrethrum flower yields for different soil fertility treatments in South Western Uganda