Farmer Participatory Experimentation as a Strategy F Technology Transfer on Sweet Potato, Banana, Tomato and Cabbage in N. Highlands of Tanzania

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Abstract

This paper presents the results of farmer participatory experimentation (FPE) that was undertaken with farmers in Kwalei Catchments Area - a benchmark site of the African Highlands Initiative, in Lushoto district, Tanzania from 2000 to 2002. Farmer Participatory Experimentation in this context is defined as a process of bringing together the knowledge and research capacities of the local farming community with that of the scientific institutions in an interactive way. Crops subjected to on farm investigations were sweet potato, banana, cabbage and tomatoes. Farmer participatory experimentation was observed as an important strategy for technology transfer that can help improve the effectiveness of technology development, raise adoption rate and add value to the agricultural research output. Likewise, it creates democratic partnerships between farmers, researchers and extension agents and other stakeholders in the natural resources management. However, the challenges of farmer participatory experimentation found were the prejudice of basic research, incorporation of the farmers' criteria/indicators in the selection of the best varieties, design research/experiment rather than "demonstrations" that will be suitable not only to progressive farmers, incorporation of "control treatment" in the trial layout and to strengthen their ability to monitor and adopt experimental procedures, over dependency on inputs supply from researchers. The discussions have theoretical and practical implications for farmer participatory experimentation, which can be used to identify recommendation domains based on the farming system.

Introduction

Agricultural and the management of natural resources are central to the economies of the smallholder farmers in the northern highlands of Tanzania. However, yields obtained by smallholder farmers are relatively low, and the opportunities for increased agricultural productivity and economic growth are severely constrained by lack of appropriate technologies like improved varieties, management techniques and quality seeds.

The last twenty years have witnessed great investments in agricultural research and development of new technologies in Tanzania. However, there is a general feeling amongst the stakeholders in the agricultural sub-sector of the national economy that adoption rates of technologies developed at the research canters in the context of "top – down" approach are generally low, because in most cases goals were partially met (Lyimo, 2004; Personal communication). This has lead to question the validity of methodologies and approaches used in the transfer of technologies to end-users. As in the case with agriculture in general, Tanzania agricultural research has suffered a significant set back in the area of transferring research results to farmers and other end users due to "top-down" approach. Sandra et al. (1989) noted that the goal of agricultural research is the development of technologies that farmers will use to improve their welfare and that of their countries. Furthermore, this is generally because no matter how well new technologies on research stations is, or the science might be or how persistent the extension efforts, it has been found repeatedly that technological advances will not be adopted unless farmers accept and use them (Sandra et al. 1989). At this juncture, therefore, agricultural research system had to conceptualize an effective mechanism and capacity to implement the transfer of appropriate technologies and results to farmers. In this case, there a need to develop a new way of making these technologies acceptable to farmers so as to increase farmers' perceptions and invariably their adoption levels. In order to contain this problem, participatory approaches (PA) in agricultural research were introduced in Tanzania during the 1990's. They aimed at bringing an analytical approach and efficiency in the

transfer of technology. Likewise, to make sure that research takes the needs of technology users, natural resources management, local resource constraints and risks into account. This was after it was recognized that development and transfer of technologies to end-users for their subsequent adoption is the prime goal of any research activity. Yet farmers especially smallholder ones in the northern highlands of Tanzania, have remained unaware and skeptical to taking full advantage of these technologies. Farmer participatory experimentation as a technology transfer approach was carried out in Kwalei catchments area - a benchmark site of the African Highland Initiative (AHI), in Lushoto district, Tanzania from 2000 to 2002. The objectives were to contribute towards increased crop productivity, enable farmers to understand better and carryout their responsibilities as investigators and innovators, and introduce on farm evaluation of technologies. There were three categories of technology evaluation schemes, which included improved crop varieties of sweet potato, banana, tomato and cabbage, crop husbandry practices and seed production schemes. The outcome of transferring technologies by Farmer Participatory Experimentation (FPE) has revealed that FPE can effectively fill the "missing linkage" between research and extension and make the programs of both research and extension institutions more efficient.

Background

This paper builds on the theoretical constructs of farmer participatory experimentation as a social learning process in the transfer of technology and natural resources management. It is well known that to improve agricultural productivity some form of appropriate technology is necessary as mentioned earlier. Central in the focus is the building of joint capacity among the various actors in technology generation and adoption, which is characterized by “face to face” interchanges of ideas between a researcher and a farmer (Bawden and Packham, 1992). In agriculture and natural resources management, transfer of technology process depends on the social and cultural context of people and their community. Therefore the design and adoption of agricultural technologies must be reflective to the local social, economic and agro ecological circumstances of farmers in order to make them adopt new technologies (Pretty and Uphoff, 2002). The value of participatory approach is that researchers and extension agents are enabled to learn on how to work with farmers in a participative rather than a “top-down” way and at the same time create the social network for facilitating exchange of knowledge between researchers and farmers (Pretty, 1995). In this regard, farmer involvement in the development of technologies, transfer, and decision-making process has generated a lot of models through several studies (Chambers & Jiggings, 1987), like the participatory approaches. Creating knowledge in this way is an integral part of sustaining agricultural production and increased output. Rather than exclusively focusing on convincing farmers to adopt introduced technologies generated outside their environment, a participatory approach provides an opportunity for farmers to tap their capacity to research and innovate according to the specific challenge of their farming system. The participatory approach provides a relevant conceptual context for exploring how farmers through farmer research groups (FRG's) in the Benchmark Site of AHI, is partnering with researchers and extension in learning together on how to disseminate new knowledge for technology introduced in natural resources management scenario.

Methodology

This study was carried out in the northern highlands of Tanzania in Lushoto District, Kwalei Village a benchmark site of AHI. It was chosen as the study area most importantly because its one of the district with higher population concentrations and extensive natural resource management problems. During the execution of the study, the farmer participatory experimentation followed a sequence of steps, including:

IDENTIFICATION OF FARMERS AND FORMATION OF FARMER RESEARCH GROUPS – FRG

Farmer research groups were formed on the basis of the crop. In this case each crop researched i.e. sweet potato, banana, cabbage and tomato had its own FRG, with a Chairperson and a Secretary. Each crop formed one group comprised of both men and women who were encouraged to participate, with special emphasis on

up coming young generation. Participation was on voluntary basis based on the interests towards a particular crop and farmers were allowed to belong to various FRG's. Kwalei village farmers are not homogeneous as they differ in social status, wealth, access to and control over resources, and proclivity to conduct research. Research activities therefore focused mainly on the needs of low-resource farmers, particularly women and youth. Informally farmers were asked to mention their source of knowledge for each crop (Table 2).

Participatory problem analysis and site selection

The aim was to rapidly identify factors limiting production, and test potential solutions for their economic and social acceptability by way of on-farm experiments. Participatory problem analysis was conducted at the case study sites to help identify major constraints and their causes and effects, before trials were implemented. However, researchers had access to an earlier baseline diagnostic survey, which provided information on local socio-economic conditions. The job of the researcher at this point was to provide farmers with as broad a range as possible of technical solutions and technologies that may help solve the farmers' problems. The farmers identified problems that were of most concern to them for each crop by a pair wise ranking. Researcher moderated the exercise to make sure that farmers' feeling to this problem is important enough to want to work and solve it. They described what actions they have been taking in the past to minimize each problem, and decide which of the problems have the highest priority. They then discussed what action they would like to take to solve these problems in future. Site selection for the on farm experimentation was based on secondary information, history of the plot, ability and farmer enthusiasm.

Participatory research design

Farmers and researchers jointly designed the experiments. The aim was to strengthen the existing experimental capacity of farmers and to sustain the local management in the process of innovation. Research and extension staff organized village meetings through FRG's to consult with farmers. At these meetings researchers discussed trial plans and their implementation with farmers. Farmers themselves selected amongst themselves to provide plots for the trials.

On-farm trials / farmer experimentation

Categories of farmers who participated in experiments and technologies introduced are shown in Table 1. The approach followed in our projects was to allow farmers to test technology on their own farms under close supervision of the Village Extension Officer and Farmer Research Group's chairperson. The researcher was responsible for experimental layout, in order to generate statistical materials. Meanwhile participating farmers were responsible for the crop husbandry. Likewise farmers were required to provide the field history i.e. concerning the previous crop/s that occupied the land and whether the plot was fertilized or not. Planting density was 30cm between plants and 90cm between rows for sweet potato, cabbage and tomatoes. For sweet potato farmers were encouraged to plant on ridges. Each farmer was treated as a replicate. Although experiments were done in the fields of individual farmers, all decisions regarding what to try out, the evaluation of the technologies, were taken by a group. The trials were formal experiments designed and implemented by researchers on farmers' fields, using a traditional experimental design with randomized experiments and replicates. Farmers provided the land and, labor for plowing and weeding as laid out in the trial plan. Researchers provided some inputs mainly planting materials.

Table 1. Category, type of technology introduced and the number of farmers participated in experiment

Category	Type of technology	No. of farmer 1999	No. of farmers 2000
Sweet potato	Varieties CIP 440024, CIP 4400131 Tengeru Red, CIP 4400117 and CIP 440105, local var. "Katagi"	10	18
Banana	Varieties: Paz fupi, Pazi ndefu, Mbwailuma, Suu, desuckering, manuring, detrashing, spacing, standard tool keeping	10	14
Cabbage	Varieties: Amigo, Gloria F1, Field Force F1	12	18
Tomatoes	Varieties: Tengeru 97, Tanya	10	13

Participatory monitoring and eevaluation and sharing of results

The aim was to give farmers opportunity to participate in an active, rather than a passive way in a process in which their own powers of observation and analysis are clearly valued. At this stage, the goal is not only to determine acceptability but also to understand how farmers continue to adapt and modify the technology based on the experimental procedures. Researchers led discussions and answered farmers' questions. Field days that were organized by research and extension staff were meant to demonstrate the potential of the technology options to farmers in the area. During this stage, farmers described which of the technologies they like and why. They also explained which technologies they do not like, and why, and what characteristics of the preferred technologies could be improved. Farmers then assessed all varieties for field performance; yield ability, quality and biomass production. Farmers were allowed to choose their own indicators for each attribute. In order to determine indicators, pair wise ranking was conducted for each category.

Results

SOURCE OF KNOWLEDGE

Six learning processes were observed in the analysis as critical as to how farmers gained increased knowledge, understanding and skills in adoption of technologies introduced in the village. Table 2 shows the different learning processes through which farmers acquired knowledge. Through focus group discussions in the FRGs, participatory monitoring and evaluation, farmers described how their knowledge, skills and management techniques for producing crop were evolved. Overall it emerged that individual experimentation, visits by researchers/extension and community meetings were the most important learning processes. Meanwhile informal group forum was found to be the least method of acquiring technology.

Table 2. Farmers' source of knowledge learning processes before the on set of the project

	Sweet potato	Banana	Cabbage	Tomatoes
	N=28	N=24	N=30	N=23
Individual Experimentation	√	√	√	√
Visit to projects		√		√
Informal group forum				√
Visit by researcher Extension	√	√	√	√
Community meetings	√	√	√	√
Private sector			√	√

Farmer perception and awareness

Table 3 shows that farmers were less aware on sweet potato and banana technologies, but they were knowledgeable on cabbage and tomatoes in terms of varieties, production techniques, diseases especially tomato late blight and marketing. This is because tomatoes and cabbages are important cash crops to all people in Kwalei village. While farmers acknowledged their familiarity with some of the technologies, like improved tomatoes and cabbage varieties, however, they themselves acknowledged that they have limitations in certain domains of knowledge that are critical to good management like – disease identification, irrigation and water management, seed production techniques, cultivars and fertilizer in sweet potato.

Table 3: Farmers' awareness of the technologies

	Sweet potato	Banana	Cabbage	Tomato
	N=28	N=24	N=30	N=23
Varieties	√	√	√	√
Improved management				√
Production techniques			√	√
Diseases			√	√
Pests	√	√	√	
Seed production				
Post harvest				
Marketing			√	√

PROBLEM ANALYSIS

Table 4 shows the outcome of the problem analysis. The principal contributing factors that need be taken into account in the participatory experimentation are listed. Problems confronted by Kwalei's sweet potato, banana, cabbage and tomatoes farmers are many and differ in intensity from one farmer to another. The participatory problem analysis conducted revealed that they cover the spectrum of production to marketing continuum, which is an important part of the research for development. Individual farmers themselves raised all these problems. In short it was not possible to portray all problems facing peasant farmers. For our purpose here, an attempt was made to examine some selected problems inherent to the crops. They range from lack of improved varieties to inadequate extension services. The farmers decided to tackle their first most important problem as lack of improved varieties and lack of knowledge on pests/diseases/management that became the focus of the project.

Table 4: Participatory Problem analysis

Type of problem	Sweet potato	Banana	Cabbage	Tomato
	N=28	N=24	N=30	N=23
Lack of improved varieties	2	2	2	2
Lack of planting material	1	3	4	6
Lack of knowledge on pest/diseases/management	4	1	1	1
Drought	5	5	5	4
Fertility soil/fertilizer	3	4	6	5
Marketing	6	6	3	3
Extension services	7	7	7	7

Farmer assessments criteria – crop performance

The major crop performance criteria were – average yield, agronomic performance, origin and disease/pest reaction as shown in Table 5. However, some farmers who hosted trials expressed a desire to try out, on their own, some of the treatments that looked promising. Farmer assessment of the technologies was limited to participatory monitoring and evaluation visits and FRG meetings with researchers and extension. The criteria used by farmers to evaluate their own experiments differ from farmer to farmer and also for the same farmer, from crop to crop. The physical stand of the crop e.g. in sweet potato, and the way a crop bears say bunches in banana, head in cabbage and fruits size/number in tomatoes are some of the major criteria observed in Kwalei village. Ideally, farmers attending the assessments, provide ideas for experimentation based on their own criteria.

Table 5. Farmer's crop performance criteria

Criterion	Sweet potato	Banana	Cabbage	Tomato
Agronomic performance	**3*****	**2****	5	5
Average yield	1*	1*	4	**3*****
Early maturity	**2****	**3*****	**2****	4
Disease/pests	5	7	1*	**2****
Origin	4	4	6	6
Drought tolerance	6	5	7	7
Market	7	6	**3*****	1*
Good taste	8	8	8	8

Table 6. Farmer's perceptions and opinions about the varieties and technology

Technology	Perceptions	Challenges
Cabbage	Amigo F1 and Field force F1 were observed to have high tolerance to black rot disease. Gloria F1 displayed medium resistant to black rot disease. Farmers preferred Gloria F1 because of its ability to mature earlier than the other two varieties.	Availability of seeds. Study on the time of planting and spacing
Tomatoes	When questioned farmers said no other tomato variety could compete with var. Tanya and Tengeru 97 in yield and shelf life.	Train farmers on seed production techniques, Train farmers on pests/diseases identification
Banana	Banana planted with well-preserved manure established fast and are growing very, over the local variety "Ussu". Three successive plants per stools' format, had bigger girth, produced bigger bunches but also a bunch per stool annually.	Availability of quality planting materials Training on pests' diseases. Intercropping studies
Sweet potato	Farmers preferred varieties CIP 440024, Tengeru Red, CIP 4400117 and CIP 440105 over he local variety "Katagi"	Management of sweet potato weevils Availability of quality planting material

Table 7. Farmer perception and comments on experimentation

Procedure	Recommendation
Experimental layout	Include few treatments
	Omit control treatments
	Farmer management to be the control
Site selection	Early planting
Data collection	Practical ones like yield, crop stand number of fruits/roots
	Training on data collection
	Data collection should be limited to the needs of the project
Data analysis/reporting	1. Summations and average yield/number of roots/fruits

Yield data-Average economic yield (Tones/ha)

Table 8: Average economic crop yield. (in bracket is farmer actual yield)

Crop	Season 1999	Season 2000
Sweet potato	17 (6)	12
Banana	22 (7)	27
Cabbage	19 (9)	25
Tomatoes	15 (10)	18

Merits of the farmer participatory experimentation at Kwalei

- Farmer Participatory Experimentation (FPE) is an important strategy in the technology transfer that can help improve the effectiveness of technology development in the research for development continuum scenario.
- Raises adoption rate and adds value to the agricultural research output
- Creates democratic and equitable partnerships between farmers, researchers and extension agents and other stakeholders, like religious organizations in the natural resources management. The project collaborated with the church in seed schemes
- Creates equitable partnership between research and farmers in technology transfer and agricultural innovation
- Farmers were equal partners in the projects as they are involved directly in the planning, implementation and evaluation of research activities in a collaborative manner
- Focus group sessions within the FRG's facilitated in-depth analyses and understanding of farmer perceptions of their partnerships with research and extension institutions, as well as motivations underlying their participation

The study also illuminates the potential inherent in a broader role of research extension linkage, by highlighting on how institutional innovations in research and extension can transform farmer learning and strengthen their capacities where traditional constructs of technology generation and adoption has failed.
It also contributes to increasing the knowledge base of agricultural professionals on emerging concepts and approaches for working with small farmers in research and extension
Farmers discovered the potential of optimizing land use by introducing and adopting improved varieties and good management practices and were inspired to solve problems by themselves

Demerits of farmer participatory experimentation

- An important problem for on-farm research is that the client is - in most cases - not (directly) paying for the services
- Agricultural research was considered as a public good and farmers were not ready to contribute financially even in input purchase
- Over dependency of inputs from donors that heavily influences the research agenda
- Expensive in terms of travel to over 500 km from SARI and HORTI
- Difficultly in generation of statistical data
- Design of experiment as "demonstration" impeded statistical analysis
- Over emphasis of "applied research" to solve practical problem
- Prejudice of "basic research" which is very important in increasing researcher knowledge

Discussion

It is well known that people's livelihood security can be improved by enhancing sustainable natural resources management. However, this depends on the type of approaches that encourage personal and social learning as it was observed in the benchmark site. Through observations, it was found that Kwalei farmers have knowledge, social capital, and entrepreneurial skills to invest in such an approach of participatory experimentation. Thus while farmers acknowledged their familiarity with some aspects of experimentation like spacing, linear planting, there were clear appreciation of the opportunity to validate their local knowledge through sustained observation and experimentation, complemented by learning through interaction with researchers. As reflected in the quote from one farmer, Mr. Hozza, that *"we farmers value interactions with researchers from SARI and HORTI who have been frequently visiting us, as we never expected to be interacting with scientists in collaborative and participative manner in terms of ideas, both formal and informal way"*.

It was observed that awareness depended mostly on the level of education and the importance of the crop to the particular farmer; whether a particular crop is grown for cash generation or for food or both. It was very difficult to work with the illiterate ones in the experiments despite their enthusiasm. It is also observed that, the more education one has, the better his/her perception of the relevance of the experimental procedures and technologies. On the other hand, wealth profiles, gender, age, and marital status were not important determinants of farmers' perception on experimentation and technologies introduced in the village. This means that these characteristics did not influence the perception of the farmers to the relevance of the experimental procedures and the particular technology.

While farmers acknowledged their familiarity with some of the technologies, like improved tomatoes and cabbage varieties, they acknowledged that they have limitations in certain domains of knowledge that are critical to good management such as: on farm pest/disease identification, spraying regimes, irrigation and water management, seed production techniques, cultivars and fertilizer in sweet potato. For sweet potato it was found that in Kwalei village, it is regarded as a women crop and treated as a "rustic crop". This coincides with the observation by Kapinga et al. (1995). Women were found to be more knowledgeable in terms of names of local varieties, seasons, time to maturity, and production practices. Sweet potato was found to receive very little attention in terms of management compared to other crops like tomatoes and cabbages, especially in terms of land allocation and input. The same was observed with low perceptions among farmers on banana production technologies. Banana was found to be poorly managed and sometimes the crop stand was left on large stools of over 10 plants per stool popularly known as *"mighunda"*. Banana fields in Kwalei catchments have been reduced to the now infamous `mighunda', which produce as few as 25 miniaturized (pocket size) bunches per hectare (Mbwana, 2000. Personal Communication). Men especially the youth dominated tomatoes and cabbage production. This is because these two crops are important source of cash income once sold, besides being capital intensive in terms of inputs.

During the problem analysis exercise, two categories of problems were short-listed. They included crop production and experimentation problems. The synthesis and summary of the problem analysis indicated that the major ones included lack of improved varieties, unavailability of quality planting materials close to the planting season and inadequate knowledge on pests/diseases/crop husbandry. The first problem was found to affects all crops, and was addressed by the introduction of improved varieties. Nevertheless, lack of quality planting materials was observed primarily on sweet potato and banana. This could be explained as due to the vegetative nature of its propagation and pest/disease especially in banana. It is sometimes very difficult to keep good quality vegetative planting in Tanzania. To counteract the problem, rapid multiplication technique on sweet potato was introduced, and good husbandry techniques like desuckering were introduced in banana. Lack of adequate knowledge on pest/diseases/crop husbandry was addressed by training farmers on all aspects like good management involving desuckering, manuring, detrashing, spacing and standard stool keeping. For tomatoes and cabbages, farmers were found to depend entirely on pesticides. The problems in the experimentation scenario, which were mentioned by farmers, were: site selection, incorporation of "control treatment", layout, data collection and analysis and presentation.

Despite the fact that traditional researches encourage control treatment, farmer suggested that it should be omitted in the layout. This is because it benefits researchers only, it occupies land without any economic benefit, costly to maintain and is often a source of pests/disease. Farmers frequently mixed up treatments, location of experiments on "bad plot" like on shade, water logging, harvesting before data could be taken. This could probably be due to the education levels, the role of the crop to the particular farmer and the over-dependency of inputs from researchers or the project. Kwalei farmers place tomato and cabbage experiments on their best plots, and sweet potato on the marginal ones because farmers got inputs like fertilizers, pesticides and fungicides for these experiments and therefore saved on costs of production. Despite these draw backs in experimentation, early harvesting before data was taken, an indication that these varieties are well adapted to the Kwalei farming systems and accepted. The peace meal harvest nature of sweet potato and banana despite affecting data collection indicated the role of these two crops in family food and nutritional security. Likewise, it indicates continued potential yield as observed by Kuoko (2004).

The challenges of farmer participatory research were: the incorporation of the farmers' criteria/indicators in the selection of the best varieties, design research/experiment that will be suitable not only to progressive farmers, in the trial layout and to strengthen their ability to monitor and adopt experimental procedures, over dependency on inputs supply from researchers. It was observed that some research data i.e. basic research data, which are very important to improve knowledge, could not be taken. These include data like percentage dry matter, plant height, and internodes longitude, number of flowers per trust, and biomass. In the choice of good cultivars, farmers consider more than one parameter.

Kwalei farmers like their counterparts in the other highlands prefer varieties that have good agronomic performance which could be readily adaptable to their farming system, with average yield, early maturity in order to capture the market and contain food insecurity and have pest/disease tolerance and aspects that will reduce cost of production especially in vegetables and maximize profitability of the enterprise. The technologies introduced were readily accepted and some of them adopted. Sweet potato varieties Tengeru red, CIP 4400123, 4400117 and CIP 4200024 were selected on taste, agronomic performance and yield basis at average of 15 tones/ha. They out yielded the local variety "Katagi" by over 60% of the actual economic yield. Farmer accepted both tomato varieties – Tengeru 97 and Tanya as they showed to have long shelf life of more than 14 days after harvest because of being very firm and hard. These tomato varieties have captured good market in Dar es Salaam and Tanga. Taste was found to be complex, incorporating sweetness, texture, and suitability for cooking and eating fresh, cooking time, flesh color, floury, lack of fiber and flatulence.

Several lessons can be drawn from Kwalei experiments. First, that it takes time to clarify objectives with farmers, and to design a methodology that meets these objectives. Second, it is important that all members of the research team (researchers and farmers) understand the methodological and technical concepts behind trials and training should be given if necessary. Experience showed that data collection should be limited to the needs of the project and that participatory research requires the same rigor and discipline as conventional

research. There is a potential contradiction between the collection of on farm research results and providing farmers with an opportunity to adapt technologies. Sustainability was the central issue in the Kwalei trials and on farm research by participatory experimentation proved that it increases opportunity for newly introduced crops, increase yield and productivity; diversify activities and income generating opportunities, and initiates sustainable research efforts based on participatory principles.

Conclusion

This study shows how farmers and researchers are learning through a participatory approach that supports adoption and natural resources management. The case study identified key elements in terms of source of knowledge, merits, demerits and challenges facing the farmer participatory experimentation. Small community based groups based on farmer research groups were constituted on the basis of the interests towards a particular crop; individual experimentation, monitoring and evaluation visit by researchers. Community FRG meetings emerged as significant factors in sustaining FPE, technology transfer and adoption. The study highlights an example of how FPE as an approach of technology transfer based on "bottom-up" can transform farmer perceptions and strengthen their capacities and increase adoption rate where traditional constructs of technology transfer i.e. " top-down approach" and adoption have not been very successful. The study illuminates the role of improved varieties and management techniques in agricultural productivity and natural resources management. Finally it contributes to increasing the knowledge base of agricultural professionals on emerging participatory concepts and approaches for working with smallholder farmers.

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