Agricultural Journal 6 (5): 201-206, 2011
ISSN: 1816-9155

Facilitating Farmer-Market Linkages Increased Adoption of Maize Technology in Chahi, Southwestern Uganda

[1]Moses Tenywa and [2]Bernard Fungo
[1]Makerere University Agricultural Research Institute,
Kabanyolo (MUARIK) P.O. Box 7062, Kampala, Uganda
[2]National Agricultural Research Organization (NARO), P.O. Box 162, Mukono, Uganda

Abstract: This study was carried out to establish the impact of facilitating farmers' access to market on adoption of maize cultivation, associated land management practices, identify the major constraints to and socio-economic determinants of adoption in Chahi sub county, Kisoro district, Southwestern Uganda. An Innovation Platform (IP) established to facilitate stakeholder participation in overcoming critical constraints of a potato value-chain was used to promote maize cultivation following exciting experience from potatoes. Data were collected from 180 households in ten participating villages of Chahi sub county. Results show that the number of maize farmers increased from 10-35% while the average maize acreage per household increased from 1.3-2.7 ha. There is also increased use or inorganic fertilizers and more careful treatment of household refuse as manure to improve soil fertility in the maize gardens. The difficulty of acquiring seed, long distance to the maize collection center and lack of knowledge of quality seed are the major constraints facing the maize farmers. Membership to IP, land holding and education level are the household characteristics that influence adoption of the maize technology in Chahi sub county. It is recommended that the IP facilitates linkages with suppliers of quality seed for farmers. Establishing several collection centers for harvested maize would reduce the burden of farmers having to transport maize to the far-off market areas.

Key words: Facilitation, farmer-market linkages, adoption, maize, transport, Uganda

INTRODUCTION

There is growing recognition of the need for smallholder producers to shift from traditional farming strategies to those of more innovative farming leading to better farm incomes. One such innovative approach relates to the establishment of linkages between farmers, producers and markets (FAO, 2008). This approach to be effective; calls for priority attention to issues on access to technology and information, institutional arrangements and support services, policies, capacity building of producers and identification and development of markets among others (Dorward *et al*., 2003), put emphasis on a lack of due consideration of markets and their roles in livelihood development and poverty reduction in application of livelihood approaches.

Conventionally, farmers have use some of the methods such as farm direct marketing, road side stands and markets, community markets (farmers' markets), direct to restaurants and more recently community supported agriculture (buyers pay the farmer in advance). This diversity of options leaves the farmer to select the option that is perceived best for them. However with the changing global agricultural economy (Boehlje, 1999), rise in commodity prices (Minten *et al*., 2010; Huang e*t al*., 2011) and complex value chains, there is growing interest in how farmers can benefit from emerging market opportunities (CAPRI, 2006). Farmers are encouraged to produce high value crops and engage in value-adding activities such as agro-processing (Barghouti *et al*., 2004). The removal of marketing bards in Uganda in particular means that farmers now have to identify market for their produce as well as set the price.

To be able to match the emerging market dynamics, there is need to strengthen competitiveness of farmers in the enterprises, value chains and wider business environments on which rural producers depend (Dorward *et al*., 2004). One such window is to making channels of information (e.g., about product specifications, market prices) and other business services accessible to rural producers (Dixon *et al*., 2001; DFID, 2005).

Under the SSA-CP, an Innovation Platform (IP) has been established in Chahi sub county where several agricultural stakeholders (farmers, researchers, extension workers, private sector and policy makers) meet to identify

Corresponding Author: Bernard Fungo, National Agricultural Research Organization (NARO), P.O. Box 162, Mukono, Uganda

a critical challenge in a value chain, devise strategies for overcoming the challenge. The Chahi IP is focusing on managing soil fertility for improving potato yields to meet the high demand in Uganda. Facilitated monthly IP meeting are held to plan for monitor and evaluate progress of the activities. IP stakeholder trainings based on IP needs assessment are also held. Some of the trainings that the IP has undertaken include, group dynamics, leadership skills, business plan development, market linkage identification and monitoring and evaluation.

This study was carried out to establish the impact of facilitating farmers' access to market on adoption of maize cultivation, associated land management practices, identify the major constraints to and socio-economic determinants of adoption in Chahi sub county, Kisoro district, Southwestern Uganda.

Theoretical framework: This study used the agro-enterprise approach developed by Centro International de Agricultura Tropical (CIAT) to facilitate farmer-market linkages. Considering agro-enterprise approach, the zonal focus was Chahi sub county while the supply chain focus was maize (Lundy *et al*., 2004).

Although, Chahi IP's focus is potatoes, one of the members is a business partner, who operates a maize processing mill. Following lessons from the potato value chain, this partner decided to apply the knowledge to maize. He approached the IP facilitators and requested them to apply the IAR4D approach to the maize value chain. The assurance was that the maize produced by farmers would be bought off by his factory which processes maize to be sold as flour. Subsequently, improved maize seeds were supplied and promoted among farmers in Chahi sub county at the start of 2009.

Interested farmers were invited to trainings on the management of the maize and were supplied with two kilograms of maize seeds to start with. More promotion was done through visits to villages in Chahi that were participating in the SSA-CP. Farmers that produced the 1st generation of maize stored some grain as seed for the next season. Other farmers, latter learnt of the technology and requested for seed from fellow farmers and from the maize miller. Following this success story, a household maize adoption survey was conducted to document the improvements in the adoption of maize production in Chahi sub county, Southwestern Uganda.

Several studies have investigated factors that are likely to affect adoption of various agricultural technologies (Nowak and Korsching, 1983; Wiersum, 1994; Mendola, 2005; Calatrava-Leyva *et al*., 2005; Adeoti, 2008; Nabanoga *et al*., 2007; Buyinza *et al*., 2008). These factors can be classified as follows:

- Farm households' asset bundles (comprises physical, natural, human, social and financial assets)
- Socio-economic characteristics of the household
- Characteristics of the technology proposed in question
- Perception of need for the technology
- The risk bearing capacity of the household

In this study, we envisage that the factors that might influence adoption of the maize variety are whether household has participated in IP activities or not; membership to Innovation Platform (IP); land size utilized by farmers in acres; position of land on the landscape; household size, age of household head, sex of household head; education level of household head and participation in farmer groups.

MATERIALS AND METHODS

The study was carried out in Chahi sub county, Kisoro district, Southwestern Uganda. The district is one of those participating in the sub-Saharan Africa Challenge Program (SSA-CP). It is a highland Agro-Ecological Zone (AEZ) characterized by steep slopes, deep volcanic soils and ample rainfall that offers good potential for agriculture production.

The area receives mean annual rainfall that varies from 900-2,200 mm and has medium to long length growing periods (180-270 days). The principal crops grown include Irish and sweet potatoes, sorghum, millet, peas, maize, beans, wheat and other tree species for fruit and forest products. Despite the apparent rich natural resource endowment, the Lake Kivu region is considered one of the poorest and most densely populated areas of Africa with densities ranging from 400-700 persons km^{-2}. This has led to over-exploitation of the natural resource wealth. Over 90% of the population derives, its livelihood from agriculture and other enterprises based on natural resources on <0.6 ha per family of six. Nearly, 60% of the land area is intensively cultivated and poverty in the region is directly linked to the low and deteriorating productivity and profitability of these enterprises.

The region has also experienced recurrent volatility of conflicts with sporadic conflict still continuing in some parts of D.R. Congo and climate change. The principal challenge in LK is thus to contribute to improved food and nutrition security, increased household incomes and improved quality of the PLS natural resource base by applying Integrated Agricultural Research for Development (IAR4D4) to develop, test and promote technological, institutional and policy innovations based on Integrated Watershed Management (IWM) concept.

Sampling and data collection: Sampling of households for the survey was done using a list of IP members that participated in IP trainings and other activities. Before the survey, the farmers were asked to indicate whether they had adopted the maize or not and from this, we divided the lists into adopters and non-adopters. From each group, households to be interviewed were selected randomly using a list of random numbers. A total of 180 households comprising of 89 adopters and 91 non-adopters were interviewed using a structured questionnaire. Additional information on previous and current percentage of farmers cultivating maize was obtained from a household baseline and end line surveys that were conducted between June 2008 and July 2010, under the SSA-CP.

Data analysis: Frequencies, percentages and means of household parameters were computed for the household characteristics investigated. Adoption of the maize technology was analyzed by employing a Binary logit model. All statistical analyses were performed using Stata 9 statistical software.

RESULTS

General characteristics of the respondents: The results show that almost 70% of the respondents had not exceeded primary level education (Table 1) and 84% are married. About 90% of the surveyed households depend on agriculture as the major source of their livelihood. Approximately 85% of the households have between 4 and 10 people (average is 7). Most of the gardens (61%) are located on the bottom part of the slope and only 4% on the top slope position. About 35% of the household heads are >50 years of age but about half are aged between 30 and 50 years. About 40% of the households belong to at least 1 farmer group.

Extent of maize adoption: Changes in maize adoption levels are shown in Table 2. The number of farmers cultivating maize increased from 10-35% between 2008 and 2010, respectively. The total are under maize increased from 5.3-27 ha and the average area per household increased from 1.3-2.7 ha within the same period.

The range of varieties that farmers are cultivating is shown in Fig. 1. It was noted from the focus group discussions that some farmers were using seeds from sources other than those of the introduced variety but claimed to be using the variety. This is because they wanted to supply the private sector. This therefore, highlights the need to secure adequate supply of seed to meet the farmers demand. By making an assessment of the relative profitability of these varieties, the results reveal

Table 1: Characteristics of sampled households in Chahi sub county, Southwestern Uganda

Variables	Codes	Responses	Frequency	Percent
Member of IP	0	No	72	40.0
	1	Yes	108	60.0
Size of land owned	1	≤0.5 ha	86	47.8
by household (land)	2	0.6-1.5 ha	53	29.4
	3	>1.5 ha	41	22.8
Position of plot in	1	Bottom	110	61.1
the landscape	2	Middle	63	35.0
	3	Top	7	3.9
Size of	1	1-3	19	10.6
household (hh. size)	2	4-6	73	40.6
	3	7-10	80	44.4
	4	>10	8	4.4
Age of household	1	≤30	29	16.1
head (hh. age)	2	31-40	43	23.9
	3	41-50	45	25.0
	4	>50	63	35.0
Sex of household	1	Male	155	86.1
head (hh. sex)	2	Female	25	13.9
Education level of	1	None	40	22.2
household head (hh. educ.)	2	Primary	87	48.3
	3	Secondary	22	12.2
	4	Diploma	18	10.0
	5	University	13	7.2
Membership in	1	Yes	72	40.0
farmers groups (groups)	0	No	108	60.0

Table 2: Changes in the maize adoption by farmers in Kisoro, Southwestern Uganda

Periods	No. of farmers adopting (%)	Total area under maize (ha)	Average area under maize (ha)
2008	10	5.3	1.3
2010	35	27.0	2.7

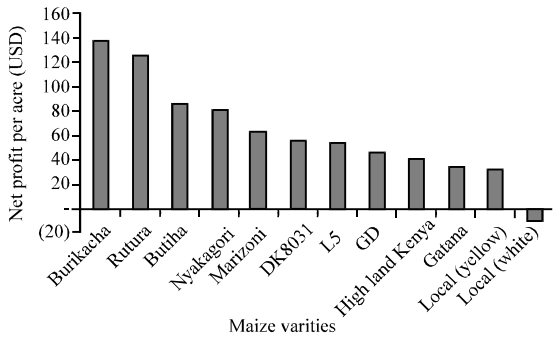

Fig. 1: Profitability of locally available maize varieties in Chahi sub county, Southwestern Uganda

that except for a local white variety, the rest of the locally used ones are profitable. However, Burikacha which is the variety promoted under the project is the most profitable, returning up to US$145. This is equivalent to twice the amount primary teachers and policemen earn in 1 month.

Changes in land management practices: Farmers that received training on management of the new maize variety also indicated significant improvement in the use of soil and water conservation as well as agronomic practices.

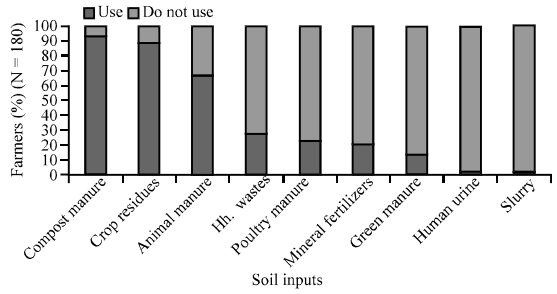

Fig. 2: Frequency of use of various organic material by farmers in Chahi sub county, Southwestern Uganda (N = 180)

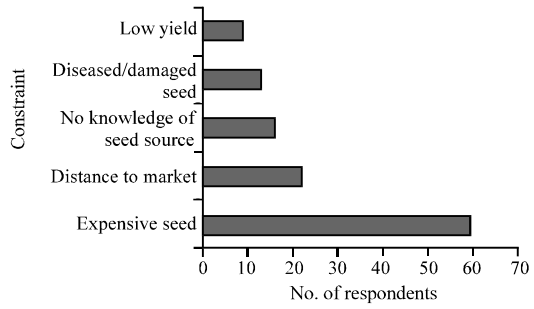

Fig. 3: Constraints faced by maize farmers in Chahi sub county, Southwestern Uganda

For example, farmers initially planted maize without addition of fertilizer. However, five farmers who never used fertilizer before reported having used NPK 17-17-17 in the maize crop, they had planted as recommended by the extension workers in the IP. Another seven farmers, also reported that household refuse is now an important material that they carefully store in pits in order to use for manuring the gardens during the planting season. Storing manure in pits is something, they did not do before. Figure 2 shows the frequency of use of various organic materials for soil fertility improvement. The abundance of various organic fertilizer resources as ranked by farmers is shown in Table 3. Legume (beans and peas) and maize stovers are the most common fertilizer resources available to most farmers in Chahi. Potato residues are also a common source as majority of farmers grow potato. Just before harvest (about 1-2 weeks), farmers de-helm (cut the plant at the root collar) the potato plants and retain the above-ground biomass as green manure in the garden. The relatively low carbon: nitrogen level allows the biomass o rapidly decompose and becomes soil even before the start of the 2nd season.

Constraints to maize cultivation: Farmers reported several constraints to maize production (Fig. 3). The greatest constraint is access to affordable seed for planting followed by the distance to the market and lack of knowledge of the source of seed and least was the fact that the yields of maize are generally low in the area.

Table 3: Abundance of various organic fertilizer resources in Chahi sub county, Southwestern Uganda

	Rank of abundance (1 = Abundant; 5 = Scarce)					
Organic materials	1	2	3	4	5	Total
Beans/peas stover	112	47	16	4	-	179
Maize stover	50	95	26	2	-	173
Potato residues	9	14	33	5	2	63
Sorghum stover	1	14	18	5	-	38
Banana remains	3	5	5	4	-	17
Wheat residues	1	-	4	2	-	7

Table 4: Binary logit model for adoption of maize technology in Chahi sub county, Southwestern Uganda

					95% conf. interval	
Variables	Coef.	SE	z	p>|z|		
IP	0.6872	0.2050	3.35	0.001*	0.2855	1.0890
Land	0.3070	0.1281	2.40	0.017*	0.0559	0.5581
Lanscape	-0.0349	0.1849	-0.19	0.850	-0.3974	0.3275
Hh. size	-0.0259	0.1393	-0.19	0.853	-0.2988	0.2471
Hh. age	-0.1084	0.0930	-1.17	0.244	-0.2907	0.0739
Hh. sex	0.1432	0.2848	0.50	0.615	-0.4149	0.7014
Hh. educ.	0.2215	0.0914	2.42	0.015*	0.0423	0.4007
Groups	0.0308	0.2118	0.15	0.884	-0.3842	0.4459
Cons.	-1.2538	0.7936	-1.58	0.114	-2.8093	0.3017

*Significant at 95% level of confidence

Determinants of adoption of the maize technology: Results show that membership to IP, land holding and education level of household head are the only factors affecting adoption of maize technology (Table 4). Farmers who participated in the IP had higher chances of adopting the maize technology than those who do not. Similarly, the probability of adopting the maize technology was higher for farmers with larger land holdings than those with small ones. The trend was the same for education level as more educated farmers had higher probability of adopting the technology.

DISCUSSION

The increased adoption of the maize technology is attributable to sensitization and training sessions provided by the IP during the study phase. Facilitation of farmers to identify and understand the market of their produce helps them realize the economic benefits associated with the technology. This is true for technologies that are quite new in an area because they do not have much competition and have also not had observable challenges by the adopting farmers. The challenge remains on whether the adoption rate will increase or decrease. The factors that may affect the future adoption trends include emergence of new and more promising technologies, changes in biophysical environment such as pests and diseases, unreliable

rainfall patterns among others. FAO (2008) noted in several case studies of linking farmers to the market that the essential feature of each case study was the concern and interest of different institutions working on Research and Development (R and D), extension among others in supporting the program/project.

As per needs, several public/government and Non-government Organizations (NGOs), a private sector entrepreneur joined hands to provide collective inputs. The studies show that a substantial progress was achieved where, 24% increase in the sale price of organic olive oil compared to the price of traditional produce in local market. Consequently, significant increase in added value and decrease of costs reflected in the net profit and improvement of rural livelihoods. Moreover, the farmers were trained on organic farming system which helps to reduce environmental impact of agriculture.

In Egypt, there was on the expansion of vegetable area in the desert. In the reclaimed desert near Qina region, a small group of farmers started in producing exportable off-season vegetables in small areas. The farmers implemented the recent developments in fertigation techniques to improve the desert land.

The results agree with the findings of Ampaire and Rothschild (2010) that farmer training and facilitation had an impact on improving animal health, livestock consumption and sale of livestock and their products. The duo noted that farmers who had received more training and facilitation had less disease in pigs in the 6 months preceding the study than those who had not been trained or who had the animals for a shorter period of time. The farmers who had more training and support also consumed more and sold more livestock.

It is expected that farmers owning big portions of land may face less pressure to increase maize acreage or establish new maize gardens as compared to their colleagues with small land holdings. These results are ironic with those of Nkonya *et al.* (2008) who found that farmers with smaller pieces of land had fewer chances of adopting soil and water conservation practices.

The high population density coupled with extensive land fragmented in Chahi in particular and Southwestern Uganda in general could explain the limited adoption potential of farmers with small pieces of land. Buyinza *et al.* (2008) observed a similar trend on adoption of wood fallows in Southeastern Uganda. These observations emphasize the need to consider site as well as technology-specific situations before attempting to predict whether adoption is likely or not. The higher probability of more educated farmers to adopt is due to the fact that such farmers know the associated benefits and therefore, quickly adopt the technology. However, the reverse may also be possible due to the opportunity cost of labour. In which case, farmers may have alternative enterprises that (potatoes in Chahi) are more profitable, the maize being promoted. Sometimes farmers are also fearful to taking risks of entering a new market.

CONCLUSION

Farmers that participate in IP activities had higher chances of adopting maize technology. The number of farmers cultivating maize increased from 10-35% between 2008 and 2010, respectively. The total are under maize increased from 5.3-27 ha and the average area per household increased from 1.3-2.7 ha within the same period. There is also increased use or inorganic fertilizers and more careful treatment of household refuse as manure to improve soil fertility in the maize gardens.

The difficulty of acquiring seed, long distance to the maize collection center and lack of knowledge of quality seed are the major constraints facing the maize farmers. Membership to IP, land holding and education level are the household characteristics that influence adoption of the maize technology in Chahi sub county.

RECOMMENDATIONS

It is recommended that the IP facilitates linkages with suppliers of quality seed for farmers. Establishing several collection centers for harvested maize would reduce the burden of farmers having to transport maize to the far-off market areas.

ACKNOWLEDGEMENTS

This research was part of the sub-Saharan Africa Challenge program funded by the European Union (EU) and coordinated by the Forum for Agricultural Research in Africa (FARA). We thank the EU for financial support to undertake this study. We are also grateful to the Open and Distance Learning Network (ODLN) for conducting the household survey in Chahi and subsequently entering the data.

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