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Research article

Agricultural technology adoption for orphan crops among rural poor farmers in Uganda

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Abstract

Researchers have developed number of improved varieties as well as appropriate management practices for orphan crops, but relatively few farmers have access to and use these technologies. The purpose of this study was to assess innovative approach for enhancing adoption of technological innovations for orphan crops among smallholder farmers in three districts in Uganda. A total of 120 participatory adaptation trials were established in Tororo (60), Mukono (30) and Ntungamo (30) starting from the second season of 2010 to the first season of 2012. The improved technologies introduced included high yielding varieties, row planting, and pest control practices. One year after the trial ended, in the second season of 2013, tracking of adoption was carried out by interviewing 300 randomly selected farmers. Of the innovation adopters, the majority (71.3%) had participated in the adaptation trial phase. However, the remaining 28.7% of adopters had not participated in the adaptation trials – indicating considerable

spill-over. In addition, 67% of farmers stated that the local monitoring and evaluation committees set up during the adaptation trials (which consisted of five committee members per sub-county), were very useful and had motivated them to adopt the improved technologies. In addition, pre-existence of farmer groups, especially in Tororo district, positively influenced technology adoption in the district with 89% of adopters having belonged to a farmer group. These findings indicate that the method used to introduce the technologies, participatory adaptation trials, was effective and could be considered for increasing the adoption of other technologies. For efficient technology transfer among resource poor smallholder farmers, we therefore recommend the use of participatory adaptation trials, combined with the formation of local monitoring committees, as well as ensuring that researchers work with established farmer groups, where they exist.

Keywords: adaptation trials, smallholder farmers, local monitoring committee

Introduction

One of the challenges in Sub-Saharan Africa is ensuring food and nutritional security for a sustainable livelihood for an increasing population. In Uganda, about 6.3% of households are food insecure and 21.3% are at risk of becoming food insecure [19]. This not only characterizes the extent of poverty in the country, especially in the rural areas, where agricultural productivity is very low [3; 9], but underpins the reason for innovative approach to agricultural technology dissemination. Therefore, empowering rural smallholder farmers to improve agricultural productivity and increasing access to markets for their produce could be a major milestone towards fighting poverty in the country [6]. This is possible through promotion and diffusion of high quality seeds of improved varieties of major food crops and their management practices, which is still a huge challenge (Agricultural Sector Development Strategy and Investment Plan 2010-15). A wide range of crops are cultivated in Uganda yet most households depend on a few traditional crops for food and income [13]. Crops such as cowpeas, yams, sweet potatoes among others, often categorised as orphan crops, have potential to enhance food and nutritional security and development for the rural poor in the country [16], if appropriate technology is availed and made accessible to farmers. These crops are valued culturally, adapt well over wide range of adverse conditions such as low soil fertility, low rainfall and are important for the subsistence [12]. In addition, these crops are major source of income to the resource poor farmers attributed to equally high rates of returns from sales [2]. Therefore, the role of orphan crops in food systems cannot be ignored if Uganda is to realise the contribution of agriculture in achieving vision 2040. Fortunately, researchers have up-to-date developed a number of improved varieties as well as appropriate management practices for the orphan crops, but only a handful of farmers ably have access to these technologies (Agri-food systems Baseline survey report 2009/10). This is because seed sector in Uganda is largely managed by private seed companies whose focus is profit generation and prefer to market seeds of major food crops like maize [8, 7]. It was against this background that we conducted this study to test innovative approach to technology transfer to the smallholder farmers by answering the following basic question; 1) how relevant is it to conduct participatory adaptation trials in improving farmers' access to improved technologies for the selected orphan crops and 2) Could formation of local monitoring committees and existence of farmer groups strengthen smallholder farmers capacity to take up improved technologies?

Materials and Method

Project location and materials

The study was conducted in two phases (adaptation phase and adoption phase) in three sub-counties per districts of Mukono, Ntungamo and Tororo located in the central, western and eastern part of Uganda, respectively. Based on

the order of importance, challenges faced and farmers' interests (yield, taste, colour, grain size, and maturity period), one to three varieties of five (5) crops were selected for the study (Table 1). Two orphan crops were studied per district: cowpea and sorghum, groundnut and yam, and groundnut and sweetpotato for Tororo, Mukono and Ntungamo, respectively.

Host farmer selection and establishment of trials

We used already existing farmer groups except in Mukono and parts of Ntungamo districts where new groups were formed. Host farmers were selected by members of each farmer group using well defined criteria - amount of land available to host trial, willingness to host and manage the trial, willingness to allow access to trial gardens by other farmers to learn and acquire skills, proximity access road, membership to a farmer group, and level of involvement in the group. A total 120 host farmers (30 host farmers each in Mukono and Ntungamo, and 60 farmers in Tororo districts) were engaged to host trials for the adaptation phase of the study. Trials were planted in host farmer's garden in a non-replicated plot for two seasons during which the technologies were introduced and adapted. The size of the plots depended on the land availed by the host for the study, which ranged from 30 to 400 Square Metres. Two to three improved varieties of each crop were evaluated against the local varieties at each trial site following recommended crop management practices. The local varieties and practices were used as controls. Planting was done jointly by farmer group members, extension workers and researchers. With the exception of sweet potato which was planted on mounts, row planting was used for the other crops besides the controls.

Table 1: Varieties used, plot size and spacing for the crop trials

Crop	Varieties	Spacing
Cowpea	Secow 1T, Secow 2W & Local variety (Ebelat)	60x30cm
Sorghum	Sekedo, Epuripur and Local variety	60x30cm
Yam	Nigeria yellow and Local variety (Balugu)	150x150cm
Groundnut	Serenuts 1, 3, 4 and Red beauty	60x15cm
Sweet potato	(Naspot1, Naspot8, Naspot11 and local variety	3 vines per mound

Adopted from Agri-food systems Baseline survey report 2009/10

Farmer training

To enhance their skills and knowledge, farmers were trained on a wide range of topics including production and management of selected orphan crops, participatory local monitoring and evaluation of farmer trials, different aspects of food security for rural farmer households (definition, indicators of food insecurity and possible interventions), how to strengthening farmer groups cohesion, and how to enhance market access for orphan crops. Classroom approach where sometimes local language was use followed by field practical demonstrations were used to conduct the training.

Tracking of adoption of technologies for orphan crops

Tracking of adoption of technologies was carried out in the second phase of study with individual farmers in the study area after 12 months of completion of the participatory adaptation phase. A tracking tool, unit questionnaire, designed socio-economists was first pretested using a small group of farmers and later administered to capture the required data. As in the pre-testing, face to face interview with a larger number of randomly selected farmers was used to administer the questionnaire. Information captured included farmer bio-data, farming experience, engagement in farming groups, participation in Agri-food system project activities, production and marketing of orphan crops, challenges faced in growing crops and access to services such as extension and financial services. Data generated was analyzed using SPSS and MS Excel computer statistical packages.

Results and Discussion

A total of 120 trials were established across the three districts – 30 trials each in Mukono and Ntungamo, and 60 trials in Tororo districts. Farmers actively participated in the trials as well as the training sessions with enthusiasm. Majority of the farmers except in Mukono and partly in Ntungamo were found to operate in farmer groups. The variation in the number of trials was attributed to availability of land and the high number of pre-existing farmer groups and individual farmers willing to offer their lands for trials as observed in Tororo. Besides being in farmer groups, the crops (cowpea and sorghum) selected by the farmers in the Tororo district were major source of food and income [7; 18]. This positively influenced technology adoption in the district with 89% of adopters having belonged to a farmer group. In Mukono and Ntungamo the concept of farmers groups was relatively new and majority of the farmer groups used in the study were newly formed. As a result, it was difficult for the research team to establish equal number of farmer groups considering the cost implications. The purpose of this trial phase was to create awareness and impart knowledge and skills to the farmers that would allow them make choices at an informed position which was achieved.

During the trial phase, four training sessions were conducted for average of 299 farmers per district. At the end of each training session, trainees were interviewed so as to identify key areas of the training they have understood and were willing to apply. Of the farmers who participated in the training, there was no significant difference in proportion of farmers who understood the training aspects. For example, 89.6% liked crop production and management skills session followed by access to markets (86.6%), household food security (86.3%) and strengthening farming groups (84.9%). This was also done to assess how effective the delivery method of the training was and whether farmers understood what they were trained about. The method of training was effective as more than 80% of the farmers chose at least one of the topics.

A participatory crop variety preference assessment was also conducted at the close of the trial phase and based on knowledge and skills acquired the following varieties were farmers' preferences; SECOW 2W, Sekedo, Serenut 1 & 3, and Naspot 8 & 11 for cowpea; sorghum; groundnut and for sweet potato, respectively. In addition to the trainings received, the choice of the varieties was also based on their popularity in the target areas. No preference could be made for yam because only the local variety was planted. This information was later used to design adoption tracking tool.

A total of 300 farmers were interviewed during the survey carried out to determine the proportion of farmers who have adopted the improved technologies after introduction in the target districts. The interview was conducted randomly so that both farmers who directly or indirectly benefited from the trial phase of the study were captured. Despite the randomization, majority of the interviewed farmers who adopted the technologies (71.3%) were those who participated in the trial phase of the study compared to 28.7% who did not participate. This is an indication that the initial trial phase, where improved technologies were introduced, was extensively done in the study area and majority of the farmers in the study area benefited.

Participating farmers in the adoption study were also asked about utilization of the orphan crops/varieties they have cultivated and the results showed that majority of farmers used the crops (varieties) both for consumption and commercialization (Figure 1). This clearly shows the potential of these crops to meet food/ nutritional needs and income of rural poor farming households in the country [7; 18].

The percentage proportion of farmers using the introduced technologies and their perception was used to measure the level of adoption. These approaches were successfully used previously [1; 4; 17]. A significant variation in level of adoption of the technologies was observed with most of the farmers, averaging at 76.4%, who participated in the trial phase having adopted at least one of the improved technologies (Figure 2.).

The results also showed that there was spill over in adoption as farmers who did not participate in the trial phase were found to have taken up the new technologies. Implying that the farmers liked the technologies that have been introduced and the method used to introduce the technologies (participatory adaptation trials) was effective and could be considered for increasing of adoption of other technologies. Farmers growing cowpea and groundnuts were the most adopters as over 60% of those interviewed adopted the improved varieties as well as crop management practices such as planting line, appropriate plant spacing, and spraying to control pests.

There was significant ($P< 0.01$) variation in the percentage of farmers interviewed who have received services such as training, extension, participation in monitoring and evaluation (PM&E[1]), and access to financial services (SACCOS[2]). Most of the farmers who adopted the technologies were found to have participated in the trial phase (Group members) and received the advisory services. For example, for those who adopted cowpea technologies 79.7%, 89.5% and 42.7% of the farmers (group members) received the extension services, participated in the M & E, and accessed financial services, respectively (Table 3). Meaning that participation in trial phase, trainings, and receiving extension and financial service were influential on adoption of the technologies. This is in agreement with earlier report [14] where farmers operating in groups learn and adopt faster as they support each other by sharing knowledge and skills acquired. Other factors which had some influence included membership to a farmer group, access to market and farmer perception. Besides external factors, characteristics of the technologies such as compatibility with the existing values and norms, complexity and relative advantage is also at play in influencing adoption by farmers [15].

[1] PM&E – Participatory Monitoring and Evaluation

[2] SACCOS – Savings and Credit Cooperative Society

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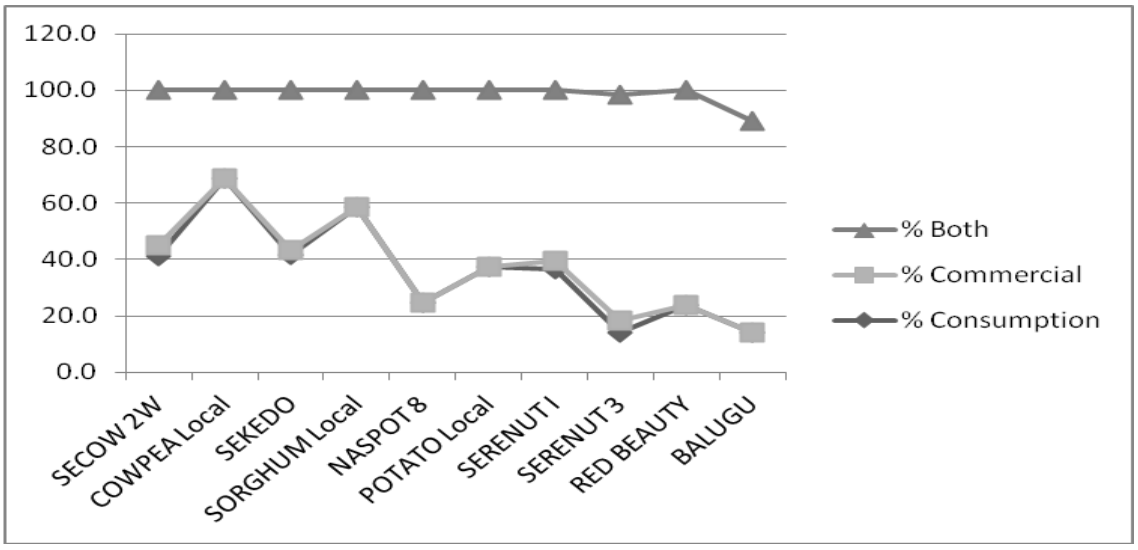

Figure 1: Utilization of crops/ varieties by farmers in study area

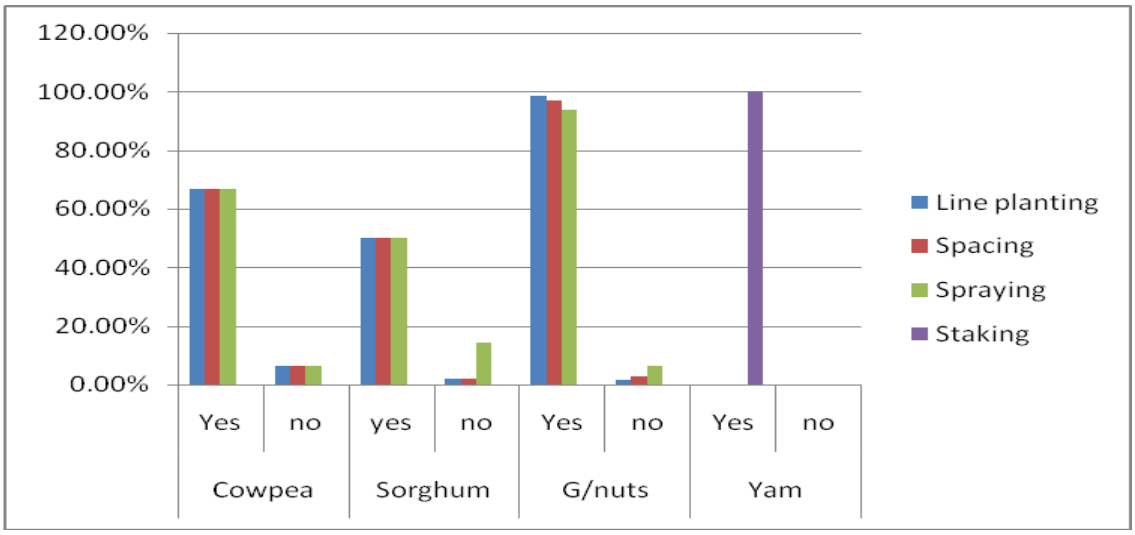

Figure 2: Rate of adoption of improved crop varieties and their management packages by members and non group members where yes = member and no = non members.

Table 3: Percentages of farmer per crop either in a group or not that received services

Crop	Farmer category	Percentage farmers per Services Received					
		Extension		PM&E		SACCO	
		Yes	No	Yes	No	Yes	No
Cowpea	Group Members	79.7	20.3	89.5	10.5	42.7	57.3
	Non-group members	6.7	93.3	7.1	92.9	38.5	61.5

	Group Members	79.5	20.5	88.4	11.6	46.0	54.0
Sorghum	Non-group members	6.3	93.8	12.5	87.5	46.7	53.3
	Group Members	72.1	27.9	81.8	18.2	45.8	54.2
Sweet Potato	Non-group members	33.3	66.7	43.8	56.3	30.0	70.0
	Group Members	68.1	31.9	73.9	26.1	27.3	72.7
Yam	Non-group members	0.0	100.0	0.0	100.0	0.0	100.0
	Group Members	74.1	25.9	83.9	16.1	55.5	44.5
Groundnuts	Non-group members	23.1	76.9	42.9	57.1	50.0	50.0
	Group Members	74.7	25.3	83.5	16.5	43.4	56.6
Average	Non-group members	13.9	86.1	21.3	78.8	33.0	67.0
Fpr (0.05)		0.001	0.01	0.001	0.01	0.01	0.05

In addition, mechanisms for small farmers to oversee their food security interventions were established. For examples, a structure (Local M & E committees), a tool and capacity for farmers to monitor and evaluate their own projects were established. This initiative was observed to be helpful in promotion of improved varieties and crop management packages. In addition, 67% of the interviewed farmers when asked stated that the local monitoring and evaluation committees set up during the adaptation trials (which consisted of five committee members per sub-county), were very useful and had motivated them to adopt the improved technologies.

Socio-economic characteristic of the sampled farmers such as age, sex, marital status, size of household, level of education, residency in the study area, ownership of land for agriculture, period of practicing farming-especially for the study crops, and membership to a farming group were collected and analysed. Though not significantly different as compared to farmer participation in trial phase and training received, these socio-economic characteristics of the farmers were found to affect the level of adoption of the introduced technologies. Most of the practicing interviewed farmers who adopted the technologies were aged between 30 and 56 years and married with average of 5 people per household. Most of them have practiced farming for over 10 years and the study crops have been used as staple though local varieties were most cultivated. Majority of the farmers were residents and therefore owned the land used for farming averaging from less than half an acre (< 0.5 acres) to over three acres (> 3 acres). Unlike in Kanungu and Mukono, 89% of farmers who adopted technologies in Tororo district belonged to an existing farmer group. However, younger farmers appeared to have adopted the technologies that required energy such as line planting and spraying than older farmers. In their study, contribution of Uganda Cooperative Alliance to farmers' adoption of improved agricultural technologies [11], Mugisha and the colleagues reported that younger farmers were more dynamic in the adoption of new farming techniques, while older ones are more experienced and skilful but less energetic. The older farmers tend to avoid technologies that demand for energy. In this study as reported earlier [10; 11], the more educated the farmers the easier to learn and adopt new technologies. This could be explained by the fact that the educated farmers easily synthesize information availed and apply them to the farming situation [5] though the trainings were conducted in both English and local language.

Conclusion

There was high level of adoption of technologies for the selected orphan crops in the study area. Some adoption was noted among farmers who did not participate in trial phase. However, participation in farmer group trials, training, participatory monitoring and evaluation at the adaptation phase were observed to be crucial in determining adoption of the innovations. Other factors which had some influence included membership to a farmer group, access to market, advisory and financial service. These findings indicate that the method used to introduce the technologies, participatory adaptation trials, was effective and could be considered for increasing the adoption of other technologies. In addition, mechanisms for small farmers to oversee their food security interventions, local monitoring and evaluation committees, helped in promotion of improved technologies and could be adopted.

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[6] IPM – Integrated Pest Management
[7] ASARECA - Association for Strengthening Agricultural Research in Eastern and Central Africa
[8] WFP – World Food Program