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Abstract

This paper investigates the farmers' awareness and perception of the relevance of agricultural technologies under the Plan for Modernization of Agriculture (PMA). A survey was conducted between July and October 2003 in the parishes of Katuugo, Kyelindula and Kakooge of Kakooge Sub-county, Nakasongola district. Using a two-stage random sampling technique, 120 farmers were selected and interviewed. A structured questionnaire was administered to them to elicit information on their awareness and perception of the relevance of agricultural technologies. Data analysis was done using a statistical Package for Social Sciences (SPSS ver. 11.0) and simple descriptive and inferential statistics were run. The results showed that there was high level of awareness among farmers of agricultural technologies: improved agroforestry fallow (92%), variety of simsim (85%), and poultry livestock management (80%). There was a significant relationship between farmers' awareness and their perception of the relevance of livestock technologies ($r = 0.42, P < 0.05$), improved crop varieties ($r = 0.44, P < 0.05$) and agroforestry technologies ($r = 0.58, P < 0.05$). However, the correlation between awareness and relevance of soil and water conservation technologies ($r = 0.02, P > 0.05$) was low and not significant. It was concluded that farmer education especially through a rejuvenated agricultural extension system was one way of improving the awareness and perception of the relevance of agricultural technologies in Uganda.

Introduction

The Plan for Modernization of Agriculture (PMA), is a framework for eradicating poverty and improving the livelihoods of the rural farmers in Uganda. It is designed to create an enabling environment for transforming subsistence farmers into commercially and market oriented producers for a better living. The transformation process involves institutional and organizational reforms, public sector policy adjustments, decentralized and participatory planning and pluralism in service delivery (MAAIF, 2001).

For more than a century, investment in agricultural research and development of new technologies in Uganda generated a number of technological innovations some of which are appreciated or used by the farmers (MAAIF, 2001). According to Semana, *et. al.* (2002), inadequate participation of rural farmers in the agricultural technology development is partly responsible for the inability of farmers to take full advantage of the improved technologies (NARO, 2001). Hence the level of utilization of agricultural technologies for development among smallholder farmers is low. To improve the agricultural production, appropriate technology is necessary to suit the local economic, cultural and geographical conditions of the region (Boesen et. al., 2004).

Available literature shows that the single most important factor behind rural poverty is low agricultural productivity (MFPED, 1997), resulting from soil nurient depletion, disproportionate reliance on native technologies including the use of unimproved and low-yielding planting material, limited practice of crop protection, and high post-harvest losses arising from unsuitable storage and processing capacity. Therefore, increasing agricultural productivity could significantly contribute to the effort to mitigate poverty in Uganda by increasing farm production and incomes.

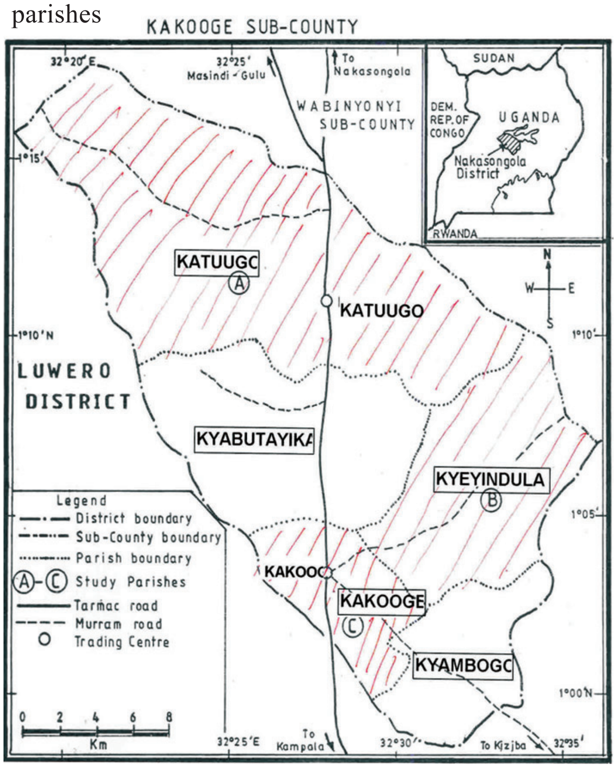
The National Agricultural Research (NARS) Act of 2005 is a legal instrument that Uganda has developed to ensure that NARS is transformed into an innovation system whose outputs tally with the needs of the clients (MAAIF, 2001). A review of the technologies in the NARS shows that Uganda has a number of improved technologies that has not been adopted and used by farmers (Semana et. al., 2002; MAAIF, 2001). One of the problems of technology uptake is the perception of demeaning attitudes of scientists towards farmers as recipients of technologies. Therefore, farmers are often reluctant to associate with scientists; their scientific knowledge and technologies they advance (Boesen et. al., 2004; Biggs and Clay, 1981). Consequently a considerable proportion of research findings have not been transformed into marketable products in the technology value chains driven by economic incentives and social benefits (Agbamu, 2000). The objective of the study was to assess farmers' awareness and perception of the relevance of agricultural technologies promoted under PMA.

Methods and materials

Description of study area

The study was conducted in Nakasongola District 114 km north of Kampala (Figure 1). The district covers an area of 3,424 km^2 of land on the central plateau between 1000 and 1400m above sea level. The topography is characterized by extensive and uniform undulating plains with broad seasonal swamps. The soils are predominantly weathered

Figure 1. Map of Kakooge Sub-county showing the study parishes



Source: Department of Lands and Surveys, 1962. Atlas of Uganda, first Edition. Entebbe, Uganda.

basement complex formations of the precambrian age, which consists of metamorphic and igneous rocks, composed of gneisses and granites. Marram and iron stones are relics of the older mid-tertiary surface geological processes (NEMA, 2000).

The annual rainfall varies from 875 - 1120 mm with two distinct dry seasons. The average temperature ranges between 22.6^{o}C and 24.6C. The main vegetation types are woodland, woodland savanna, thicket and soft wood plantations of mainly *Accacia-Combretum* continuum associated with *Hyperhernia*. There are cultivated patches in the woodland.

The district has a total population of 528,126 people, the population density is about 230 persons per km^2, and the growth rate is 2.7 %. The ethic groups include the Baganda (70%), Baruli (28) and others (2%).Eighty nine percent of the population are subsistence farmers (MFPED, 2000).

Data collection

The study was conducted in Katuugo, Kyehindula and Kakooke parishes in Kakooge Sub-county, Nakasongola district between July and October 2003. A cross-sectional descriptive research design employing both quantitative and qualitative methods was employed. The parishes were purposively selected because they were classified as PMA compliant (MAAIF, 2001). A two-stage random sampling technique was used to obtain a sample size of 120 respondents for focused group interviews. Participatory rapid appraisal (PRA) tools which included open-ended interviews, focused group discussions, and semi-structured questionnaire administered to the respondents. Information was collected on farmers' awareness and perception of the relevance of agricultural technologies such as agroforestry technologies, soil and water conservation, livestock multiplication technologies, and improved crop varieties. Additional information was obtained from the district National Agricultural Advisory Services (NAADS) Coordinator.

Data analysis

The data collected were entered in the SPSS version 11.0 and analysed using cross-tabulation and correlations. The Pearson Product Moment Correlation was used to show the relationship between awareness and farmers' perception of the relevance of the different technologies. Descriptive statistics were used to obtain percentages, frequencies, chi-square values and relevance indices. The relevance indices were depicted as a ratio of percentage relevance to percentage awareness. The indices were used to compare the farmers' perception of the relevance of technologies that are popular among farmers. The average of the indices among technology categories reflected the farmers' preference for the given technology.

Results

Farmers' awareness of agricultural technologies promoted by PMA

There were four major categories of agricultural technologies in Nakasongola district under PMA framework. The survey covered farmers' awareness and perception of the relevance of selected agricultural technologies Table 1.

The results showed that farmers' awareness of the technologies varied. The most popularly known technologies were: improved agroforestry fallows (92%); hedgerow intercropping (87%), vegetative practices (84%), improved simsim varieties (85%), and poultry management technology (80%). Fewer farmers were aware of clonal coffee varieties (30%), multi-storey (42%) and fish pond management (45%) technologies than agroforesty fallows, hedgerow intercropping, vegetative practices, improved simsim varieties and poultry management.

Farmers' perception of the relevance of agricultural technologies

The technologies perceived to be relevant by the farmers included: improved crop varieties (98%), livestock technologies (92%), and agroforestry technologies (82%). The soil and water conservation technologies, however, were perceived to be less relevant by the farmers.

Towards the end of 1960s, eight outstanding clones of coffee in terms of yield, bean size, vigor, and cup quality were selected. Mother gardens were established in 14 main robusta coffee growing districts including Nakasongola in 1970. By 1987 two of the coffee clones had been dropped because of high susceptibility to coffee leaf rust, leaving six clones, namely, IS/3, IS/2, IS/6, 223/53 and 258/24 (Mubiru, 1996). It was estimated that clonal coffee yields up to 3000 kg ha^{-1} of unhusked coffee beans which was more than twice the yield of traditional coffee (1200 kg ha^{-1}).

At the commodity levels the technologies perceived to be relevant by the farmers included: improved agroforestry fallow (87%), poultry management (87%), improved cassava varieties (82%), and maize (83%). Vegetative practices (12%), contour ploughing (12%), clonal coffee varieties (12%) and trash lines were perceived to be less relevant than others. The corresponding relevance indices of prefered technologies were high (Table 1). With the exception of soil conservation technologies (contour cultivation, trashlines and vegetative practices), high level awareness was associated with high levels of relevance and relevance indices. This was confirmed by results from , homegarden (1.20), improved

Table 1. Farmers' perception, use and assessment of use of selected agricultural technologies

Technologies	Awareness	Perception	
	Aware (%)	Relevance (%)	Relevance index
Agroforestry technologies (0,82)			
Improved fallow **	92	87	0.95
Hedgerow intercropping*	87	53	0.61
Multistorey	42	25	0.60
Homegarden **	50	60	1.20
Clonal coffee ^{ns}	30	12	0.40
Soil and water conservation (0.44)			
Contour ploughing*	76	12	0.16
Trash lines ^{ns}	66	18	0.27
Terraces*	78	58	0.74
Vegetative practices	84	12	0.14
Compost and green manure ^{ns}	60	53	0.88
Improved crop varieties (0.98)			
Banana**	80	73	0.91
Cassava**	75	82	1.09
Beans**	76	75	0.99
Simsim*	85	70	0.82
Maize**	74	83	1.12
Livestock technologies (0.92)			
Multiplication of goats*	74	58	0.78
Cattle cross-breeding*	68	63	0.93
Fish ponds management ^{ns}	45	42	0.93
Poultry management**	80	87	1.09
Feed grinder (350 kg per hour)	76	67	0.88

** = 0.01 level of significance, * = 0.05 level of significance, ns = not significant

Table 2. Zero-order correlation between farmers' awareness and perception of agricultural technologies

Technologies	Correlation coefficient (r)	P – Value
Agroforestry technologies	0.58	p < 0.05
Soil and water conservation technologies	0.02	p >0.05
Improved crop varieties	0.44	p<0.05
Livestock technologies	0.42	p<0.05

S = Significant at p<0.05; NS = Not significant

maize and cassava varieties (1.12; 1.09) respectively, and poultry management (1.09) were perceived to be relevant.

Discussion

The farmers' awareness and perception of the relevance of agricultural technologies has a significant impact on the rate of adoption of technologies promoted under the PMA.

According to the survey results, farmers perceived agroforestry technologies to be relevant. Farmers also prefered traditional coffee to clonal coffee because of the high levels and cost of inputs requires despite the high yields. This partly explained why a number of farmers in the study area who participated in the trial demonstrations of clonal coffee never adopted the varieties (Sserunkuma, 2003, personal communication). This contrasts with the cassava case where farmer participation fuelled the adoption of improved varieties. To use farmers' words,

> *Before clonal coffee was introduced, there was no wilt and now all we hear on radio and from extension agents is that clonal coffee is tolerant to the wilt. What a coincidence*! (Sserunkuma, 2003, personal communication).

Such misconception need to be rightly addressed by Uganda coffee Development Authority (UCDA), otherwise the future of coffee in Uganda is threatened. With regard to coffee, the UCDA needs to intensify education and extension programs to educate farmers to the benefits of clonal coffee, while at the same time addressing the risks associated with the adoption of clonal coffee.

The findings in this study also show that fish pond management technology was also not popular among farmers because the technology was new to the farmers. Fish farming was introduced to the smallholder farmers in Katuugo parish by Integrated Rural Development Initiaves, an NGO dealing in small-scale bee-keeping and fish farming. The farmers reported that fish farming required high technical skills, demands more labourer, highly perishable on harvest yet markets were not locally available.

On the other hand, several factors led to lack of awareness of soil and water conservation technologies among farmers. There was limited understanding of PMA and its objectives amongst the public, private sector and civil society; lack of appropriate micro-financing for expensive soil and water conservation structures; and slow roll-out of PMA and/or NAADS to the farmers which left some sub-counties of the district without effective advisory services regarding soil and water conservation approaches. According to Semana *et. al*. (2002), such perception was surprising especially at a time when there is increasing consciousness for sustainable environment management and efficiency in resource utilization.

Technologies on improved varieties of some arable crops are also perceived to be relevant by the farmers. These crops feature prominently in the farming systems in the study area. Our study and many others (Nabbumba, 1998; Chambers and Ghildyal, 1985) show that the farmers' perception and eventual use of any agricultural technology, practice or innovation can improve if farmers have a good understanding of the technology in respect to its contribution to the farmer's welfare. In the case of cassava the yield incentives for improved (20t ha^{-1}) compared to 9t ha^{-1} (Otim-Nape *et. al*., 1999) was considered sufficiently attractive becuase of food security and income.

The positive farmers' perception of improved crop varieties was partly explained by the "seed loan" scheme. The loan scheme involved giving farmers 0.5 kg of seed (beans, maize and simsim) to plant and pay back 1kg after harvest. The recovered seed was distributed to other farmers. About 21 tonnes of improved seed were distributed to over 100 farmers in the study area within two years and some of these farmers also shared seeds with other farmers.

In addition to the to the training programmes carried out by the extension staff operating in the district, the "graduates" of the farmer field schools were now passing on knowledge and skills to other farmers in the communities. In Katuugo parish, farmers' perception was influenced by a farmer's familiarity with the type of maize, beans or simsim. For example, farmers showed positive perception to NABE 12C bean variety which yielded six tonnes ha^{-1}. In Kyelinda parish, where climbing beans were not known, farmers preferred the variety known as WR1946 a bush type, which is drought resistant, high yielding (4.8t ha^{-1}) and has medium size seeds.

For farmers to perceive a given technology as relevant, the technology must be compatible with the farming system. Therefore, a high degree of appreciation implies that the technologies have or are compatible with farmers' farming systems and expectations (Maxwell, 1995; Biggs and Clay, 1981; Scoones, 1999). Historically, Nakasongola district is well known as a simsim producing area, accounting for 30 percent of the production. But from the year 2000, farmers in Kakooge parish experienced yield losses of 100% due to simsim root rot. On this basis, therefore, the factors to be considered in the farming systems for example labour allocation according to time and gender could strength the above explanation.

The favourable perception for agroforestry technologies could be due to the dependency on fuelwood (firewood and charcoal) for cooking and domestic heating (Jacovelli and Caevalho, 1999). Available literature shows that 90% of the low income rural population in Uganda depend on agroforestry products as sources of affordable energy for cooking and domestic heating (UBOS, 2002; MAAIF, 2001). This underscores the importance of farmer participatory approach in technology development and transfer. Through participation, farmers are stimulated to evaluate and adopt innovations that fit well within their goals and socio-economic complexity.

Farmers preferred livestock technologies especially poultry, feed grinders and mixer. This is because deep litter system of poultry production has improved welfare among subsistence farmers. The Community Integrated Development Initiatives (CIDI), an NGO had pioneered a method of improving local chickens through programmed hatching on one particular day of the week as well as cockerel exchange. Farmers were organized into groups and trained in the selection and breeding of local chickens, modern husbandry practices and improved soil fertility with manure. Much of the research into improved chicken productivity is carried out at Serere and Namulonge Agriculture and Animal Production Research Institutes (SAARI and NAARI), and Makerere University, but little information finds its way to the farmers. Therefore CIDI networked with these institutions to enable people on the ground to benefit.

Additionally, the results show that soil and water conservation approaches were not as popular and were perceived to be less relevant compared to livestock husbandry and improved crop varieties. This was attributed to the physical labour and high level of competency required to establish and maintain the soil and water conservation structures. According to Boesen *et. al.*, (2004), many farmers in Uganda have low education levels, are poor and therefore, regard soil and water conservation innovations as an extra burden on their limited family labour and other resource base.

It is not surprising that farmers' ranking of soil conservation measures as less relevant because in Uganda, traditional extension services focused on land productivitiy, crop varieties and pest control and ignored soil and water conservation (Semana *et. al*., 2002). Secondly, most villages in the study area are inaccessible, making it difficult to link research, extension and farmers. To increase farmers' awareness and perception of the soil management approaches, there should be synergetic linkages and strong partnerships in research among development agencies under PMA.

The results show no significant relationship between farmers' awareness and relevance of the agroforestry technologies, improved crop varieties, and livestock husbandry. The farmers' awareness of any technology, does not in any form affect their perception of the relevance of the technology. This is because these technologies are commonly practiced in the farming system and seem to provide for the current interests and needs of the farmers. The perception of farmers of agroforestry, crop husbandry and livestock multiplication technologies, emphasizes the need for a demand-driven technology generation as opposed to the tradition supply-driven extension philosophy.

Past studies (Boesen *et. al*., 2004; Nabbumba, 1998; Maxwell, 1995) have reported that the farmers' socio-economic characteristics such as level of education, age, farming experience and size of landholding are some of the factors that might influence perception and use of a technology. The farmers' perception may be indicative of the overall correct understanding of the technology, however, some of these technologies are new and expensive to acquire given the poor economic standards of the farmers in Nakasongola district.

Farmers are the best judges of agricultural technologies. It is crucial therefore, that they are given chance to get more involved in research processes in the NARS. The cassava case in this study clearly shows that involving farmers in the evaluation, multiplication and transfer of improved cassava varieties significantly improved their perception. This is because farmers were able to communicate what they wanted to researchers, who in turn responded by addressing the farmers' needs. Involving farmers in determining NARO's research agenda would also ensure that research is demand-driven and problem solving, thus making the research more relevant.

Conclusions and recommendations

Farmers' perception of the relevance of technologies is affected by awareness of the technology; and the relevance propels adoption. Farmers are aware of soil conservation technologies. But the awareness has not influenced perception because the perceived cost/benefit ratio is not sufficiently attractive. Agricultural research policy should enhance existing agricultural technologies since farmers' awareness of the technology significant affect their perception to the relevance of the agricultural technology. The results of this research strongly suggest that research, innovative credit schemes, market, and farmer involvement are vital components of an investment in a value chain.

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