Agroforestry practices in the buffer zone area of Mt Elgon National Park, eastern Uganda

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Abstract

In this study, we investigated the attitude of local people towards the contribution of agroforestry practices to socio-economic development in the buffer zone area of Mt Elgon National Park, Uganda. Primary data were collected through formal household survey conducted during June–October 2004 with the use of questionnaires administered to 120 households selected randomly from Mutushet and Kortek Parishes. Data were analysed using chi-squared test and logistic regression model. The results support the hypothesis that the attitude of people towards agroforestry practices is independent of existence of collaborative forest management, ethnic group, sedentary farming experience and family size but depends on main occupation, education status, distance from park boundary, damage caused by wild animals, landholding size and total livestock units owned. Factors that significantly influenced adoption of agroforestry technologies were age of the household head, education status, extension contact, family labour force and gender. There is need to intensify extension programmes in those areas where the majority of people have negative attitude towards agroforestry practices.

Key words: agroforestry, attitudes, Mt Elgon National Park

Introduction

Agroforestry is a historical practice in Uganda where people raised trees, crops and animals together traditionally on the same unit of farmland. It played an important role in livestock production, maintaining soil fertility, meeting rural energy demand (95%), controlling soil erosion and natural disasters including floods and landslide. Almost all rural farming communities depend on agroforestry for their daily needs of fodder, firewood, timber and fruits, as an integrated system (Howard, 1991). Likewise, it provides raw materials for medicine and contributes indirectly to sustainable management of forests especially on hills. Swinkels *et al.* (2002) reported the importance of planting fodder trees on agricultural fields. Farmers grow trees along the border of the agricultural farm, fallow and degraded land (Peden, 1991). Fodder trees are grown in terrace side-slopes, bunds and intercropped within horticulture, as hedgerows, as well as, in and around agricultural fields, woodlots and inside community forestry and leasehold forestry in recent years.

Local communities adjacent to Mt Elgon National Park have a long tradition of farming with trees, and fodder and agriculture as the essential components of rural livelihood (Gombya-Ssembajwe *et al.*, 2001). Tree fodder provides about 32% of all animal feed, but it is in short supply in the dry season (Howard, 1991). Presently, few farmers grow fodder trees on their farmland, the rest use agricultural by-products as a major alternative (Gombya-Ssembajwe *et al.*, 2001). Forests are an integral part of the farming system and the farmers heavily depend on forests including those in buffer zone for essential supply of fodder, fuelwood and construction materials.

Agroforestry practices can significantly contribute to maximize land use for food production as well as to soil and water conservation (Franzel *et al.*, 2001). There is need to promote agroforestry to sustain rural livelihood and to move forward in addressing the twin goals of development and conservation. Nearly 67% of fuelwood and 58% of timber consumed by the people residing adjacent to the national park comes from the forest buffer zone itself (Scott, 1998). Therefore, to keep the forest buffer zones intact, it is high time that agroforestry should be applied in the buffer zone area (Howard, 1991).

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The overall objective of the study was to assess the attitude of people towards the contribution of agroforestry practices in their farmland for their socio-economic development. The study hypothesis was that the attitude of local people towards the contribution of agroforestry practices was a function of existence of village environment committee, main occupation of the farmer, ethnic group, education status, family labour force, distance from protected national park boundary, crop damage by wild animals, sedentary farming experience, size of landholding, livestock owned and family size. An assessment of the factors influencing the adoption of agroforestry technologies in the buffer zone area of Mt Elgon National Park was carried out.

Materials and methods

Study area

Mt Elgon National Park (1°N and 34°30′E) is situated *c.* 100 km north-east of Lake Victoria on the Kenya–Uganda border. The protected area covers 2045 km^2 with 114 km^2 comprising Mt Elgon National Park on the Ugandan side. The mean annual rainfall ranges from 1500 mm on the eastern and northern slopes to 2000 mm in the south and the west. On lower slopes, the mean maximum temperatures decrease from 25 to 28°C and mean minimum temperatures are 15–16°C. The study was conducted in Mutushet and Kortek Parishes, Kapchorwa District. The two parishes were selected for the study after discussion with park authorities based on the availability of forest resources in the buffer zone.

Data collection and analysis

This study was based on primary data obtained through a questionnaire survey, key informant interviews, field observations and group discussions. The household survey was conducted between June and October 2004. The sample size for the household survey was determined using the sampling method devised by Arkin & Colton (1963). We selected one parish with collaborative agreement (Mutushet) and one without agreement (Kortek), with a sample of 60 households from each parish. Altogether, 120 households were interviewed. We further selected villages within the two parishes with different distance to the forest. Households were drawn at random from village register lists. In addition, key informant interviews were conducted with the park wardens, village environment committee and local council leaders. Secondary data were obtained from Uganda Wildlife Authority, National Environment Management Authority, National Forest Authority and Makerere University libraries.

Chi-squared tests were carried out to examine the variation in attitude towards agroforestry. High chi-squared values for association and variables that passed a 0.01 significant level were included in the analysis. If the percentage of farmers attitude towards agroforestry was higher than 75%, it was rated as high, 50–75% as moderate and below 50% as low. Respondents showing rejection, moderate support and strong support attitudes on agroforestry were assigned values 1, 2 and 3, respectively. All analyses were performed on SPSS, version 11 (SPSS Inc., Chicago, IL, U.S.A., 2001).

Conceptual model specification

Many studies have used the logistic analysis approach to examine similar issues in different agro-ecological zones and for different technologies (Alavalapati, Luckert & Gills, 1995; Adesina *et al.*, 2001).

The equation used to estimate the parameters is:

$$E(Y_i) = \alpha + \beta_1\,GND + \beta_2\,AGE + \beta_3\,EDUC + \beta_4\,MBR + \beta_5\,EXT + \beta_6\,INCOM + \beta_7\,FLBR + \beta_8\,CRDT\,\beta_9\,LSIZ + \mu_1$$

where Y_i is the dependent variable, adoption of agroforestry, α is the constant, βs are the coefficients of each explanatory variable and μ_1 are random errors. The μ_1 are unknown parameters representing the threshold values and are estimated with βs (Maddala, 1983).

In the model above, i = household (1–120) and all variables, except size of family labour force (FLBR) and size of the farm (LSIZ), are transformed into binary form. The details of cut-off values used in transforming variables into binary form (explanatory variables) were age of household head (AGE), where 1 if ≥30 years, 0 otherwise; gender (GND), where 0 if female, 1 if male; education level (EDUC), where 1 if ≥6 years of schooling, 0 otherwise; membership to farmer organization (MBR), where 1 if member, 0 otherwise; number of family labour force (FLBR); on- and off-farm income-generating activities (INCOM), where 1 if household scored ≥10 points, 0 otherwise; access to credit (CRDT), where 1 if obtained credit, 0 otherwise; contact with extension staff (EXT), where 1 if household scored 5, 0 otherwise.

Attribute	Strongly support	Moderate support	Negative attitude	Total	χ^2 calculated	χ^2 tabulated
Collaborative forest management						
Mutushet	18	28	15	61	1.94	
Kortek	25	25	9	59		5.91
Ethnic group						
Ndorobo	21	25	24	70	7.05	
Bagishu/Sabiny	18	15	3	36		9.49
Others	5	7	2	14		
Farming experience						
<10 years	6	5	5	16	5.42	
10–20 years	18	16	8	42		6.52
>20 years	22	25	15	62		
Family size						
<5 persons	9	7	4	20	1.64	
5–10 persons	26	29	12	67		9.23
>10 persons	20	24	15	59		
Main occupation						
Agriculture	27	44	15	86	28.37**	
Service	12	1	0	13		12.89
Business	5	4	2	11		
Others	5	2	3	10		
Education level						
Illiterate	6	25	16	47	27.31**	
Under primarily	18	21	6	45		9.49
>Primary level	20	6	2	28		

Table 1 Farmers' characteristics to attitude towards agroforestry (n = 120)

*10% (P = 0.1), **5% (P = 0.05), ***1% (P = 0.01) significance level respectively.

Results

Table 1 shows that the attitude of the people towards agroforestry is independent of existence collaborative forest management (CFM), ethnic group, sedentary farming experience and family labour force. The ethnic groups around Mt Elgon National Park include the Ndorobos, an ethnic community dwelling in the north-eastern part of the mountain. The Ndorobos were allowed to graze and reside inside the reserve. About 83% of Ndorobo ethnic community has negative attitude towards promotion of agroforestry as compared with 10% for Bagishu.

The results show that in Mutushet Parish with CFM agreements, few farmers (4%) strongly favoured the development of agroforestry in the buffer zone areas compared with Kortek (58%) with no CFM agreements. In Mutushet Parish, 62% of the respondents were opposed to the development of agroforestry in the buffer zone as compared with only 38% rejection in Kortek Parish.

Based on farming experience, we discovered that farmers with <10 years of farming (39%) had a strong positive attitude to promotion of agroforestry and only 17% showed negative attitude. More farmers with longer farming experience (>20 years) had a negative attitude to promotion of agroforestry (54%).

The attitude of people towards agroforestry practice is dependent on occupation, education level, distance from National Park (NP) boundary, damage caused by wild animals, landholding size and number of livestock holding. In respect to occupation, 75% of the people with agriculture as the main occupation had negative attitude towards agroforestry, whereas those in the service sector (24%) and business community (10%) strongly supported the promotion agroforestry. Similarly, about 67% of illiterate and 25% of people with education under primary level have negative attitude towards agroforestry in the buffer zone areas.

Information on farm characteristics given in Table 2 shows that people residing adjacent to the park boundary were in favour of promoting agroforestry (56%). Similarly,

Table 2 Effect of village conditions on attitude towards agroforestry (n = 120)

Attribute	Strongly support	Moderate support	Negative attitude	Total	χ^2 calculated	χ^2 tabulated
Crop damage by wild animals						
Damage	36	40	19	92	10.94**	
No damage	6	10	12	28		5.99
Distance from NP						
Bordering park	26	32	5	63	10.44**	
Distance from park	20	22	15	57		5.99
Landholding size (ha)						
<0.42	4	4	6	14	13.48**	
0.42–0.65	12	12	3	27		12.59
0.66–2.0	16	16	7	39		
>2.0	14	16	10	40		
Livestock (TLU)						
<2	18	26	16	60	11.49**	
2–5	23	27	15	65		8.24
>5	14	7	0	21		
Type of animal	Cattle	Pig	Poultry	Goat	Bird	
Conversion factor	0.70	0.30	0.02	0.10	0.05	

TLU, tropical livestock units. χ^2 tabulated ($P > 0.05$) < χ^2 calculated ($P > 0.05$), hypothesis is rejected.

people who had suffered crop damage by wild animals (86%), people with more than 0.42 ha of land and more than five tropical livestock units (TLUs) have a positive attitude towards promotion of agroforestry practices in buffer zone.

A negative attitude was shown by 25% people bordering with the park and by 75% of those residing in villages far from the park. About 55% of the people whose crops had been damaged by wild animals showed negative attitude towards agroforestry as compared with 44% of those whose crops had not been damaged.

About 25% of people with <0.42 ha land showed negative attitude towards agroforestry promotion. It was discovered that about 30% of the large landholder (>2.0 ha) supported agroforestry. The study revealed that illiterate people having <0.42 ha of land and less livestock (>5 TLUs) showed unfavourable attitude towards promoting agroforestry in buffer zone areas.

The results of the logistic regression analysis showed that, from the eight explanatory variables used in the analysis, only five had significant influence towards the adoption of agroforestry technologies. The variables with significant coefficients included: farmers' age, education, extension contact, gender and size of family labour force (Table 3). The other three variables (farmer organization, access to credit and sources of income) did not have

Table 3 Logistic regression analysis for adoption of agroforestry in buffer zone, Mt Elgon National Park

Variable	Parameter estimate	Standard error	t-ratio	Marginal effect
Constant	−0.24	1.22	−0.24	–
AGE	−2.01	1.11	−2.02**	−0.04
GND	−2.21	1.06	−2.15**	−0.05
EDUC	2.81	1.14	2.43**	0.11
MBR	−0.54	0.84	−0.56	0.18
EXT	3.31	1.37	2.49***	0.01
INCOM	−0.72	0.69	−1.06	−0.12
FLBR	1.68	0.51	2.32***	0.02
CDR	52.8	23.1	1.40	0.17

AGE, age of household head; GND, gender; EDUC, education level; MBR, membership to farmer organization; EXT, extension staff; INCOM, income-generating activities; FLBR, family labour force; CDR, access to credit. Maddala R^2, 0.32; *$P = 0.1$, (10%); **$P = 0.05$, (5%); ***$P = 0.01$, (1%) significance level respectively; correctly predicted (%) 72.

significant effect on adoption of agroforestry technologies. Contact with extension staff 'EXT' and family labour force 'FLBR' were both significant at the 1% level. Farmer's age 'AGE' has a negative effect on adoption of agroforestry ($P > 0.05$).

Discussion

The study revealed that the attitude of the people towards promotion of agroforestry practices was independent of existence of CFM, ethnic group, size of labour force and farming experience. However, the attitude was dependent on occupation, education level, distance from the national park boundary, crop damage by wild animals, landholding size and number of livestock owned by the people.

The people with agriculture as the main occupation had negative attitude towards agroforestry, whereas the positive attitude was by service holders and business people. This was expected because the farmers depend on agriculture for their subsistence and cash incomes; therefore, agroforestry would prove risky as trees would compete with annual crops. Furthermore, the farmers fear that agroforestry would lead to increased demand on the already constrained family labour force.

Statistically, the hypothesis that the attitude of people towards agroforestry practices was independent of farmer's ethnic group is therefore accepted. Similarly, the attitude depends neither on farming experience nor on size of family labour force. This finding conflicts with the perceptions that farmers' attitudes towards agroforestry differ based on their farming experiences and cultural values attached to the park resources (Scott, 1998). Traditionally, the Sabiny are pastoralist and the park was one of the areas they once lived in and grazed their livestock. The Sabiny value fodder more than the Bagisu, however, the latter have a strong cultural attachment to the park. This is due to land pressure they have been forced to extend their agricultural activities and hence encroachment.

Generally, the illiterate farmers tend to have negative attitude towards agroforestry (Jacovelli & Caevalho, 1999). In the present study, there was a general lack of awareness about the full benefits of agroforestry and sometimes farmers had bad experiences with regard to the tree tenure rights where past Forest Department policy denied the farmers full revenue from the tree crop on maturity.

The attitude towards agroforestry differed with distance from the park boundary. A negative attitude was shown by people residing in villages adjacent to the park. Farmers bordering the park reported that they incur economic losses from crop damage by wild animals. The present park management plan provides for joint village–park management committee that address the concerns of the local community as important stakeholders.

The crop damage in village bordering the park was higher than in the village that were away from park boundary. As fodder, fuelwood and grazing area are not sufficient in both study sites, people depend on the park to fulfil their human and livestock needs. This has added more pressure on the forest resources of core areas.

The finding that illiterate people having less landholding and few livestock had negative attitude towards promoting agroforestry in buffer zone areas is surprising because agroforestry helps these farmers to maximize their small land plots and supply their fodder requirements. This finding re-enforced the strong mistrust between local communities and the park officials. Some farmers believe agroforestry could be a government strategy to prohibit them from accessing park resources.

Past studies (Omregbee, 1998; Nyirenda *et al.*, 2001) reported that education is positively associated with adoption of agroforestry technologies. From our study, we discovered that formal and informal training has the potential to increase the rate of adoption by directly increasing awareness, imparting skills and knowledge of the new technology.

The age of the household head is an important factor towards adoption of agroforestry. The younger farmer has a higher probability to be an agroforestry adopter than an older farmer. This finding is supported by other studies (Jacovelli & Caevalho, 1999; Nyirenda *et al.*, 2001), who reported that a farmer's age was negatively related to adoption of agroforestry technologies.

The probability of adoption was higher for men farmers than women farmers. This can be attributed to the fact that in the rural parts of Uganda, women still do not have secure land and tree tenure because of the largely patrilineal inheritance systems (Gombya-Ssembajwe *et al.*, 2001). Similar studies conducted in Malawi (Nyirenda *et al.*, 2001) showed that the average female-headed household did not adopt agroforestry compared with the male-headed farm household.

Farmers with access to technical information through extension contact had more accurate information to do a cost–benefit analysis of the agroforestry technology. Our finding is supported by that of Adesina *et al.* (2001), who reported that adoption of any agricultural technology will be accelerated if farmers have an accurate understanding of the principles underpinning extension recommendations.

The present analysis illustrates that family labour force has a positive impact on adoption of agroforestry

technology. A typical African farm is labour demanding and families constrained with labour force are not able to practise agroforestry (Adesina *et al.*, 2001). The more the people available to work on the farm, the higher the probability of adopting agroforestry (Omregbee, 1998).

Acknowledgements

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