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Potential of agroforestry in improving livelihoods in eastern and mid-northern Uganda

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Abstract

Agroforestry can play a significant role in improving rural livelihoods and enhanced integrated management of natural resources in Uganda. To develop an agroforestry research and development strategy for eastern and mid-northern Uganda and a benchmark for measuring impact of future activities, community resource assessments were conducted in these areas between October 2002 and June 2003. The districts of Iganga, Busia, Tororo, Kumi and Katakwii were covered in the eastern lowlands agro-ecological zone, while the districts of Mbale and Sironko were covered in the eastern highlands zone. In the mid-northern agro-ecological zone, Lira district was covered. Both qualitative and quantitative data was collected using rapid rural appraisals, field observations and in depth interviews through field surveys. Results obtained from the various assessments were validated through feed back workshops involving all the major stakeholders. The study identified the current tree growing practices in the zones; tree species preferred by households and their uses; tree management practices by the households; major factors affecting tree growing by households and the potential agroforestry interventions in the zones. The opportunities for research and development in the zones are also highlighted. It is concluded that agroforestry has potential to contribute to the improvement of rural livelihoods in these areas. However, for this to happen, the involvement of farmers and stakeholders in designing agroforestry interventions is paramount.

Key words: Assessment, farmers, livelihood, local knowledge, natural resources

Introduction

Agroforestry, the growing and management of trees on farms, has been practiced by man since time immemorial and its potential to improve livelihoods has been highlighted (FAO, 2001; Alavalapati *et al.*, 2004; Garrity 2004). It is common practice for example in northern Uganda to intercrop *Cajanus cajan* with millet and simsim, while in eastern Uganda *Tamarindus indica, Mangifera indica* and *Vitellaria paradoxa* are commonly retained or planted on farmlands. However, studies conducted by NEMA (1994) indicated tremendous reduction of tree cover, insufficient supply of tree products and services in most households in eastern and northern Uganda. In addition, the review of existing literature and experience from past agroforestry initiatives reveals that little information has been documented on the potential of agroforestry in eastern and northern Uganda (Djimde and Hoekstra, 1988; Okullo *et al.*, 2004).

Generally, trees are useful in livelihood and production strategies of rural households and communities. They are a source of fuelwood, poles, fruits, medicines and timber, in addition to providing important services especially shade and windbreaks. Of particular importance, however, is their contribution to the local diets, household food security and income generation. Therefore, the growing of trees on farms has been identified as a very important production and livelihood strategy by rural communities in Sub-Saharan Africa (Muok *et al.*, 1999, Ngulube, 1995; Levasseur *et al.*, 2004). Although the potential role of trees in providing wood and non-wood products and the associated services has been identified, little information is available on their propagation, use and management by households in rural communities (Maghembe 1994; Muok *et al.*, 1999).

Current levels of deforestation suggest that the rising demand for tree products will have to be met by increased levels of tree planting (Simons *et al.*, 2000). While traditional forest plantations will satisfy some of this demand, there is likely to be a substantial increase in the planting of trees on farms. Several studies have shown that tree planting increases with increasing human population densities in continuously cultivated small farms (Patel *et al.*, 1995; Pretty *et al.*, 1995; Place and Otsuka, 1997).

Therefore to scale up the benefits of agroforestry in eastern and mid-northern Uganda, the agroforestry research and development programme of FORRI embarked on agroforestry needs assessments in these areas to identify the potential role agroforestry can play in improving people's livelihoods while conserving the natural resources. The paper presents results on the common tree growing practices; trees commonly grown or preferred and their uses and management; factors that affect tree growing on farms and the potential agroforestry interventions in these areas.

Methodology

Study areas

In eastern Uganda, the study covered the eastern lowlands agro-ecological zone (Busia, Iganga, Tororo, Kumi and Katakwii districts) and the eastern highlands zone (Mbale and Sironko districts). In the mid-northern part of the country, the study covered the mid-northern agro-ecological zone (Lira district). Table 1 summarizes the districts and the sub-counties covered during the study. Most of the population in these areas are rural (90%) and depend almost entirely on agriculture. Some parts of the eastern lowlands agro-ecological zone is an agro-pastoral system, which is based on the production of annual crops and livestock, in a mixed arrangement at subsistence level. The other parts of the zone comprise perennial crops with little livestock production. Steep slopes, soil erosion and cultivation of perennial crops such as coffee and banana characterize the eastern highlands zone. Land sizes are much smaller in this zone than in the other two zones due high population densities. The mid-northern zone is characterized by cultivation of annual crops like millet, groundnuts, simsim and maize. There is some livestock production in the zone as well.

The rural economy in these areas is predominantly small-scale subsistence agriculture largely dependent on human labour and use of simple hand tools such as hoes, machetes and ox-ploughs. Traditionally, cattle keeping was an integral part of the eastern and mid-northern zones. Over time, over grazing became prevalent which led to high competition for land use between grazing and cultivation. Today, however, the combined effect of insecurity and cattle rustling has reduced livestock populations in these areas significantly. In their struggle to survive, the impoverished populations rely heavily on the natural resource base for their livelihoods. Thus, existing woodlands have been subjected to the pressures of providing energy and construction materials for an increasing human population. The eastern lowlands zone has serious problems of soil degradation and shortage of wood and non-wood products.

Sampling strategy

After consultation with the district departments of agriculture, forestry and environment, each district was stratified into discernible agro-ecological zones based on climatic, soils and vegetation characteristics. Sub-counties were then randomly selected to represent the various agro-ecological zones identified within the district. Sampling for both the RRA and field surveys used these strata during sample selection.

Methods and tools used in the study

The study was done in three phases. First, a rapid rural appraisal (RRA) was carried out so as to narrow down the scope of the work and allow more rigorous inquiries during household field surveys. During the RRA, three tools were used, that is, focus group discussions, semi structured interviewing and preference ranking. During the exercise, one parish was identified in each selected sub-county to ease mobilization of the groups. Within a parish, informants were mobilized from several villages. One of the villages in the parish hosted the exercise at a convenient venue.

Table 1: The zones, districts and sub-counties where the study was conducted

Agro-ecological Zone	District	Sub-counties
Eastern Lowlands	Busia	Bulumbi, Dabani, Masafu, Lunyo, & Buhehe
	Iganga	Waibuga and Magada
	Tororo	Osukuru, Rubongi and Kisoko
	Kumi	Nyero, Ngora, Kapir, Kachumbala & Ongino
	Katakwii	Katakwii, Kapujan, Magoro, Kuju, & Asamuk
Eastern Highlands	Mbale	Busoba, Busano, Bunghokho, and Wanale
	Sironko	Bulago
Mid-Northern	Lira	Aputi, Muntu, Awelo, Bata, Dokolo, & Kangai

Formal household surveys verified the hypotheses drawn from the RRA and refined the information that was collected. They focused on areas that required quantitative information that had not been gathered during the RRA. When conducting the surveys, households (between 100 – 120) were randomly selected. Within individual farm-households, the head or spouse responded to the interview on behalf of the household.

The preliminary findings of these two phases were then scrutinized at a stakeholder feedback workshop. Feedback workshops presented an overview of preliminary findings to all the major agroforestry stakeholders in each district. These included farmers, local government officials, religious and opinion leaders, extension workers and private service providers. Discussions were generated on the extent to which findings were accurate and tallied with local experiences of the stakeholders. The workshops also evaluated the potential or proposed agroforestry interventions for the zones.

Data entry and analysis

Data was collected from the field using questionnaires. It was later coded and entered in computer using Ms-Excel and analyzed using SPSS. Descriptive statistics were used to derive frequencies and averages, and the results presented in summary tables.

Results and Discussion

Tree growing practices in the zones

The locations where trees are commonly found on-farm and reasons for planting them in those locations in the zones are shown in table 2. The results show that trees are commonly

grown around homesteads, mixed with crops, planted on boundaries of cropland and woodlots. In some zones such as eastern lowlands, trees are also grown in fallow and grazing lands. Generally, most tree species are grown in more than one location on the farm. *Markhamia lutea, Albizzia spp.* and *Ficus natalensis,* for example, are found around homesteads, mixed with crops or planted along plot boundaries. However, other species are grown in specific locations, for example fruit trees are mainly grown in or around homesteads, while boundary markers such as *Euphorbia trucalli, Dracaena steudneri* and *Jatropha javanica* are usually planted to demarcate boundaries between farms. Woodlots especially of Eucalyptus species were a common feature in the eastern lowland and highland zones and planted in areas not suitable for crop production.

The purposes for planting trees around homesteads included easy supervision and management, provide fruits, shade, fencing, and serve as windbreaks. The reason for mixing trees with crops included shade for crops, improve soil fertility and provide wood products such as poles and firewood. The main reasons for planting trees on boundaries were to act as boundary markers, control soil erosion and provide wood products. Woodlots are a main source of income for households from sale of tree products but also provide energy and building materials for households. In some cases trees are planted in grazing lands or areas that are being fallowed to provide shade for grazing livestock and also to improve pastures. It is clear that farmers locate trees in specific areas for particular reasons (Obua *et al* 2001; Place *et al* 1997). It is, therefore, important to take into consideration these reasons when integrating trees on farm.

Trees and their main uses

Table 3 shows the most commonly grown tree species and their uses in the eastern lowlands and highland zones. Ranking of tree use in order of importance was firewood, timber, soil conservation, poles, food (fruits), shade for crops, fodder and stakes. The tree species ranked highly for poles were *Eucalyptus spp, Markhamia lutea* and *Syzigium cuminii,* while *Cordia africana, Milicia excelsa, Albizia coriara* and *Grevilllea robusta* were ranked highly for timber production. *Calliandra calothyrsus,* Castor oil and *Sesbania sesban* were ranked highly for firewood. Others were *Cordia africana, Markhamia lutea, Syzigium cuminii, Grevillea robusta, Prunus africana* and Bamboo species. Tree and shrub species ranked highly for fodder include *Sesbania sesban, Calliandra calothyrsus, Moringa oleifera* and *Grevillea robusta,* while *Ficus natalensis, Calliandra calothyrsus, Milicia excelsa, Moringa oleifera* and *Albizia coriara* featured for soil fertility enhancement. *Moringa oleifera and Prunus africana; Ficus natalensis, Grevillea robusta* and *Cordia africana*; Friut trees, *Syzigium cuminii* and bamboo and Castor oil, *Sesbania sesban* and bamboo were ranked highly for medicine, shade, fencing, food and stakes material respectively.

Table 2: The most common locations where trees are found growing in the three agro-ecological zones.

Location or niche	Purpose for growing trees in location
Around or in homesteads	• Easy supervision and management • Serve as windbreaks • Provide shade and fencing • Provide wood and non-wood products
Mixing with crops	• Provide shade for crops • Shelter crops from strong winds (act as windbreaks) • Improve soil fertility • Provide poles and firewood
Boundaries of cropland	• Trees act as boundary markers (minimize conflicts) • Protect crops from strong winds • Control soil erosion • Provide poles and firewood
Woodlots	• Source of income • Provide poles for building • Ensure steady supply of firewood
Fallow land	• Improve soil fertility • Source of poles and firewood
Grazing land	• Provide shade for livestock • Source of fodder • Improve pastures

It is clear that most species are ranked highly for more than one use, indicating their multi-purpose nature. All respondents expressed the need to have trees grown on farms to access tree products and services. From the above table it is recommended that interventions to address natural resource management in these areas should target the priority species. The table also presents the views of the respondents about trees and it is apparent that the respondents did not highlight some of the documented uses of the trees. This calls for sensitization of the people about the unknown uses and hence creates potential for agroforestry. When designing agroforestry interventions, it is also important to clearly understand the major uses or functions that communities expect from any tree growing endeavor.

Most preferred tree species

The species preferred by gender for planting in the eastern lowlands and highlands are presented in table 4. Tree species preferred by women varied significantly from those preferred by men. The preference for a particular tree species was closely associated with the use to which the

Table 3: Tree species use ranking in the eastern lowlands and highlands

Tree species	Uses									
	Poles	*Medicine*	*Shade*	*Fencing*	*Firewood*	*Timber*	*Food*	*Soil*	*Fodder*	*Stakes*
Markhamia lutea	*1*	*5*	*5*	*5*	*2*	*3*	*5*	*4*	*5*	*5*
Eucalyptus spp.	*1*	*5*	*5*	*4*	*3*	*2*	*5*	*5*	*5*	*5*
Cordia africana	*4*	*5*	*3*	*5*	*2*	*1*	*5*	*5*	*5*	*5*
Fruits	*4*	*5*	*5*	*5*	*2*	*3*	*1*	*5*	*5*	*5*
Calliandra	*5*	*5*	*5*	*5*	*1*	*5*	*5*	*2*	*3*	*4*
Castor oil	*5*	*5*	*4*	*5*	*1*	*5*	*5*	*3*	*5*	*2*
Ficus natalensis	*4*	*5*	*2*	*3*	*5*	*5*	*5*	*1*	*5*	*5*
Milicia excelsa	*5*	*5*	*4*	*5*	*3*	*1*	*5*	*2*	*5*	*5*
Moringa oleifera	*5*	*1*	*5*	*5*	*5*	*5*	*4*	*2*	*3*	*5*
Syzgium cuminii	*3*	*5*	*5*	*5*	*2*	*4*	*1*	*5*	*5*	*5*
Albizia coriara	*5*	*5*	*5*	*5*	*4*	*1*	*5*	*3*	*5*	*5*
Grevillea robusta	*4*	*5*	*2*	*5*	*2*	*1*	*5*	*5*	*3*	*5*
Sesbania sesban	*4*	*5*	*5*	*5*	*1*	*5*	*5*	*5*	*2*	*3*
Prunus africana	*4*	*1*	*5*	*5*	*2*	*3*	*5*	*5*	*5*	*5*
Bamboo	*5*	*5*	*5*	*5*	*2*	*5*	*1*	*4*	*5*	*3*

NB: The higher the score, the less important is the tree species for the given use

Table 4: Tree species and/or shrubs preference by gender in eastern lowlands and highlands

Species	Reason for preference
	Men
Markhamia lutea	Building poles and fencing posts
Grevillea robusta	Timber, firewood
Sesbania sesban	Fodder
Calliandra calothyrsus	Fodder, soil fertility improvement
Lueceana leucocephala	Fodder, soil fertility improvement
Milicia excelsa	Timber
Maesopsis eminii	Timber
Eucalyptus species	Building poles
Fruit trees	Income generation, nutrition
Ficus natalensis	Soil fertility
Melia azederach	Building poles and fencing posts
	Women
Lantana camara	Firewood
Thevitia peruviana	Firewood
Tithonia	Firewood
Grevillea robusta	Firewood
Calliandra calothyrsus	Soil fertility
Eucalyptus species	Firewood
Fruit trees	Nutrition
Castor oil	Firewood
Croton species	Firewood

species is put. Women mostly preferred to grow fruit trees and firewood species. Men on the other hand preferred to plant trees for timber and building poles as they are a source of income. Similar findings were reported elsewhere (Arnold 1997; Fleming *et al.*, 1995; Mrema *et al.*, 2001). It can be noted that *Grevillea robusta, Eucalyptus spp.*, Calliandra *calothyrsus* and fruit trees were preferred by both men and women although the reasons for preferences differed. Interventions to promote tree growing need to consider the various uses to which trees are put by different gender categories in the household.

Table 5 shows priority indigenous tree species for various uses as ranked by households in the districts of Lira, Kumi and Katakwii. Priority indigenous fruit trees in Kumi district were *Tamarindus indica, Vitellaria paradoxa, Strychnos spinosa* and *Vitex doniana, while Vitellaria paradoxa, Tamarindus indica* and *Vitex doniana* were raked highly in Katakwii (table 5a). In Lira district *Vitex doniana, Vitellaria paradoxa* and *Tamarindus* were the most important fruit

Table 5a: Priority indigenous fruit trees in Kumi, Katakwii and Lira districts

Tree species	Species ranking in District		
	Kumi	Katakwii	Lira
Tamarindus indica	1**	2	3
Vitellaria paradoxa	2	1	2
Carrissa edulis	6	4	4
Vitex doniana	4	3	1
Ximenia Americana	-	5	7
Strychnos spinosa	3	-	5
Bridelia micrantha	-	6	-
Diospyros mespilformis	5	7	-
Annona chrysophyla	-	-	6
Rhus vulgaris	7	-	-

** The lower the figure, the more important is the species, while – means species was not ranked highly in the district

Table 5b: Priority indigenous tree species for fuelwood in Kumi, Katakwii and Lira districts

Tree species	Species ranking in District		
	Kumi	Katakwii	Lira
Tamarindus indica	2	7	-
Vitellaria paradoxa	4	3	6
Terminalia macroptera		8	4
Albizia malacophylla	-	-	2
Harrizonia abbysinica	1	-	
Combretum molle		5	7
Combretum collinum	3	1	1
Combretum frgarans	-	2	3
Acacia hockii	7	4	
Acacia pennata	6	-	
Bridelia micrantha	-	6	5
Crysopteryx febrifuga	5		

** The lower the figure, the more important is the species, while – means species was not ranked highly in the district.

species. It is clear that the priority indigenous fruit trees across the three districts were quite similar.

Priority indigenous tree species for fuelwood varied greatly between the districts (table 5b). *Harrizonia abyssinica, Tamarindus indica* and *Combretum collinum* were ranked highly in Kumi district, while *Combretum collinum, Combretum fragrans* and *Vitellaria paradoxa* were ranked highly in Katakwii district. In Lira, *Combretum species* and *Albizia malacophylla* were ranked highly for fuelwood. Tree species that were ranked highly for poles in the districts of Kumi and Lira included *Markhamia lutea, Vitellaria paradoxa* and *Senna siamea*, while *Prosopis africana, Terminalia macroptera* and *Haeria reticulata* were ranked highly in Katakwii district.

Any agroforestry interventions in these areas will need to take into account these preferred and priority species identified for farmers. Finding ways and means of mass propagation them, improved management practices on them and integrating them into cropping and livestock systems will be the major challenges in these systems.

Common tree propagation and management practices

Table 6a and 6b show the most common tree propagation and management techniques used by households in the zones. A majority of households in all the zones use seedlings, wildings and natural regeneration as the major methods of tree propagation. Very few households use stem cuttings and grafted seedlings as methods of tree propagation. This was found to be consistent across the zones. Overall 47.8, 26.0, 15.0, 7.8 and 2.4% of the households in the eastern lowlands use seedlings, wildings, natural regeneration, stem cuttings and grafted seedlings respectively (Table 6a). In the eastern highlands zone the figures were 45.5, 20.7, 13.5, 17.0 and 4.0 respectively, while in the mid-northern they were 62.0, 15.0, 10.0 3.0 and 0.0 respectively.

The major forms of tree management found in the zones were weeding of tree seedlings and pruning of mature trees. Coppicing and pollarding of mature trees were done occasionally, while root pruning of trees was not done in all the zones. Overall 50.6, 36.2, 7.6, 2.6, 0 and 85 % of the households in the eastern lowland zone managed the trees through weeding, pruning, coppicing, pollarding, root pruning and protect trees from fire and livestock respectively. Corresponding figures for the eastern highland zone were 49.0, 25.5, 19.5, 4.0 and 0.0, while for mid-northern they were 62.0, 15.0, 10.0, 3.0 and 0.0.

A majority of households use tree seedlings for tree propagation. It is imperative, therefore, that they be trained on seed collection and nursery establishment and management skills as it seems that most of the seedlings currently being planted are got free from NGO's or/and government departments. If farmers are helped to develop these skills, then there will be an element of continuity. However, a good number of households still depend on natural regeneration for tree establishment. It would be necessary to compare and refine this indigenous knowledge that households have. Grafting of seedlings for improved growth and productivity is not common among households, but it is a kill that needs to imparted to them.

The main tree management practiced by farmers is weeding and pruning of trees. However, elements like root pruning that are important when intercropping trees with crops is not performed. Assisting farmers therefore in acquiring this skill is very important in order to improve the productivity of tree/crop systems that need to be promoted.

Factors affecting tree growing in the AEZ

Lack of technical skills on tree growing and lack of planting materials were ranked highest across the zones. Drought and land shortage were mentioned in all districts but are most severe in Tororo, Kumi and Katakwii districts. Other constraints to tree growing in the zones included termites and destruction by livestock.

For agroforestry practices to be adopted by a majority of farmers in these farmig systems, it will be important to address issues on lack of knowledge on tree growing and also the lack of planting material or germplasm. This calls for intensive sensitization of the communities on tree growing, local seed collection, handling and storage. At the systems or national level, there will be needs to organize proper channels for seed supply and demand. The issues of pests and diseases also needs serious attention, especially termites that have proved to be a mjor limiting factor in tree planting efforts in these zones. Research will need to find appropriate and affordable methods of controlling termites. Some work has already started in some districts in eastern Uganda through the Agroforestry Programme of FORRI mainly on identification of termites and the testing of some indigenous methods of termite control.

There are several factors hindering women and the youth across the zones in tree growing. Women consider tree growing a man's domain, while the youth lack land and are not interested in long gestation enterprises such as tree growing. Minimal efforts in tree growing by these gender categories presents a future problem of scarcity of tree products and services if steps are not taken to encourage and support them to participate. More sensitization, therefore, is required though extension services to involve these gender groups in tree growing. The role of extension services in creating awareness on available means of production of enterprises has been underscored elsewhere (Swanson, et al., 1997; Van den Ban and Hawkins, 1996; Mulofwa et al., 1994).

Opportunities for agroforestry development in the zones

Various institutions are currently actively involved in promoting agroforestry activities in the zones. The National Environment Management Authority (NEMA) and the Mount Elgon Conservation and Development Project (MECDP) and GTZ have been the most important institutions promoting tree growing in Mbale and Sironko districts. In Tororo and Iganga districts, Africa 2000

Network has been instrumental in promoting tree growing and general sensitization on environmental protection issues, while SOCADIDO has been very active in Kumi and Katakwii districts. Apart from these institutions, there are other opportunities that exit to promote the use of agroforestry technologies in these areas. Poor soils as indicated in some districts create an opportunity of using short-term shrubs as improved fallows to enhance soil fertility. The districts of Tororo and Kumi have little tree cover which has resulted in serious shortages of tree products and services in these areas. These can be overcome by promoting agroforestry technologies such as boundary and scattered tree planting for wood and energy requirements of the households. Hilly areas such as Mbale and Sironko districts suffer from landslides, soil and water losses that have led to loss of property and low crop yields. The use of shrubs such as Calliandra and Leuceana as contour hedges offer opportunities of reducing these problems and hence increase crop productivity. The other major opportunity is the willingness of local governments to promote tree growing as an option for improving rural livelihoods in these areas. The promotion of improved tropical fruits such as mangoes and oranges in the lowland areas will greatly improve the income and nutritional status of households. Similarly, the promotion of improved tropical (avocado) and temperate fruits (apples and pears) in the highland districts will enhance the income and nutrition status of the households.

Potential agroforestry interventions

Some technologies are specific to some zones while others are general. Efforts therefore need to be made to test and validate these potential technologies in the various areas to suit the socio-economic environments of these areas. It is important to note that the use of indigenous knowledge and indigenous trees should be given priority since they are more likely to be adopted much faster than new ideas.

Conclusion

The results of this study summarize the current tree growing practices, tree species preferences, tree propagation and management, major factors affecting tree growing by households, and the potential agroforestry interventions for the zones. This information obtained from the study will is very relevant when designing suitable agroforestry packages to farmers in these zones. The existence of institutions supporting tree growing in these areas provides great potential for agroforestry development through collaborative networking. The negligence of gender as a factor in development has not spared tree growing as an enterprise. Women and youth are mainly constrained due to lack of access and control over production resources and the benefits from tree growing. Capacity building for farmers to equip them with the management and technical skills in tree growing would go a long way in creating opportunities for agroforestry development. To address the issue of inadequate planting material, there should be deliberate government policy to support the establishment and management of tree nurseries for communal supply of seedlings to the farmers at sub county, parish and village levels.

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