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Rural Livelihoods Through Hot Pepper Cultivation (*Capsicum frutescens L.*) In Agroforestry System in Kamuli District, Eastern Uganda

[1]Buyinza Mukadasi and [2]Kabi Maxwell
[1]Forestry and Nature Conservation, Makerere University, P.O. Box 7062 Kampala, Uganda
[2]National Forestry Authority of Uganda, P.O. Box 70863, Kampala, Uganda

Abstract: Confronted with problems of soil erosion and nutrient mining, agricultural lands require coherent efforts and comprehensive management plans to understand their complexities and avert degradation process. In this regard, sustainable farming alternatives like agroforestry that conserves soil, minimizes land degradation and improves living condition of resource poor farmers are required. Hot pepper (*Capsicum frutescens L.*) is cultivated widely in Uganda as an agricultural crop either in an open field or in the agroforestry system. Hot pepper is a cash crop, which generates income to the farmers because of its multiple use and high demand in the market. A cost-benefit analysis of hot pepper cultivation under agroforestry farming system was carried using the rapid rural appraisal method and field observation between June to December 2004 in Kamuli district, Uganda. Grevillea (*Grevillea robusta)* was selected as the tree crop and hot pepper, maize (*Zea mays L.*) and beans (*Phaseolus vulgaris L.*) as agriculture crops intercropping. Based on the cost-benefit ratio it was found that hot pepper was the most profitable cash crop in comparison to monocultural beans and maize production. Our results suggest that although the price of hot pepper is variable, it can be grown as a cash crop which can contribute to the rural livelihoods and poverty reduction in Uganda.

Key words: Agriculture, agroforestry, farmers, livelihood, Uganda

INTRODUCTION

Limited land holdings and preferences to cereals to fulfill the immediate basic needs along with shortage of rural labor due to migration to cities has raised critical issues at local farm management level. Trees farmland has affect production of cereals by competing with soil nutrients, light and water resources influencing the livestock productivity and thereby livelihood of the hill farmers. Thus agroforestry systems with increased productivity to fulfill local food demand and to provide employment opportunities and income generation should be the vision of agro-forestry in Uganda. Secondly, depletion of soil fertility is widely accepted to be the most widespread serious biophysical constraint to food security in sub-Saharan Africa (Jama *et al*., 1997). Many soils are inherently depleted and require good management of frequent moderate amounts of organic and inorganic inputs (Maxwell, 1995).

In response to the problem, a number of soil conservation and fertility replenishment measures have been developed and promoted, including agroforestry technologies. Agroforestry has the potential to make a long- and short-term contribution to farm production. Studies in other parts of Africa and beyond have demonstrated the economic and agronomic returns of agroforestry practices such as short-term improved fallow (Siriri and Bekunda, 2001).

Agroforestry technologies can make significant contribution towards addressing high levels of poverty and associated land degradation in the east and central Africa region (Franzel and Scherr, 2001). In Uganda, agroforestry is an essential component for developing sustainable agricultural systems, especially in tropical countries of the world with a multiple objectives like maximizing productivity, creating jobs and income in rural areas and safeguarding sustainability (Place and Dewees, 1999). Trees are introduced into agricultural production systems to decrease soil erosion, maintain soil moisture and produce useful products such as fuelwood, nuts, fruits and building materials for the rural household and commercial markets.

Raising agricultural productivity remains the most patent force for reducing food insecurity. Higher production and productivity on farmlands enhances household food security (Siriri and Bekunda, 2001).

Corresponding Author: Buyinza Mukadasi, Forestry and Nature Conservation, Makerere University, P.O. Box 7062 Kampala, Uganda

However, poverty constrains the ability of farming households to invest in productive assets and agricultural technologies. Moreover, poor market systems result in high costs of inputs and low prices for farm outputs, providing poor economic incentives for farmers to invest in yield-enhancing sustainable agricultural production systems. Moreover, for both rural and urban Ugandans, stable access to food through the market requires that the food marketing system is effective in supplying food, while also providing benefits to farmers who have food to sell (Place and Dewees, 1999). Yet efforts within agriculture alone, if conducted in isolation from activities in other sectors such as marketing, health and education, will not bring food security to the many under-nourished Ugandans.

People have been planting it under the shade of natural, planted forest as well as under shade of other trees. Grevillea is a fast growing multipurpose species, which can be grown easily on the sloppy erosion prone areas as it also binds soil, gives optimum shade, increases fertility, retains soil moisture, grows fast and used as fuelwood and timber (Franzel and Scherr, 2001).

Hot pepper locally known as *Kamulali* cultivation under agroforestry systems, is extensively practiced in eastern and western highlands as well as in the central Uganda (Franzel and Scherr, 2001). Hot pepper is an important crop grown for its aromatic rhizomes, which are used both as a spice and a medicine. It is cultivated over the greater part of the tropical parts of East Africa. In Buzaya County, hot pepper is cultivated usually under planted trees mainly *Grevillea robusta*, *Eucalyptus* sp. (kalitunsi), *Markhamia lutea* (omusanvu), *Erythrina abyssinica* (ekikoo) and *Ficus natalensis* (ekikooma), Hot pepper cultivation has been adopted by majority of people in the areas since 1980s. It has been found to grow well as an integral part of traditional farming system (Franzel and Scherr, 2001). Out of the potential tree species grown on cropland in the study area, *Grevillea robusta* + *Ficus natalensis* + hot pepper was purposively selected for this study. This reasoning being that other combinations, for instance, *Eucalyptus* + *Markhamia lutea* + hot pepper intercropping has not equally been successful from the productivity point of view. Secondly, farmers prefer *grevillea* because it is a multipurpose tree crop that provides farmers with multiple functions such as provision of fuelwood, timber, fodder, cash incomes and as a soil fertilizer (Okorio and Kasolo, 1996).

There are no standard cultivars of hot pepper in Uganda (Maxwell, 1995). The pool of all Chile cultivars comes from five species of the genus Capsium: C. annuum, C. Chinese, C. baccatum, C. frutencens and C. pubescens (Otim-Nape *et al*., 1999). It is extremely difficult to maintain purity of any cultivar for a long time. The crop is mainly raised from farmer-saved seed. The two major cultivar groups of hot pepper grown in the country are bird eye hot pepper group which represents the most pungent hot pepper grown for the fresh market as well as for processing into dry hot peppers. The fruit size is rather small, 2-3.5 cm long and, Indian group characterized by a dark green type of hot pepper fruits highly adaptable to hot and humid areas (Otim-Nape *et al*., 1999). The fruit length reaches 5-10 cm and this group is popularly referred to as red pepper. This study dealt with the latter type, namely the red pepper. The objective of this study, therefore, was to investigate the economic viability of hot pepper cultivation in Agroforestry System in Kamuli district, Uganda.

MATERIALS AND METHODS

Description of study area: Buzaya county lies between latitude $0^{0}09^{l}$ and $0\ ^{0}11^{l}$N and longitude $31^{0}50^{l}$E. Annual rainfall varies from 900-1200 mm with two marked dry seasons and the average temperature ranges between 22.6 and 24.6°C. Buzaya county was selected because it has characteristics typical of the diverse social, economic, rural and urban setting found in the Busoga region. Population density is about 230 persons per km^2 with a growth rate of 2.3%. Subsistence agriculture is the major economic activity employing about 84% of the population (UBOS, 2002). The bulk of agricultural production is from manually cultivated rain-fed crops and inter-cropping systems is a prevalent practice (UBOS, 2002).

With the decline in commodity prices of the principal cash crops such as coffee, farmers are increasingly viewing timber and aromatic crops such as hot pepper as viable cash generating enterprises (Otim-Nape *et al*., 1999).

Data collection: A household survey and in-depth studies were conducted in the three parishes of Bugulumbya, Kasambira and Nawandhyo of Buzaya County. The primary data based on the questionnaire were collected using Rapid Rural Appraisal (RRA) method and field observations carried out between June to December 2005. One focused group discussion, which took place in the form of a workshop, was used to collect qualitative data. Semi-structured, closed and open-ended questions were used during the discussions. Some key informants and particularly those farmers involved in pepper intercropping, were consulted to collect information on cultivation, production, income and marketing of hot pepper. To conclude the discussions, a transect walk was taken across the cropping fields and

other places where hot pepper is grown. To make a comparison, data on price of different agricultural produce, labour and transportation was obtained for the year 2000 from the district agricultural office.

Soil sampling and analysis: Soil samples (15 cm topsoil) from five locations, four from corners and one from the centre in the selected plots were taken with the help of a soil auger. These five samples were mixed and composite samples were made. Altogether 10 composite soil samples were analyzed by standard methods in the laboratory (Maxwell, 1995). Hydrometer was used for soil texture analysis, Digital pH meter for determination of pH, Kjeldahl for Nitrogen, Colorimeter for Phosphorous and Spectrophotometer for other nutrients.

To maximize benefits, some farmers add organic matter before transplanting. One commercial farmers had applied fertilizers at the rates of 60-100 kgs Nitrogen, 10 kgs phosphorous, 100 kg potash and had got over 4 tons ha^{-1} in the previous season.

RESULTS

From household perspective, the adoption of any technology depends on whether the returns from new initiatives are greater than the existing practices. The experience shows that introduction of location suitable agroforestry and intensification of traditional farming practice to improve income is economically viable. Farmers have been practicing different systems and combinations that are more productive and compatible to the area specific farming systems in the hills. Practices adopted by the farmers have been helpful for soil conservation and fertility improvements.

Soil properties: Result of analysis of soil samples revealed five different types of soil in the area as follows: Sands, gravel, boulders, excessively drained soil; moderately drained soil; grey brown sandy loam, sandy loam, slightly calcareous soil and sandy loam, loamy sand over sand, excessively drained, calcareous soil. The chemical analysis of the soil samples gave the following results: pH = 4.7 - 7.0, Phosphorus (P) = 16 - 69.9 ppm, Nitrogen (N) = 0.1 - 0.25%, Carbon (C) = 1 - 1.3%, Calcium (Ca) = 1.5-12 meg 100^{-1} gm and Potassium (K) = 1-0.5 meg 100^{-1} gm.

Comparison of hot pepper cultivation with other crops under agroforestry farming system: Agroforestry system being practiced in Buzaya County was agri-silviculture system. The major agricultural crops grown were maize and beans raised as intercrops in farming systems together with trees (Buyinza *et al*., 2005). Most hot pepper production in Uganda is mainly rain fed. If natural rainfall is lacking, supplementary irrigation is required. To achieve maximum production, the pepper plant should have sufficient moisture during fruit setting (Andrews, 1984; Icraf, 1989). The average yield of these commonly raised agricultural crops is given in Table 1-3 to compare with hot pepper cultivation (Table 4) and to judge in terms of yield and its economic viability.

Maize production: Maize is one of the major food crops grown in the study area and adjoining villages. It is widely cultivated with traditional techniques of seed sowing during rain season mostly using self-saved seed and labor. The average maize production under agroforestry system was found to be 1.03 ton ha^{-1} during the first and second year of plantation of Grevillea. The costs of production and benefit of maize cultivation (ha^{-1}) in the year 2000 and 2005 are given in Table 1.

Beans production: The area after maize harvest was manually cultivated with mixed cropping of beans. The maize and beans production and the actual costs of for year 2000 and 2005 are presented in Table 2. The net profit

Table 1: The cost of production and revenue from maize cultivation (Shs ha^{-1})

			Rate	Cost	Rate	Cost
S.N	Particulars	Quantity	2000	2000	2005	2005
1	Removal of tree	20 ma^{-1}-days	1000 man^{-1}-day	20 000	1000 man^{-1}-day	20 000
2	Seed	15 kg	150 kg^{-1}	2 250	240 kg^{-1}	3 600
3	Light weeding	8 man-days	800 man^{-1}-day	6 400	800 man^{-1}-day	6 400
4	Harvesting, plucking	20 man-days	1000 man^{-1}-day	2 000		
	1200/ man-day	24 000				
5	Transportation - bicycles (3 km)	10 trips	7500/ trip	75 000		
	10,000/ trip	10 000				
6	Threshing	15 man-days	1000/ man-day	15 000		
	1,500/ man-day	10 000				
	Total cost			120 650		164 000
7	Average	2200	350 kg^{-1} (local		460 kg^{-1} (local	
	production	kg ha^{-1}	market price)	770 000	market price)	1 012 000
	Benefit			649 350		848 000

Table 2: Cost of production and revenue from beans cultivation (Shs ha^{-1})

S.N	Particulars	Qty	Rate 2000	Cost 2000	Rate 2005	Cost 2005
1	Seed	10 kg	450 kg^{-1}	4500	500 kg^{-1}	5000
2	Site prep, weeding and thinning cost	-	-	-	-	-
3	Harvesting	5 man-day	1000 man^{-1}-day	5000	1000 man^{-1}-day	5000
4	Transportation by bicycle	4 trips	1000 $trip^{-1}$	4000	1500 $trip^{-1}$	6000
5	Threshing by labors (cost)	4 man-days	1000 man^{-1}-days	4000	1200 man^{-1}-day	4800
6	Total cost			17500		20800
7	Av. production (Stumpage Price)	1500 kg ha^{-1}	500 kg^{-1}	750000	650 kg^{-1}	975000
	Benefit			732500		954200

Table 3: Comparison of annual profit per ha from cultivation of maize and beans between 2000 and 2005 (Shs.)

Crop production	Gross profit in 2000	Net profit in 2000	Gross profit in 2005	Net profit in 2005
Maize 2 200 kg	770000	649350	1012000	848000
Beans 3 000 kg	750000	732500	975000	954200
Total	1520 000	1381850	1987000	1802200

Table 4: The cost of production and benefit of hot pepper cultivation (Shs ha^{-1})

S.N	Particulars	Qty	Rate 2000	Cost 2000	Rate 2005	Cost 2005
1	Seed	100 kg	180/kg	18000	260/kg	26000
2	Site preparation, weeding and thinning cost	15 man-days	800 man^{-1}-day	18000	260 man^{-1}-day	26000
3	Harvesting	10 man- days	1000 man^{-1}-day	10000	1000 man^{-1}-day	15000
4	Transportation by bicycles	5 trips	5000 $trip^{-1}$	25000	1000 $trip^{-1}$	50000
5	Sowing	40 man-day	1200/man- day	48000	2000/ man-day	80000
6	Total cost	118 000		180000		
7	Av. production (Stumpage price)	4000 kg ha^{-1}	450 kg^{-1}	1800 000	600 kg^{-1}	2 400000
	Total			1 682 000		2 220 000

Table 5: Benefit-cost ratio of different crops for single harvest and combination of maize and beans grown on the same piece of land (Shs.)

	Benefit						B/C Ratio			
	Total cost		Total		Net		Absolute		Net	
Crops	2000	2005	2000	2005	2000	2005	2000	2005	2000	2005
Maize	120 650	164 000	770 000	1 012 000	649 350	848 000	5.38	6.17	5.38	5.17
Beans	175 000	208 000	750 000	975 000	732 500	954 200	4.25	5.57	4.18	4.85
Total	1 381 850	184 800	1 520 000	1 987 000	1 381 850	118 000	1.09	10.75	1.01	0.63
Hot pepper	118 000	180 000	1 682 000	2 400 000	1 682 000	2 220 000	14.25	13.33	14.25	12.33

from the combination of intercropping with maize and beans under agroforestry systems was Shs. 1 381 850/= and Shs. 1 802 200/ = in year 2000 and 2005, respectively (Table 3). Thus, there was an increase by 30 percent in net profit from the combination of intercropping in year 2005 as compared to year 2000.

Hot pepper: Estimated hot pepper production and the actual costs of production ha^{-1} in year 2000 and 2005 are given in Table 4. These results show that the cost of production increased from Shs. 118 000-Shs. 180 000 and the benefit rose from Shs. 1 682 000-Shs. 2 220 000 for the year 2000 and 2005, respectively.

Benefit-Cost Ratio (BCR): The yields of all the crops vary considerably depending on a number of factors. The average expected yield is 4-6 tonnes per hectare. Hot pepper cultivation provided highest net profit of Shs. 1 682 000 ha^{-1} in year 2000 as compared to Shs. 2 220 000 ha^{-1} in year 2005 followed by single crop of maize (Shs. 649 350 ha^{-1} and Shs. 848 000 in year 2000 and 2005, respectively) and beans (Shs. 732 500 ha^{-1} and Shs. 954 200 in year 2000 and 2005, respectively). The total net profit from the cultivation of maize and bean in the same land was Shs. 1 802 200 ha^{-1} in year 2005 as compared to Shs. 1 381 850 ha^{-1} in year 2000.

The BCR has been analysed in absolute and net ratio. Benefit-Cost Ratio in both absolute and net values for maize and beans and combination of these crops and hot pepper cultivation have been presented in Table 5. The net value of hot pepper was highest with 14.25 in year 2000 as compared to 0.01 for all crops together, 5.38 for maize and 4.18 for beans. As the cost of investment increased in year 2005, the net BCR for hot pepper and all crops together decreased to 12.33, 5.17 and 4.85, respectively.

DISCUSSION

This study showed that the yields of all the crops vary considerably depending on a number of factors. According to the National Agricultural Research Organization, the average expected yield is 4-6 tonnes per hectare (NARO, 2001). The BCR of beans was found to be highest in both absolute and net terms when compared with other crops for a single harvest of each and total for all crops. It was observed that despite the lack of during the dry seasons which led to flower abortion, the average production was found to be economically viable.

Soil analysis results showed that the well drained sandy loam or loamy sand was good for the production of hot pepper in the agroforestry system. There was no significant difference among soil nutrients and their effect on pepper production. Clearly, the soils in the study area have very a good potential for tree growth (Nabbumba, 1989; Maaif, 2002). It was of interest to note that despite their excessive drainage properties, these soils also favor growing of a wide range of agricultural crops in the study area. Production can be further developed if good cultivars are identified and quality seed is made available to traditional areas (Semana *et al*., 2002). In Uganda, hybrid pepper has been only partially successful due to the high price of seed and low pungency (NARO, 2001). The farmers indicated no availability of planting materials from national research organization and the main supply of seeds are farmers themselves, however, of recent germplasm collections are maintained by the Kawanda National Agricultural Research Institute (Maaif, 2002). Ongoing breeding programs are mostly for yield, earliness, pungency, flavour and colour (Otim-Nape, 1999; Byerless *et al*., 1982). With an extended harvesting period of 8 months, farmers still have to rely on old seeds.

It is granted that this present study, did not explore the nutritional value of hot pepper, however, farmers identified nutrition security as an important factor when considering the crop combinations on their farmland. There is need to reduce the health burden at the individual and household level arising from food and nutrition insecurity. The economic burden of malnutrition on the household has far reaching national effects as the preventable problem of malnutrition translates into reduced aggregate economic productivity, reduced intellectual capacity and general human capital erosion, increased cost of care and increased demand for health services (Buyinza *et al*., 2005). Food and nutrition insecurity fundamentally undermines efforts to meet the vision of the Poverty Eradication Action Plan (Maaif, 2002; Buyinza *et al*., 2005). It is in view of comprehensively addressing these problems that the Food and Nutrition Strategy and Investment Plan is needed.

The present study also shows that hot pepper requires partial shade for better growth and yield and therefore, the agroforestry system provides an ideal condition for hot pepper cultivation (Bosland and Votava, 2000). However, the farmers realize that there is no difference in monoculture and intercropping of hot pepper, with respect to yield due to high manure requirement of crops for better production. From the focused group discussions, farmers reported identified crop compatibility as a major consideration that farmers use to decide crop mixtures on their farmland. The farmers reported that they do less weeding when multiple cropping is practised as against sole cropping. Intercropping of grevillea and hot pepper helps to reduce the menace of weed infestation that is responsible for low yields (NARO, 2001; Maaif, 2002).

The cost-benefit ratio was better for intercrops than for those planted alone. It is concluded that with appropriate crop management, optimal crop production could be obtained. Intercropping benefits the short cycle crops, since agroforestry tree species protects them from heavy intense rains and winds and also some management practices and some inputs are shared by both the crops, so costs are reduced.

The present study has shown that it is difficult to attach a monetary value to all the ecological and economic services and products obtained from agroforestry intercropping since few products are traded in the market. However, we believe that if accurate pricing is carried out using suitable proxy methods, then it is likely that the value from the hot pepper with grevillea intercrop would more than double the farmers incomes. Past studies have demonstrated that on-farm tree farming provides a variety of indirect products and services such as fodder, firewood, tanning flowers, medicines, dyes, bee forage, stakes and soil fertility improvement, soil erosion prevention and shade provision (ICRAF, 1989; Bosland and Votava, 2000).

The marketing of hot pepper is done in two ways viz. through the middlemen or sometimes traders directly collect hot pepper from farmers' fields (Andrew, 1984). Also sometimes, farmers themselves carry hot pepper on bicycles to the nearby market points on Jinja-Kampala Highway. From these markets, hot pepper is distributed to bigger markets like Kampala and Jinja. Small scale hot pepper producing farmers sell it in the local weekly markets. The price of hot pepper at field is lower than the market because of transportation, loading, unloading and other relevant costs associated with transportation to market areas.

The farmers sell their hot pepper mostly to assemblers, or at the local assembly markets (which are mostly held in villages along road side). Direct selling of pepper to consumers is only possible on small scale. Most big consumers buy only from assemblers because of the economies of scale of buying large volumes. This is because local demand for hot pepper is very limited, farmers sell their product to local assemblers, or at an assembly market. The assemblers sell hot pepper mostly to rural industries, because the profit of selling it to urban buyers is on average lower. The urban buyers may be industries, or market sellers who act both as wholesalers and retailers. Few urban market seller are involved directly in the transportation of their purchases from the assemblers in the production area.

CONCLUSION

Agroforestry makes it possible to grow different plant species which can be used as fuel wood, fodder, food supply and regenerative alternative energy at farm level to substitute fuel wood from forest, agricultural residues and animal waste that are being used as energy sources. Similarly, promotion of different species including aromatic plants is a potential source of farm income. Modification of management options, inclusion of cash crops and modification of the technology to suit to local biophysical and socio-economic conditions should be considered. In view of escalating agricultural intensification and population growth threatening the productivity of farming systems, promoting use of cash-earning fodder species and alternative sources of farm income will contribute considerably towards sustainable economic development in the hills.

This study showed that total revenue from hot pepper is a function of production and price. Market price of both fresh and dried hot pepper is very fluctuating. Hot pepper cultivation under agroforestry system should be encouraged rather than monoculture growing of either maize or beans. The agroforestry intercropping system ensures maximum benefit from the unit of land and to fulfill other basic needs like fuelwood, timber and construction poles.

Although the price of hot pepper is variable, it has gone up very high in the last 5 years in the market due to high demand. Therefore, it can be grown as a cash crop which can contribute to the livelihood and poverty reduction in Uganda. A cooperative society of ginger cultivators should be formed in order to provide maximum benefit to the cultivators rather than middlemen. There should be direct interactions between producers and consumers or traders.

Limited as it is in sample size and breadth, the present study forms a stepping stone for future agroforestry studies involving hot pepper cultivation with other annual crops. Ultimately, such studies are likely to help in understanding the contribution of agroforestry practices to the national goal of poverty reduction and food security. It is recommended that agronomic investigations into cultivation of hot pepper as an agroforestry enterprise be undertaken. Those studies could contribute significantly in government policies to improve food security in rural areas and in poverty reduction. Further research is also required to explain whether or not the trend found in this study can be statistically confirmed.

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REFERENCES

Andrews, J., 1984. Peppers: The Domesticated Capsicums. University of Texas Press, Austin, Texas.

Bosland, P.W. and E.J. Votava, 2000. Peppers: Vegetable and Spice *Capsicumic*. Crop production in horticulture. CABI Publishing, United Kingdom, pp: 74-94.

Buyinza, M., S. Kizza and M. Nabalegwa, 2005. Multiple cropping pattern and domestication of woodland fruit tree species to improve household food security in Nakasongola district, Uganda. Uganda J., 50: 57-68.

Buyinza, M., M. Nabalegwa and M. Bukenya, 2005. Information Communication technology use pattern by women tree farmers in Buzaya county, Kamuli district, Uganda. Uganda J. Agric. Sci., 11: 26-33.

Byerless, D.L., L. Harrington and D.L. Winkleman, 1982. Farming System Research: Issues in Research Strategy and Technology Design. Am. J. Agric. Econ., 64: 897-904.

Franzel, S. and S.J. Scherr, 2001. Trees on the farm; Assessing the adoption potential of Agroforestry Practices in Africa. CABI Publishing, Willingford. USA.

ICRAF. International Council for Research in Agro-forestry, 1989. Viewpoints and issues on agro-forestry and sustainability. Nairobi, Kenya.

Jama, B., A. Swinkels and R. Buresh, 1997. Agronomic and economic evaluation of organic and inorganic sources of Phosphorus in Western Kenya. Agron. J., 89: 597-604.

MAAIF. Ministry Of Agriculture, Animal Industries and Fisheries. 2002. National Agricultural Advisory Services; Master Document of the NAADS Task Force, Entebbe. Uganda, pp: 32-39.

Maxwell, D., 1995. Alternative Food Security Strategy: A Household Analysis of Urban Agriculture in Kampala. World Dev., 23: 1669-1681.

Maxwell, D., 1995. Alternative Food Security Strategy: A Household Analysis of Urban Agriculture in Kampala. World Dev. Rep., 23: 1669-1681.

Nabbumba, R., 1998. Promoting productivity and competitiveness of African agriculture: A Profile of Ugandan Agriculture. Economic Policy Research Centre. Kampala, Uganda, pp: 7-38.

NARO, 2001. National Agricultural Research Organization, Uganda, 2001. Outreach and partnership initiatives: A strategy for decentralization and Institutional learning. Entebbe, Uganda, pp: 1-120.

Okorio, J. and W. Kasolo, 1996. Agroforestry in Uganda: Proceedings of National Workshop on Agroforestry in Uganda. Mukono District Farm Institute. ICRAF, Kampala, Uganda.

Otim-Nape, G.W., A. Bua, G.N. Ssemakula, Y.K. Baguma and G. Acola, 1999. Impact of a Century of Cassava Research and Development on the Economy and Well-being of the people of Uganda. Namulonge Research Station, Uganda.

Place, F. and P. Dewees, 1999. Policies and incentives for the adoption of improved fallows. Agroforestry Sys., 47: 323-343.

Semana, A.R., R. Percy and R. Kibwika, 2002. Sharing experiences on participatory technology development. International Rural Development Department, University of Reading, United Kingdom, pp: 108-132.

Siriri, D. and M.A. Bekunda, 2001. Soil fertility Management in Uganda: The potential of Agroforestry. AFRENA, Kabale, Uganda.

Thomas, G.W., 1982. Exchangeable cations. In: AL Page (Ed). Methods of soil analysis: Chemical and microbiological properties. ASA Monograph, 9: 159-165.

UBOS Uganda Bureau of Statistics, 2002. Population and Housing Census. Kampala, Uganda.