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Socio-economic importance, structure and indigenous management of woody perennials in the homegardens of Mpigi District, Uganda

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Abstract

Homegardens are a form of agroforestry in which multipurpose woody perennials are grown together with agricultural crops and livestock is kept on the compounds of individual homes. A study was carried out in Nangabo and Kira sub-counties of Mpigi district to assess the species composition, diversity, structure, socio-economic importance and indigenous management of woody perennials grown in the homegardens. Data were collected from 150 farmers using a semi-structured questionnaire and on-farm survey. It was found that more than 70% of the farmers planted or spared woody perennials in their homegardens and depended on them for nutrition and income. Farmers who practiced homegarden agroforestry owned land under the *mailo* or free hold land tenure system and the size of land holding varied from 0.1 to 4.2 ha per individual. Eighty three species of woody perennials were recorded in the homegardens and these were mainly trees and shrubs grown for provision of fruits, timber, building poles, craft materials, fibres, medicines, firewood, fodder and shade. The plants were grown for both subsistence and cash. The indigenous management practices of the homegardens included use of wood ash to control agricultural crop and tree pests, pruning and pollarding of trees and shrubs to stimulate flowering, increase fruit yield and reduce the effect of shading on the agricultural crops, and improvement of soil fertility by incorporating animal waste and crop residues into the soil.

Key words: homegardens, woody perennials, structure, indigenous management

Introduction

Woody perennials are common in the homegardens of Uganda. They include trees and shrubs whose stems and/ or branches are lignified into woody structures. Woody perennials are mainly grown in homegardens for subsistence although the surplus products can be sold or bartered (Gradnohl and Greenberg, 1988). Environmental and socio-economic factors, market demands and the need for food determines the choice of species planted or protected in the homegardens. Generally, farmers plant or protect woody perennials for provision of food, medicine, fodder, fuelwood, timber, fibre, shade, windbreaks, handcrafts and construction materials (Soemarwoto, 1987; Olayiwo, 1988).

Homegardens represent the interaction between Man and the environment as well as between demand and availability of resources in a given area combined in a sustainable production pattern on the same piece of land (Beets, 1989). It is a land use system in which multipurpose trees and shrubs are grown in association with annual and perennial agricultural crops and livestock on the compounds of individual homes (Puvanseway, 1997). As such, it is a form of traditional agroforestry, which permits ecological interactions between woody and non-woody components. Homegardens evolved over time under the influence of resource constraints such as population pressure, land scarcity, decrease in capital and labour and physical limitations such as lack of transport and market outlets for farm products (Fernandes and Nair, 1986). According to Alvarez et al. (1989), homegardens are sinks for nutrients from organic wastes such as farm yard manure, optimise capture of solar energy in a multistratified vegetation structure and allows growth, reproduction and regeneration of wild species. The structure of homegardens depends on land size, species composition, species diversity and cropping pattern (Ninez, 1985).

It is clear from literature that studies of homegardens have concentrated mainly on ecological interactions between plants and animals (Nair, 1993), light utilization by plants (Torquebian, 1988, soil conservation (Hoekstra, 1985) and the composition and structure of plants (Oduol and Aluma, 1990). The indigenous management and contribution of homegarden woody perennials to household livelihood remains relatively obscure and little

documented. Yet homegardens are important for genetic conservation of indigenous plants, maintenance of ecological stability and preservation of culturally valuable plants. In view of the above, a study was conducted between June 1999 and January 2000 in Mpigi District, central Uganda, to provide information on the socio-economic importance, structure and indigenous management of woody perennials which are cultivated and or naturally grown in homegardens. Such information is needed for planning agricultural development and improving the livelihood of small-scale farmers. The objectives were to (1) document the composition and structure of homegardens (2) assess the socio-economic importance of woody perennials and (3) document the indigenous methods of homegarden management.

Methods

One hundred and fifty farmers in Nangabo (a rural sub-county) and Kira (a peri-urban sub-county) were interviewed and their homegardens surveyed. A technique developed by Casley and Kumar (1992) was used to choose the sample frame and farmers were selected from the local tax register with the assistance of Local Council Chairpersons. A semi-structured questionnaire was administered to the farmers to collect information on the demographic and socio-economic profile, land tenure and use, woody and non-woody components of the homegardens, products obtained from the woody perennials and their economic importance, and indigenous management of the homegardens.

Guided farm walks and direct observations were used to cross-check the information collected during the interviews. Profile diagrams showing the vertical and horizontal structure of the woody perennials along transects (25 m long) laid in the homegardens were drawn. Two sample plots (each 25 x 25 m) were established along each transect and all woody plants identified and counted for computation of woody species diversity index. The local, common English or botanical name of each plant was recorded. Data were entered in SPSS and Minitab computer programmes and analyzed using simple linear regression, Z and t-tests. Woody species diversity index was computed using Simpson's diversity index (Magurran, 1988). The reciprocal of each diversity index was derived to show how the index increases with species diversity (James and Shuggart, 1970).

Results and discussion

Demographic and socio-economic profile of the farmers

It was found that in Nangabo sub-county 33% of the farmers were male and 67% were female whilst in Kira sub-county 37.3% were male and 62.7% were female. Forty percent of the farmers were aged between 36-53 years and 90% had formal education. Fifty five percent of the farmers in Nangabo had secondary education and 55% in Kira had primary education. There was no significant difference in the number of farm households headed by male and female (Table 1). On average, there were five people per household and, according to NEMA (1998), this figure has remained stable for the last three decades. In Kira sub-county, the size of the household was positively related (R=0.046; P=0.065) to the educational background of the farmers. This observation is important because according to Andersen (1994), the size of a household determines the ability to satisfy the basic needs, and educational background determines the ability of members of that household to gain employment outside agriculture. It was also found that over 70% of the farmers depended on farming as the main source of income and engaged in other enterprises such as small-scale retail trading, tailoring, brick making, brewing and selling of local beer, bicycle maintenance and shoe repair for additional income.

Land tenure and use

Land in Nangabo and Kira sub-counties is held either under *mailo* or *freehold* land tenure systems. *Mailo* is a Luganda word for 'mile' and *mailo* land refers to the holding of registered land, which is restricted to allotments introduced by the Buganda Agreement of 1900. Freehold land refers to holding of registered land in perpetuity subject to statutory and common law regulations (Government of Uganda, 1998).

The size of land holding varied from 0.1 to 4.2 ha per household and the average land holding was significantly smaller in Nangabo than in Kira (Table 1). Land is acquired through inheritance, renting or purchase. According to Nair (1993), the average size of homegardens is usually less than one hectare because of the subsistence nature of the farming practice. There was a weak but positive relationship (R=0.26; P=0.01) between the size of land holding and size of household in Kira but not in Nangabo.

Eighty per cent of the farmers in Nangabo and 65.3% of the farmers in Kira cultivated between 0.01 and 1 ha and used the rest of the land for grazing. This observation concurs with reports by Warner (1994), Dharmasena and Wijeratne (1996), and Puvanesway (1997) that in the countries where homegarden agroforestry is widely practiced, e.g. in Sri Lanka, much of the land tends to be underutilized because of fallowing, shortage of labour and lack of capital to hire labour.

Seventy seven percent of the farmers kept livestock such as cattle, pigs, goats, sheep and poultry. The animals were either stall-fed or tethered and poultry was reared on a free range system. There were significantly more cattle ($Z=2.87$, $P<0.05$) and pigs ($Z=2.27$, $P<0.05$) in Nangabo (rural) than in Kira (peri-urban) and the relationship between livestock rearing and size of land holding in Nangabo was positive but weak (R=0.21, P=0.06). This implies that even smaller households in the rural areas would keep more livestock than the relatively larger households in peri-urban areas. Livestock is an important part of the farm for income earning and, according to Warner (1994), livestock is a major form of capital accumulation by rural households. Farmers indicated that they sold livestock when they required large sums of money like for paying school fees or meeting medical costs. The most convenient animals in this case were said to be pigs and goats. The main reason for keeping these animals was that livestock traders who do not have much money could easily buy pigs and goats.

Table 1. Demographic and socio-economic characteristics of farmers in Nangabo and Kira sub-counties, Mpigi District

Characteristic	Category (%)	Nangabo (%)	Kira	Test statistic	P value
Sex of farmer	Male	52	63	Z=1.58 ns	0.05
	Female	48	37	Z=1.58 ns	0.05
Size of household	Mean	5.84	5.97	T=0.30 ns	0.76
	Std. Dev	2.61	2.73		
Size of land holding (ha)	Mean	1.28	1.81	T=2.04*	0.043
	Std. Dev	1.11	1.63		
Land acquisition	Inherit	20	56	Z=5.29**	0.01
	Purchase	65.3	30.7	Z=4.94**	0.01
	Rent	14.7	13.3	Z=0.29 ns	0.05
Land tenure	Secure	61.3	56		
	Insecure	38.7	44	Z=0.77 ns	0.05
Off-farm job	Yes	74.7	77.3		
	No	25.3	22.7	Z=1.45 ns	0.05
Livestock	Yes	69.3	77.3		
	No	30.7	22.3	Z=1.24 ns	0.05

ns=not significant **=significant at p=0.01

Plant composition, structure and diversity

The major plants in the homegardens were trees, shrubs, herbs and cash and food crops. The main cash crop was coffee grown by 77.3% of the farmers in Kira and 89.3% of the farmers in Nangabo. Other cash crops were chillies, tomatoes, cabbage, banana and passion fruits. The food crops grown were beans, maize, cassava, banana, yam, Irish pntatoes and sweet potatoes. There was a significant difference in species diversity (t=2.34, P=0.02) of the homegardens in the two sub-counties (Table 2).

Table 2. Abundance and diversity of woody perennials in the homegardens

Characteristic	Kira	Nangabo	Test statistic	P value
Number of woody species				
Minimum	3	4		
Maximum	16	22		
Mean	8.17	9.24	T=2.34	0.02
Std. Deviation	2.84	2.73		
Number of woody individuals				
Minimum	5	5		
Maximum	73	175		
Mean	26.3	38.5	T=32.9	0.0013
Std. Deviation	18.3	26.4		
Reciprocal of Simpson's diversity index	6.12	8.32	T=2.7	0.008

Eighty three species of trees and shrubs were identified and recorded in Kira and Nangabo (Appendix 1). Of these, 56 species were common in both sub-counties, 10 were found in Kira only and 15 were found in Nangabo only. These findings are consistent with a report by Bafiirawala (1994) who found that in Masaka District, there were more species of woody perennials in the rural than peri-urban homegardens.

Regression analysis revealed that the species diversity and abundance of woody perennials were positively related to the size of the household (R=0.35, P<0.001) and land size (R=0.43, P<0.001). It was noted that every member of the household was free to plant trees or shrubs of their choice provided there was enough land and the plant was beneficial to the family. It was also found that farmers collected seed and planting materials from either their home gardens or bought from neighbours for the next season's planting. Land scarcity in Kira dictated the choice of tree species to be planted because trees which attain large sizes upon maturity, such as *Canarium schweinfurthii* (muwafu) and *Milicia excelsa* (muvule), were only planted by farmers who owned more than 1.5 ha of land. Large trees with wide crowns were not commonly integrated with agricultural crops because they retarded crop growth and reduced the yield.

Simpson's diversity index (Kira=6.12 and Nangabo=8.32) showed that the homegardens had a diverse species of woody perennials. According to Kumar et al. (1994), such diversity reflects the uniqueness of plant species found in homegardens and the traditional nature of the agricultural system practiced by the local people. However, a similar study done in Sri Lanka by Jacob and Alles (1987) revealed much lower Simpson's diversity indices ranging from 1.35 to 3.98. This study found a weak but significant relationship between the species diversity and size of land holding ($R=0.06$, $P<0.02$) but no significant relationship between the species diversity and land tenure system. It therefore appears that security of tenure had no significant influence on the establishment of woody perennials in the homegardens. Discussions with the farmers revealed that, whereas security of tenure was an incentive to plant trees and other woody perennials in Kira, it was not the case in Nangabo. According to Cook and Grut (1989), even with secure tenure, some farmers are not willing to plant trees that do not have positive returns to labour and capital.

Structure of the homegardens

The horizontal and vertical structure of the homegardens in selected villages of Nangabo and Kira sub-counties are illustrated in the profile diagrams (Figures 1 and 2).

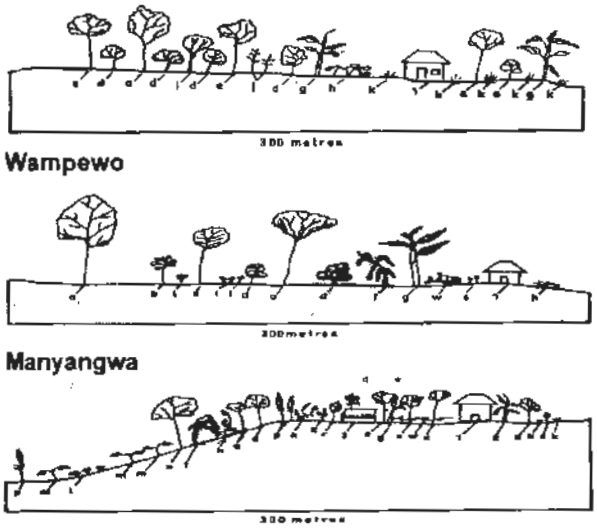

Figure 1. Profile diagrams of homegardens in the study villages in Nangabo sub-county.

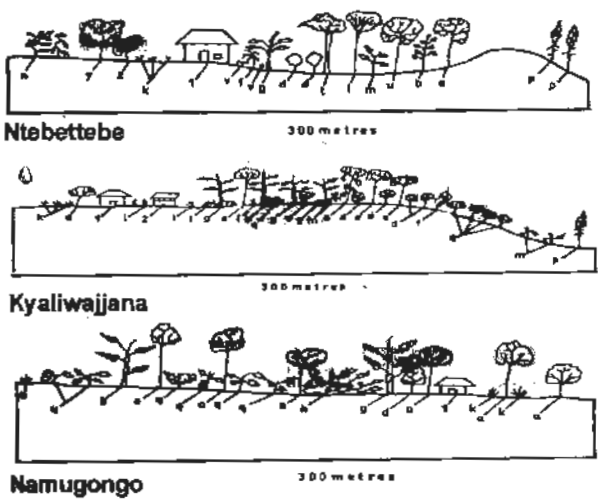

Figure 2. Profile diagrams of homegardens in the study villages in Kira sub-county.

Legend of Figures 1&2: a-*Ficus natalensis*, b-*Carica papaya*, c-bitter vegetable (jjoboyo), d-Coffee, e-*Persea americana*, f-Sugar cane, g-Banana, h-Sweet potatoes, I-*Syzigium comminii*, j-maize, k-short grass, l-vegetables, m-cocoyam, n-passion fruit, o-*Artocarpus heterophyllus*, p-Eucalyptus, q-beans, r-mango, s-ornamental pants, t-*Milicia excelsa*, u-*Sapium ellipticum*, v-Solanum sp., w-pumpkin, x-fodder tree, y-*Sena spectabilis*, z-*Cedrella odorata*, 1-residential house, 2-animal pen.

The horizontal structure comprised of ornamental, fruit and shade trees (e.g. *Casuarina equisetifolia*, *Mangifera indica*, *Artocarpus heterophyllus*, *Callistemon citrinus*), grass and low growing crops (e.g. sweet and Irish potatoes) planted on the compounds. The other crops were grown and livestock kept close to the homestead. Coffee, banana and maize were planted on the periphery of the homestead. There was no pattern of integrating food and cash crops with trees. Tall trees with buttress roots (e.g. *Ficus natalensis*), short trees with broad crowns (e.g. *Kigelia africana*), and crawling plants and runners (e.g. sweet potatoes) were mainly planted on the slopes. Eucalyptus and cocoyam, which are considered to be resistant to waterlogging, were planted in the valleys, while maize, beans, Irish potatoes, banana and vegetables were planted in the flatter and well-drained areas.

About 50% of the woody perennials with medium and small crowns such as *Cedrella odorata, Casuarina equisetifolia, Psidium guajava, Citrus reticulata, Jatropha curcas* and *Carica papaya* were planted on the periphery of the homegarden (Table 3).

Table 3. Location of woody perennials in the home gardens in Mpigi District

Area	No. of species	Border	Interior	Border and interior
Kira	66	15	32	19
Nangabo	71	21	33	17
	Z=0.147*	Z=1.25 ns	Z=0.8 ns	Z=0.84 ns

* significant at $P<0.05$, ns=not significant at $P<0.05$

The farmers gave various reasons for the above spatial arrangement of woody perennials in the homegardens. Firstly, fruit trees such as *Psidium guajava, Carica papaya* and

Artocarpus heterophyllus were planted near the houses for protection from thieves, livestock damage and vandalism, a position also alluded to by Jacob and Alles (1987). Secondly, larger trees were planted relatively further away from the houses to avoid damaging houses during pruning, felling or heavy storms. Thirdly, trees and shrubs with broad crowns were planted on the periphery of the homegarden to reduce competition with agricultural crops and smothering of crop growth. In other parts of Uganda, farmers adopt a deliberate planting arrangement to take care of the intrinsic phyto-sociological behaviour of plants especially where plants may foster each others growth e.g. *Ficus natalensis* which is planted with coffee (Oduol and Aluma, 1990). It was noted that farmers did not plant pumpkins together with bananas because pumpkins were

believed to reduce the growth of banana although a more plausible reason is that both crops are surface feeders and compete for nutrients in the top soil.

Four canopy strata characterized the vertical structure of the homegarden vegetation. The uppermost/forth layer was made up of canopies of timber trees such as *Milicia excelsa* and *Maesopsis eminii* and fruit trees such as *Mangifera indica* and *Artocarpus heterophyllus*. The third layer was made up of canopies of shade tolerant trees such as *Psidium guajava, Persea americana, Syzygium comminii, Sapium ellipticum, Aleurites molicana* and *Sena spectabilis*. The second layer consisted of canopies of banana (*Musa* spp.), coffee (*Coffea*), *Carica papaya, Sesbania sesban, Calliandra calothyrsus* and climbers such as *Passiflora* spp. The lowest layer was made up of herbaceous annuals such as *Phaseolus vulgaris, Cucurbitacea pepo, Ipomea batata* and *Amaranthus currents*.

Socio-economic importance of the woody perennials

Woody perennials are usually important to the households' welfare socially, economically and culturally. The social importance refers to improving livelihood without involving monetary expenses, whereas the economic importance refers to improving livelihood by involving markets and money. In Kira and Nangabo sub-counties, the woody perennials were categorised as having either use value (tangible) or non-use value (intangible). Use values include products that are marketed and also consumed by the households. The consumed products are those given away as gifts, shared with neighbours or exchanged for other products. The woody perennials provided fruits, poles, timber, firewood, fodder, medicine and spices. In Nangabo sub-county, *Carica papaya* was grown solely for fruits, but in Kira sub-county, in addition to the fruits, the leaves of *Carica papaya* were used as medicine for treating asthma and the root extracts were used to treat skin diseases in children. Similarly, whereas *Markhamia lutea* was grown mainly for building poles and firewood in Nangabo, the flowers were also used as medicine for treatment of ear infections. According to Raintree (1991), woody perennials have intrinsic biophysical attributes, which make them more or less appropriate to different users, and different trees have different degrees of relevance to different users. At the same time, Chandrasekharan (1994), reported that the importance of non-woody forest products to local communities are location specific and dynamic.

There were few fodder trees and shrubs grown e.g. *Caliandra calothyrsus*, *Sesbania sesban* and *Gliricidia sepum*. *Ficus natalensis* and *Rhus natalensis* (indigenous) and *Calliandra calothyrsus* (exotic) were the fodder trees grown by farmers keeping stall-fed cattle to improve and maintain milk production. In Uganda, *Calliandra calothyrsus* is preferred as a fodder crop because it contains 20-25% dry matter and is a major source of protein.

Tree species such as *Markhamia lutea, Ficus natalensis*, and *Erythrina abyssinica* were used for making household items like motars, pestles, hoe and spear handles and racks for storing utensils such as spoons and laddles. It was found that five female-headed households in the study area were dependent on trees as a source of raw materials for handcrafts and earned between UgShs. 20,000 – 40,000 (US$ 13.3-26.6) per month from sale of handcrafts.

Although farmers preferred to plant tree species such *Milicia excelsa, Albizia glaberrima, Eucalyptus camaldulensis, Markhamia lutea*, and *Maesopsis eminii* for timber and building poles because of their high income potential, the proportion of woody perennials grown for firewood seemed to be higher than for other products. However, farmers did not grow any single tree only for firewood. In Kira, 42.7% of the respondents said they obtained firewood form their gardens. Firewood was got from parts of trees pruned or branches cut logs being prepared for sawing. Of these 21.8% said the firewood was enough for household use and 9.3% said they had surplus for sale. In Nangabo sub-county, 65.3% of the respondents said they got firewood from the home gardens and of these 61.2% indicated that they had enough firewood for household use and 8.1% had surplus for sale. Based on these findings and reports from Ethiopia by Asseged (1996) and Sri Lanka by Puvanesway (1997), it can be said that homegardens are important sources of firewood. In Uganda, the average fuelwood requirement per household is 1.3 m^3 per day (Howard, 1991) and more than 92% of wood consumed in Uganda is used for fuel. Therefore, farmers need to plant and manage woody perennials in home gardens in order to fulfill their fuel wood requirements for household use.

Thirty two species of woody perennials of medicinal value were grown by farmers in the studied area. There were more medicinal species in the rural than peri-urban homegardens. The commonest ones were *Mangifera indica* used for treatment of cough, *Ficus ovata* for high blood pressure, *Senna spectabilis* for measles, *Markhamia lutea* for ear infection and rheumatism, *Vernonia amygdalina* for malaria, *Carica papya* for skin rushes, *Prunus africana* for sexual disorder and *Azadirachta indica* used for deworming and treatment of fungal infections and malaria fever. According to Cunningham (1996), collection and cultivation of medicinal plants is species-specific and leaf materials form the major component plant parts used to treat people or livestock. As such, traditional medicine is a major source of health and dental care in the rural areas of developing countries including Uganda, and especially for populations that do have access to other types of medication.

About 30% of the woody perennials were grown for fruit production e.g. *Persea americana, Carica papaya, Citrus limon, Citrus reticulata, Mangifera indica* and *Artocarpus heterophyllus*. Fruits provide food security during drought and are important as off-season food sources because some fruits e.g. *Carica papaya*, are produced throughout the year unlike other seasonal crops. It was also found that fruit trees added diversity to the homegardens and farmers planted fruit trees as a strategy to ensure harvests throughout the year and aver risks of crop failure. Within families, children were served with fruits before adults, and among the adults men were served first. Fruits of *Carica papaya* were spared especially for children. Fruits were also given as offertories in church and as gifts shared between families thereby building social cohesion among the local community.

Over 70% of the respondents depended on farming for income and of these 42-48% depended on incomes got from the sale of products of woody perennials such as fruits, building poles and timber. It was found that the home gardens were not exclusively subsistence oriented. Forty two percent and 48% of the households in Kira and Nangabo sub-counties respectively said they sold products of some woody perennials. The contribution of woody perennials to household income was expressed in form of cash saved on purchase of food and other products and cash earned from sale of products of woody perennials. For example, fruits of *Carica papaya, Artocarpus heterophyllus, Psidium guajava, Mangifera indica* and *Citrus limon* and timber and poles of *Eucalyptus* spp, *Markhamia lutea, Sapium ellipticum* and *Maesopsis eminii* were sold for cash in Kampala and/or Mpigi markets (Table 4). A case in pint was a farmer in Nangabo sub-county who said he harvested and sold, at farm level, 345 poles of *Markhamia lutea* per annum earning about Ug. Shs. 34,500 (approximately US$ 230 as at 12 December 1999). This also represented 0.24% of the farmer's annual income. The average market prices of selected woody perennials sold by farmers in Kira and Nangabo are sub-counties are given in Table 4.

The non-use/non-monetary values of woody perennials included planting of trees and shrubs as boundary makers, hedges and cattle enclosure using species such as *Dracaena fragrans, Cedrella odorata, Euphorbia tirucali, Erythrina abyssinica, Jatropha curcas, Ficus natalensis, Dovyalis caffra* and *Spathodea campanulata*. Tree branches were also used as stakes to support climbing beans and passion fruits (*Passiflora quadrangularis*).

Table 4. Average market prices of selected woody perennials quoted from farmers and four markets in Kampala and Mpigi Districts. Prices are in thousands of Uganda shillings as at 12 December 1999.

Item	Kabubu[3]	Kalerwe	Kyalliwajala[1]	Kireka	Nakasero
Charcoal per bag[2]	3	7.5	4.5	6	11
Avocado fruit	0.025	0.25	0.035	0.15	0.25
Jackfruit	0.3	0.8	0.65	1.5	1.5
Papaw	0.1	0.6	0.25	0.7	2.2
Mango (3 fruits)	0.01	0.2	0.035	0.2	0.25
Citrus (8 fruits)	0.15	0.75	0.25	1	1.5
Milicia excelsa[4]	4.5	6.5	5	7.5	Na
Maesopsis eminii[4]	4	5	4	5.5	Na
Eucalyptus pole	3	4.5	4.5	5	Na
Markhamia lutea pole	0.9	Na	2	Na	Na

[1]Farm , [2]bag estimated at 30-35 kg, [3]market in the heart of Kampala, [4]3 x 2 ft piece of timber, na=not available

Soil protection and fertility conservation is a non-monetary value of trees and shrubs often cherished by farmers. In Kira and Nangabo, farmers planted trees species such as *Albizia coriaria, Artocarpus heterophyllus, Canarium schweinfurthii, Ficus natalensis, Grevillea robusta, Maesopsis eminii* and *Sapium ellipticum* because they drop many leaves annually and help to keep the soil around them moist and fertile. Trees such as *Canarium schweinfurthii* and *Maesopsis eminii* were planted as ornamentals to provide shade, shelter and serve as windbreaks.

Some households planted or retained trees for cultural purposes. For example, *Ficus natalensis* was retained or planted by many farmers because of its relationship with the kingship of Buganda Kingdom. The King of Buganda usually plants a *Ficus natalensis* tree for each crown prince in order to make him a clan head. In addition, the bark of *Ficus natalensis* is processed into bark cloth which is used for coronation of the King, burial and funeral rites. The production of bark cloth has for a long time been a commercial enterprise and source of employment to many people in Buganda.

Indigenous management of the woody perennials

Trees and shrubs were either planted or spared by farmers when preparing land for planting the next season's crops. Direct planting of seed or seedling (especially of trees) was used to establish trees. Farmers bought seedlings from private or government tree nurseries and gathered wildlings or saplings of woody perennials from nearby forests or their neighbours' gardens and planted them. In the case of fruit trees and medicinal plants propagated by seed, farmers collected the seeds and placed them in the middle of banana stools to germinate and grow until they were ready for transplanting. Seedlings and saplings were protected from roaming animals and scavenging birds by erecting guard stakes or putting branches of thorny shrubs around them.

Tree pests e.g. leaf bugs, were controlled by spreading wood ash at the base of the seedlings especially in the dry season when infestation was most common. Soil fertility was improved and maintained by mixing the soil with chicken droppings, animal manure and crop residues during land preparation. Woody perennials were weeded at the same time with the agricultural crops. Trees and shrubs were thinned by removing the unwanted saplings and poles. This was done mainly by women during weeding of the agricultural crops. Men pruned and pollarded the trees and shrubs to reduce the effect of shading, stimulate flowering, increase fruiting, facilitate harvesting and reduce excessive branching. The parts removed were used as

firewood and building poles. Weeding, thinning and pruning were done mainly in the wet season and men carried out all forms of harvesting that involved tree climbing.

Conclusions and recommendations

1. The size of household and land holding influenced the choice of woody perennials planted in the homegardens.
2. Land tenure/security of tenure did not significantly affect the composition and diversity of the woody perennials planted.
3. The horizontal structure of the homegardens' vegetation comprised of ornamental, fruit and shade trees such as banana, *Casuarina equisetifolia, Mangifera indica, Artocarpus heterophyllus, Callistemon citrinus*, grass and low growing crops such as pumpkins, beans, sweet and Irish potatoes.
4. The vertical structure was made up of four canopy layers. The uppermost layer comprised of canopies of timber trees such as *Milicia excelsa* (muvule) and *Maesopsis eminii* (muzizi) and fruit trees such as *Mangifera indica* (muyembe) and *Artocarpus heterophyllus* (ffene). The third layer comprised of canopies of shade tolerant trees such as *Psidium guajava, Persea americana, Syzygium commnii, Sapium ellipticum, Aleurites moluccana* and *Sena spectabilis*. The second layer consisted of canopies of banana, coffee, *Carica papaya, Sesbania sesban, Calliandra calothyrsus* and climbers such as *Passiflora* spp. The lowest layer consisted of herbaceous annuals such as *Phaseolus vulgaris, Cucurbitacea pepo, Ipomea batata* and *Amaranthus currents*.
5. There was no significant difference in the species composition of the homegardens, but there was a significant difference in the woody species diversity in Nangabo (rural sub-county) and Kira (peri-urban sub-county).
6. The woody perennials were established in the homegardens from seed, wildlings or seedlings raised in nursery beds. These provided fruits, timber, building poles, craft materials, fibres and medicines for household use or sold for cash.
   Indigenous management practices carried out by the farmers included protecting seedlings from roaming animals, pest control using wood ash, improvement of soil.

1. Fertility using livestock waste and crop residues and controlling the growth and productivity of trees and shrubs by pruning and pollarding.
2. Homegarden agroforestry is socio-economically beneficial. The woody perennials were grown for domestic use and cash. Over 70% of the respondents depended on farming for income, of these 42-48% depended on incomes got from the sale of products of woody perennials such fruits, handcrafts, building poles and timber. However, there is a need to carry out long-term studies to understand the indigenous knowledge systems of homegarden agroforestry as well as the costs and benefits of practicing it.

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Appendix 1. Woody perennials and their uses in Nangabo and Kira sub-counties, Mpigi District

Scientific name	Luganda	Uses
Albizia coriaria	Mugavu	T, m, fw, th, sc, sh, wb,
Albizia glaberrina	Nnongo	T, fo, m, fw, th, bp, or, sh, wb, ho
Aleurites molucana	Kabakakanjagala	Bm, fw, bp, cr, sh, wb
Antiaris toxicaria	Kirundu	T, fw, th, bp, cr, sh, wb
Artocarpus heterophyllus	Ffene	Fr, fo, m, bm, fw, cr, sh, wb
Averrhoa carambola	Kalambasi	Fr, fw
Azadirachta indica	'Neem'	T, m, fw, bp, sh, wb, pc, ho
Arundinaria alpina	Mabanda	Bm, fw, th, bp, cr
Bougainvillea buttiana	Muzikabafu	Fw, or. Sh, wb
Bridelia micrantha	Katazamiti	Fo, m, fw, th, sh, ho
Cajanus cajan	Nkolimbo	Fr, fo, m, bm, fw, sc, wb, ho
Calliandra calothyrsus	'Calliandra'	Fo, fw, bp, cr, or, sc, sh, wb, mu, ho
Callistemon citrinus	Nyambalabutonya	M, fw, cr, or, sh, wb, ho
Canarium schweinfurthii	Muwafu	Fr, t, m, bm, fw, th, re, cr, sc, sh, wb, mu, ho
Carica papaya	Papali	Fr, fo, sh, ho
Casuarina equisetifolia	Kasalina	T, bm, fw, th, or, sc, sh, wb
Cedrella odorata	Cedero	T, m, lf, bm, fw, bp, sh, wb, pc
Cinnamomum zeylanicum	Budalasini	T, sp, cr, or, sh, wb, ho
Citrus reticulata	Mangada	Fr, m, or, ho
Cocoa hteobroma	Kokoa	Fr, fw, cr, or, fr, m, fw, th, sh, wb, cu, ho
Coffee spp	Mwanyi	Fr, m, fw, th, sh, wb, cu, ho
Combretum molle	Ndagi	T, bm, fw, th, bp, sh, wb, ho
Cyphomandra betacea	Kinyanya	Fr, fw, sh, wb, ho
Datura suaveolens	Maduudu	M, fw,sc, cu, ho
Dovyalis caffra	Kai apple	Lf, bm, fw, or, wb, ho
Dracaena fragrans	Luwanyi	Lf, bm, cr, wb
Dracaena steudneri	Kajjolyanjovu	M, cr, sh, wb, ho
Elaeis guinensis	Omunazi	Fr, m, fw, cr, or, sh, wb
Entada abyssinica	Mwolola	M, bm, fw, th, or, sc, sh, wb
Erythrina abyssinica	Girikiti	M, bm, th, sc, sh, wb, ho
Eucalyptus camadulensis	Kalatunsi	T, m, bm, fw, bp, cr, or, sh, wb, ho
Euphobia tirucali	Nkoni	M, lf, bm,
Ficus natalensis	Mutuba	Lf, bm, fw, th, bp, sc, sh, wb, mu, cu
Ficua exasperata	Luwawu	Fw, th, sp, sh, wb
Ficus ovata	Mukokoowe	Lf, bm, fw, th, bp, or,
Garcinia buchananii	Nsali	Fr, fw, th, or, sh, wb
Grevillea robusta	'Grevillea'	T, bm, fw, bp, or, sc, sh, wb, ho
Gliricidia sepum	'Gliricidia'	Fw, sc, sh, ho
Hibiscus rosasinensis	'Hibiscus'	Or, sh, ho
Jacaranda mimosifolia	Mwolola muzungu	Fw, bp, cr, or, sh, wb, ho
Jatropha curcas	Kiloowa	Lf, bm, cr
Kigelia africana	Mussa	Fr, m, fw, bp, sh, wb
Leucaena leucocephala	Lucina	Bm, fw, bp, cr, or, sc, sh, wb, mu, ho
Maesopsis eminii	Musizi	T, fw, bp, th, or, sh, wb
Mangifera indica	Muyembe	Fr, m, bm, fw, re, cr, sc, sh, wb, ho
Manihot gaziovii	Kiwogowogo	Or, sh, wb, ho
Margaritana discodeus	Kamenyambazi	T, fw, sh
Markhamia lutea	Nsambya	T, m, bm, fw, th, bp, cr, or, sc, sh, ho
Milicia excelsa	Muvule	T, m, bm, fw, th, re, cr, sc, sh, wb, ho
Mitragyna stipulosa	Nzingu	T, fw, sh, wb
Morinda lucida	Kabajjansali	T, fw, th, or, sh, wb, cu
Morus alba	Nkenene	Fr, lf, sc, wb, ho
Morus mesozygia	Mukooge	Fr, fw, bp, sc, sh, wb
Persea americana	'Avocado'	Fr, fw, sh, wb, ho
Polyscias fulva	Setala	Fw, bp, sh, wb,
Prunus africana	Ngwabuzito	T, m, fw, th, bp, sh, wb, ho
Pseudopondias microcarpa	Muziru	T, fw, th, sh, wb
Psidium guajava	Mupeera	Fr, m, fw, th, bp, cr, sh, wb, pc, ho
Punica granatum	Nkomamawanga	Fr, fw, ho
Rhus natalensis	Kakwansokwanso	Fr, fo, lf, fw, sc, wb
Ricinus communis	Nsogasoga	Fo, m, fw

Sapium ellipticum	Musasa	T, fw, th, bp, sc, wb, cu
Schinus molle	Kamulai	Fr, sp, pc, ho
Senna spectabilis	Kassia	T, fo, m, fw, bp, th, cr, or, sh, wb, cu, ho
Sesbania sesban	Muzimbandegeya	T, fo, bm, fw, cr, or, sc, sh, wb
Solanecio manii	Kilalankuba	M, fw, sc, sh, wb
Solanum aculeastrom	Ettengo eddene	M, fw, or, sc, sh, wb,
Solanum melongena	Katunkuma	Fr, m, fw, ho
Spathodea campanulata	Kifabekazi	M, bm, fw, th, bp, cr, sh, ho
Steganotaenia araliacea	Munulangombe	Fr, fw, bp, sc, sh
Syzigium comminii	Jjambura	Fr, m, bm, fw, th, cr, sh, wb, ho
Tamarindus indica	Ssekabembe	M, fw, bp, cu
Teclea nobilis	Enzo	T, fw, bp, th, wb
Terminalia microptera	'Umbrella tree'	Fw, th, bp, or, sh, wb
Tetradenia riparia	Kyewainaia	M, fw, sc, ho
Unidentified	Muttanjoka	M, fw, sc, pc, ho
Unidentified	Munyango	M, fw, sh, wb
Unidentified	Kasitani	Bm, fw, cr, or, ho
Unidentified	'Rose flower'	Bm, or, ho
Unidentified	Mutuluka	M, sc, sh
Unidentified	Omuwo	M, fw, sc, sh
Vangueria apiculata	Mutugunda	Fr, fw, cr, sh, wb, mu, ho
Vernonia amygdalina	Mululuza	M, bm, fw, wb, mu, hc
Vernonia auriculifera	Kikokooma	To, bm

Common English names are in quotes. Fr=fruit, t=timber, m=medicine, sp=spice, lf=live fence, bm=boundary marker, fw=firewood, th=tools/tool handle, re=resin, sp=sand paper, bp=building poles, cr=crafts, or=ornamental, sc=soil conservation, sh=shade, wb=windbreak, mu=mulch, cu=cultural, pc=pest control, ho=bee forage/honey production, to=toilet.