

Full length Research Paper

Indigenous knowledge of rural communities in Malawi on socio-economic use, propagation, biology, biodiversity and ecology of *Uapaca kirkiana* Muell. Arg

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***Uapaca kirkiana* Muell Arg. is one of the most popular indigenous fruit trees in the Miombo woodlands of southern Africa. An investigation into existing indigenous knowledge and socio-economic use of this fruit tree was conducted in Malawi. The survey revealed that *U. kirkiana* fruits contribute considerably to livelihood as a food supplement and for income generation among local communities. However, *U. kirkiana* trees are not widely cultivated due to lack of improved planting materials and difficulties in establishment outside their natural habitats. The results from the survey indicate that fruits are the main non-timber products that contribute to demand for domestication and the attributes preferred by the rural communities for improvement are mainly related to fruit taste and yield. Poor management and anthropogenic activities have resulted in the destruction of forest reserves and the local people do not have maximum stewardship of *U. kirkiana* trees in the forest reserve. The indigenous knowledge on *U. kirkiana* trees provides a valuable basis for domestication, propagation and improvement of fruit and tree attributes, and management issues on both co-managed and government forest reserve.**

Key words: Euphorbiaceae, domestication, forest reserve, Miombo.

INTRODUCTION

Uapaca kirkiana Muell. Arg. belongs to the family *Euphorbiaceae*, a woody plant that is very important because of its fruits and multiple uses of other parts of the tree (Maghembe et al., 1998). In Malawi, food shortage period (October to February) precedes the first rains hence availability of *U. kirkiana* fruits contribute significantly to diet while the sale of fruits generates much needed cash which can be used to buy farm inputs and other household requirements (Akinnifesi et al., 2004). Apart from the fruits, the species supply timber, wood fuel, livestock fod-

der, fibre and shade to local people (Kwesiga et al., 2000). The leaves, bark and roots are used for curing different ailments (Gowela et al., 2005). Available studies indicate that *U. kirkiana* has high nutritional value in terms of sugars, vitamins, and minerals (Saka and Msonthi 1994; Kadzere et al., 2006; Saka et al., 2007). *U. kirkiana* trees are found growing in forest reserves (government and community managed) and farmlands. Available studies conducted in Malawi indicate that local communities would like to plant the species in their gardens for easy access but limited knowledge about its biology and propagation has slowed down the domestication of *U. kirkiana* (Maghembe et al., 1994). Mwamba (1995) reported that poor seedling establishment has contributed to low rate of domestication. Cultivation of *U.*

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Table 1. Districts and corresponding villages sampled for the study of *U. kirkiana*.

Forest reserve type	Region	District	Number of villages	Number of people
Dzalanyama Govt. Reserve	Central	Lilongwe	31	546
Dedza Govt. Reserve	Central	Dedza	2	33
Chimaliro Com.Reserve	Central	Kasungu	9	160
Perekezi Govt. Reserve	Northern	Mzimba	5	84
Mulanje Govt. Reserve	Southern	Phalombe	1	17
Total	3	5	48	840

kirkiana onto the farmland is not dependant on success in propagation alone, but also peoples' values. There is need to develop appropriate domestication strategies and policies that will promote conservation and utilization of the species.

Local communities have been recognized in recent years as contributing significantly to natural resources management (Demel and Abeje, 2004) as they retain a lot of knowledge on the trees they value. Partnership of scientists and rural communities in planning, implementation and sustainability of *U. kirkiana* programs is important in order to fulfil aims of conservation and satisfy claims of utilization by the local population. A concept of 'conservation through utilization' is also important in tree domestication. Documentation of indigenous knowledge of *U. kirkiana* is limited to ranking of priority indigenous fruit trees (Minae et al., 1995; Malembo et al., 1998) and utilization of the fruits (Kadzere et al., 2006ab) but does not include biological, ecological and diversity issues. Mwase et al. (2006) has recently documented the genetic diversity of *U. kirkiana* in Malawi and the importance of land tenure associated with *U. kirkiana* and other trees conservation (Mwase et al., 2007) but documentation of the rural communities' perspective is limiting. An assessment and analysis of indigenous knowledge on *U. kirkiana* and its utilization is very important in determining strategies for promoting domestication. Scientific information integrated with indigenous knowledge may provide a strong foundation for domestication of indigenous fruit trees. The study was initiated to document the indigenous knowledge on socio-economic use, propagation, biology, ecology and biodiversity of *U. kirkiana* as a basis for its domestication.

METHODOLOGY

Description of study area

The survey was conducted in five districts of Malawi namely, Mzimba (Northern region), Lilongwe, Dedza, and Kasungu (Central region) and Mulanje (Southern region) in 2004 (Table 1). The study areas were selected based on differences in forest management systems, population pressure, and land availability explaining the inclusion of Mulanje though with few people but is a vulnerable area to forest. Central region areas especially Kasungu has little problems of land except for population pressure in Lilongwe and Dedza districts. In the northern region there is no population pres-

sure and land availability in contrast to Mulanje which has both problems.

Selection of communities

A community comprising 10 men and 10 women were interviewed together with their traditional leaders in 48 focused group discussions. Meetings were conducted at the sites to brief the forestry staff and local communities about the survey. Introductory meetings served to introduce the survey and collect basic statistics about the villages. A forestry research assistant responsible for extension assisted in selecting communities that were interviewed. The villages were purposely selected based on proximity to the forest reserve and accessibility.

Data collection

Indigenous knowledge from the local communities was collected using an informative questionnaire. The questionnaire was pre-tested during a prior reconnaissance trip for validation and to allow relevant corrections to be made before final administration. The outcome of the discussion was used in the results. Considering that communities tend to be loyal in answering questions that are sensitive to policy issues, the information collected was backed up through observations and repeated questions. Informal discussions provided valuable information that was not considered in the questionnaire and it is documented in this paper. Data collected fell under the following sections: socio-economic uses, biology, propagation, ecology and biodiversity of *U. kirkiana*.

Socio-economic use

Information was collected on the various uses of *U. kirkiana* and marketing information related to selling points, prices and quantity of the fruits that are sold after they are harvested. The survey provided information on the socio-economic importance of the tree in the livelihood of the people.

Biology and propagation

Information collected included natural regeneration, phenological stages such as tree age, season of flowering, fruit set, maturation and harvesting. Other data collected included characteristics of male and female trees as perceived by the communities and their preferred attributes for tree and fruit improvement.

Ecology and biodiversity of *U. kirkiana* information

Ecological data collected included tree species associated with *U. kirkiana*, type of soil, geographical zones and climate of the location

Table 2. Demographic characteristics of communities utilising *U. kirkiana*.

Community	Age of household head (years)	Household head size	Land holdings per household (ha)	Proportion that grew maize (%)	Proportion that grew tobacco (%)
Dzalanyama	44	5.1	1.8	97	34.6
Dedza	44	5.5	1.38	96.8	5.9
Chimaliro	46	5.5	5.67	95.9	64
Perekezi	45.9	5.5	6.3	99	32
Phalombe	46	5.3	0.8	97	4.6

of the trees. Communities provided information on other species apart from *U. kirkiana* species that they perceived to be important for cultivation or to be considered for improvement. Information gathered also considered distances covered to collect fruits.

Statistical analysis

The responses were coded and analysed using a Statistical Package for Social Sciences (SPSS) 14.0. Most of the data collected was analyzed using descriptive statistics, proportions and Chi-square (χ^2) tests.

RESULTS AND DISCUSSION

A total of 840 persons were interviewed from the 48 villages (Table 1). The proportion of the interviewees relates to proximity and value that the communities place on *U. kirkiana*, based on the evaluation by forestry staff, local leaders, men, women, school boys and girls. All the respondents had directly harvested *U. kirkiana* fruits from the different forest reserves for consumption, marketing or both. Most of the people (65%) interviewed were from around Dzalanyama government reserve as they were easy to identify because their villages were close to the Forest reserve (Table 1). *U. kirkiana* fruits are collected from both government and community forest reserves.

In Mulanje (Phalombe), the *U. kirkiana* trees are limited to use because they are more than 10 km away from the communities and under government protection. In the Phalombe area, the trees are only found in Mulanje Mountain where there is biodiversity conservation project under the Global Environmental Facility (GEF). Where it is close to urban areas, for example Zomba and Malosa, the harvesters of fruits are mostly urban based vendors. These people could not be traced therefore, could not be interviewed. In the Northern region many trees are found within areas under cultivation as well as in protected forest reserves. This could be attributed to low population density hence less demand for clearing land for agriculture. In all the study areas the government manages the forests except for Kasungu (Chimaliro Forest Reserve), which is under a co-management system in Malawi where the community and Forest department jointly manage the forest. Agricultural activities dominate the areas of study describing the livelihood of the communities but there is a clear land pressure in Dedza and

Phalombe areas where land holding size is relatively low (Table 2).

Socio-economic use

The survey confirmed that *U. kirkiana* fruit trees make an important contribution that covers a range of socio-economic niche for the rural communities in Malawi. Rural communities use *U. kirkiana* fruits, leaves, roots and the trunk to meet their basic needs of subsistence livelihood.

In terms of ranking, fresh fruits (dessert) were rated highest (42 respondents), followed by income (41 respondents), medicine (36 respondents) and animal feed 1 respondents (Figure 1). Though not stated, income could be in form of selling fruits and fuel wood. In Malawi, fuel wood is a necessity and 84% of the urban population use wood fuel for cooking (NSO, 2000), and is sold by the rural people. It is normal for the people not to disclose the income generated from sales of wood fuel because the government penalizes illegal wood fuel collectors and only allows such collection for domestic use.

Fruit collection and selection

Sixty four percent of the respondents (school boys and girls) reported that they collect fruits and 61% of respondents select fruits based on the quality (Table 3). Selection of fruits after fruit collection involves choosing those that are big and not damaged for marketing. There was a gender significant in balance ($\chi^2 = 16.2$ at $p < 0.05$) in the collection of the fruits indicating that the fruits are mostly collected by women and boys and girls. Collection of fruits in the central region seems to be affected by the vendors who collect more than the community while in the southern region access to the trees is not easy in the area of survey as they are only available in the Mulanje Mountain forest reserve, which is quite a distance from the communities.

Fruit utilization

The fruits are used as a source of income (41%), fresh food/dessert (38%), juices (2.1%), beverages (2.1%) and

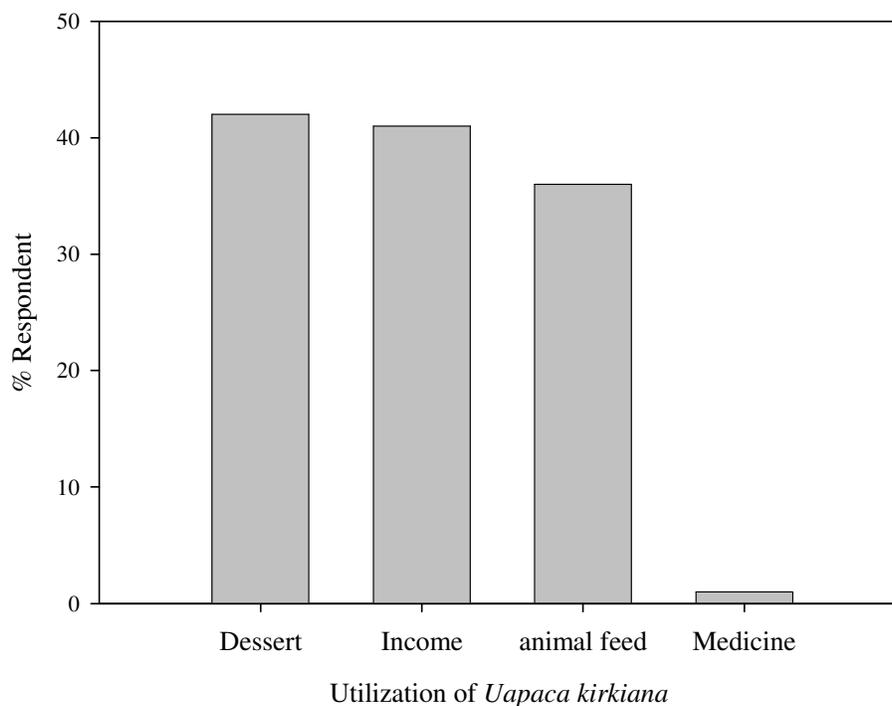


Figure 1. Ranking of utilization of *Uapaca kirkiana* tree by rural communities.

Table 3. Community responses on collection, selection, sales and processing of *U. kirkiana* fruits by gender.

Gender and age of respondent	% Respondent			
	Collection	Selection	Processing	Sales
Men	4	2	0	42
Women	32	37	82.6	15
Boys and girls	64	61	14.6	43
No response	-	-	2.8	-
Total	100	100	100	100

other uses (16%) for example as a sweetener in porridge (Figure 2). This shows that the most important uses of the fruits are consumption and income generation except for Phalombe where the fruits are not enough to generate cash. Mithofer and Waibel (2003) found that majority of the rural households benefit from consumption and sale of *U. kirkiana* fruits in Zimbabwe. The results indicate that fruits do contribute to the livelihood of local communities in both normal and drought years. Sale of fruits is usually a supplementary activity to subsidise immediate domestic needs. People in the study areas specifically Dzalanyama area complained bitterly about lack of control over forest area. Chimaliro forest reserve where co-management is enforced has not experienced felling of trees for collection of fruits. This suggests that community ownership is important in conservation of tree species. This agrees with Mayers et al. (2006) who reported that engaging local people in forest stewardship promotes formalized

ownership and responsibility.

Wood utilization

The trunk of *U. kirkiana* is used for fuel wood (27%), poles (15.8%), and timber (2.6%) which shows that these trees species is cut down (Figure 2). Although people collect the wood for fuel when the trees are cut by vendors, there was obvious community resentments when emphasizing that 'people who do not belong to the village do not value the forest hence they end up cutting the fruit trees'. However, the forestry law restricts/regulates the fuel wood collection and not fruit collection if evidence is not available that the fruit collectors had cut down trees. Removal of trees to meet fruit collection threatens the livelihood of the local people consequently denying them from collecting adequate fruits and other benefits from the tree species.

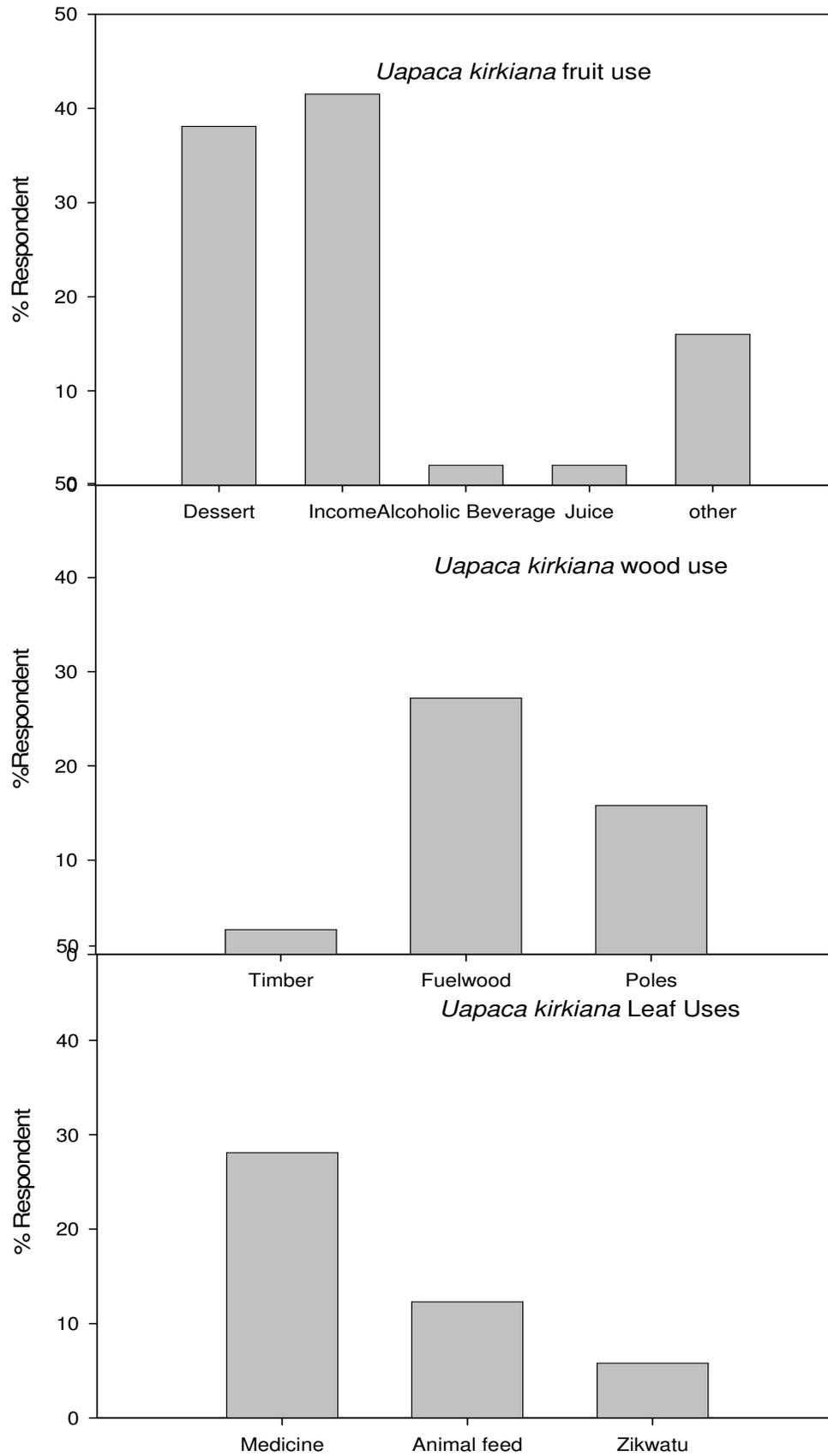


Figure 2. Community responses on utilization of *Uapaca kirkiana* fruits, trunk and leaves.

Leaf Utilization

Twenty eight percent of the respondents use leaves for medicine, while 12% use them for animal feed and 6% zikwatu (Zikwatu is a vegetable storage bundle made from *U.kirkiana* interwoven leaf sheets) (Figure 2). The respondents indicated that they also use the leaves for any stomach upset. Gowela et al. (2005) reported that the leaves from the shoot tips of *U. kirkiana* are used to cure stomach ailments. In the survey areas, it was observed that access to modern medical services is limited by distance and financial implications giving suggestive evidence that people depend on local plants for medicinal purposes. *Zikwatu* are used to store dried mushrooms and leafy vegetables and are also sold in urban areas to generate cash (Lowore, 2006) but this was not revealed by the respondents in this study.

Marketing of *U. kirkiana* fruits

In addition to providing food and nutritional security, *U. kirkiana* fruits are sold locally to generate income. Men (42%) are mostly involved in sales of the fruits though they are mostly not involved in collection an indication of marketing of the fruit within the village (Table 3). The majority of the fruits collected by rural communities are sold at local trading centre (36%), urban (28%) or along the farm gates (23%) and relatively very small amount of fruits are sold within their villages (12%). Dzalanyama communities sell their fruits in village and urban market. This is an indication that *U. kirkiana* fruit has a substantial market value as reported by Mithofer and Waiber (2003) that sales of fruits provide the communities with some cash in Zimbabwe. In the central and northern region very little is sold in the local area as people usually collect the fruits themselves, instead of buying. Sales of *U. kirkiana* fruit are dependent on the volume collected. Community members indicated that the fruits collected at one collection trip have a total market value in the farm gate and village market of about MwK300.00 (\$1.20) while Mulanje prices are comparatively higher (MwK450). They could not provide the number of collections per season. The total amount of money realised is probably an underestimation, though little, it is able to supply the communities with cash to buy essential items like soap and salt. This verifies the importance and potential of *U. kirkiana* fruits to generate cash.

In Malawi, *U. kirkiana* qualifies as an important tree for livelihood. The results indicate that one of the most important parts of the tree is the fruit. Therefore, promotion of the tree should include improvements in fruit yield and taste. The value placed on the trees by the community is confirmed by the few trees that are retained on the farm as they are left during the land clearing, suggesting the need for domestication of the trees by the community (Akinnesi et al., 2004).

Fruit processing

U. kirkiana is mostly processed into porridge (27.1%), juice (2.1%), and alcoholic beverages (2.1%). This is in agreement with information reported by Maghembe and Seyani (1991) indicating that people process the fruits. In this survey the fruits are mostly used as a dessert which may suggest that the fruits are no longer in abundance but could also be due to lack of processing knowledge. The survey revealed that 82.6% of the women (Table 3) are significantly ($\chi^2 = 27.34$ at $p < 0.01$) involved in processing of *U. kirkiana* fruits when the fruits are in abundance which is in agreement with the findings of Lado (1992) where women are involved in processing of foods hence have profound impact in food security. The respondents indicated that fruits are usually processed to make them more palatable, for example porridge and juice, or to preserve them for a longer period. In Dzalanyama, Dedza and Phalombe district, where there is population pressure there was no indication of fruit processing. This is in accordance with earlier research that revealed that *U. kirkiana* fruits are not processed because they are usually available at a time when food is not in abundance, therefore, any type of fruit available would be consumed fresh (Kwesiga et al., 2000; Akinnesi et al., 2004; Kadzere et al., 2006).

Biological information

The respondents were knowledgeable in *U. kirkiana* fruit set (77%), maturity (63%) and harvesting (65%) but not for flowering. Forty four percent of the respondents indicated that flowering usually occurs in August. Indigenous information on flowering of *U. kirkiana* varied widely among the rural communities compared to reports by Ngulube et al. (1998). This may indicate that the very important issues to the communities are fruit set and maturity clarifying the importance of *U. kirkiana* as fruit trees. Ngulube et al. (1998) reported that the male tree flowers earlier than female flowers resulting in an overlap of flowering and fruiting and that female trees flower gradually through January to March as the species are highly cross pollinated. This is an indication that there is a wide variation in flowering which could in the end affect fruit set and this is confirmed by Kadzere et al. (2006) who reported variation in fruit size and total soluble solutes (TSS) within the same tree an indication of variation in maturity. The community knew that the male plants do not fruit. The respondents demonstrated some knowledge on morphological and phenological traits and reproduction of *U. kirkiana* trees. Respondents reported that the species have male and female trees. Biological knowledge from the survey included imperfect flowers that are on different trees as female and male flowers; fruiting (once a year), regeneration (seed) and fruit set age (10 - 15 years). Almost every respondent had information that the fruit trees do not bear fruits every year. In

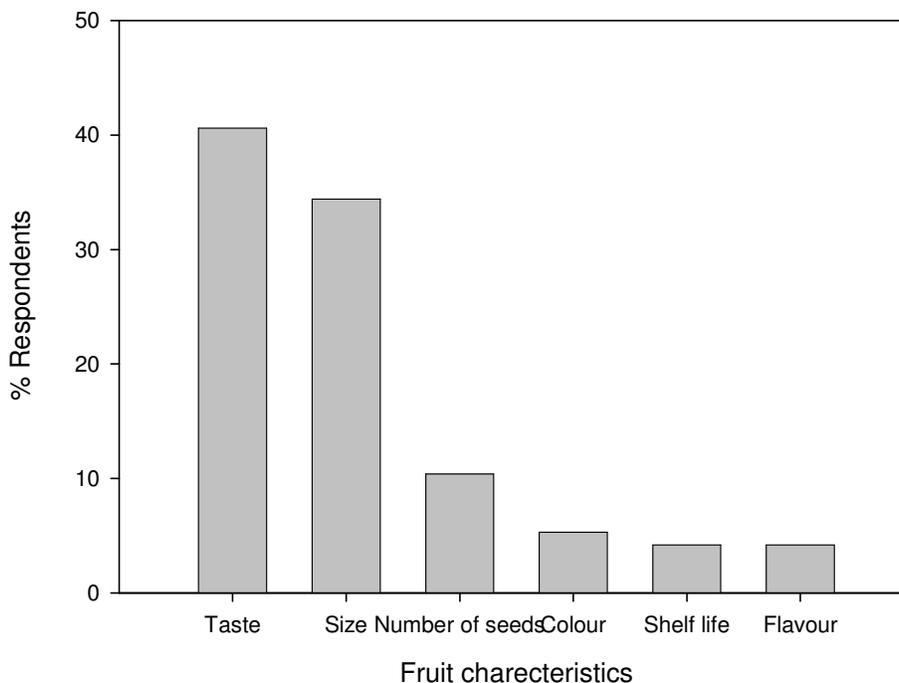


Figure 3. Community preferred fruit quality parameters in *Uapaca kirkiana* for improvement.

Table 4. Community criteria used in selection of *U. Kirkiana* fruits.

Criteria	Percent response
Tasting	55
Colour	32
Size of fruit	12
Frequent collection	1
Total	100

discussions the women in the survey revealed that the male fruit trees have small leaves and tend to grow longer compared to female trees, which have broader leaves and have dense crown. In this survey the communities knew that male trees do not produce fruits but indicated that they were important for medicine, poles and fuel wood. The communities had little knowledge (4%) that the male trees were important for pollination but knew that insects assisted the trees to fruit (33%). Ngulube et al. (1998) found that insects did not significantly improve fruit production. Drummond (1981) indicated that *U. kirkiana* fruit trees are dioecious. Mwase et al. (2007) confirmed that the plants have their male and female reproductive organs on different plants through identified markers linked to sex by AFLP and bulk segregant analysis which will identify the sex of young seedlings.

Fifty five percent of the respondents indicated that *U. kirkiana* fruits are selected through tasting whilst 32% indicated that colour helped in the selection of the best

fruits (Table 4). A brown colour indicated the best fruits. The respondents generally indicated that there are two types of fruits: big and small ones regardless of tree height. The big ones that are brown in colour are the most favoured and marketable as they are the ones that are sweet (Kadzere et al., 2006). The rural communities mentioned differences in taste were the main concern. It is, however, not known if the differences could be due to genetic or environmental differences.

Proposed *U. kirkiana* fruit and tree attributes for improvement are mainly related to fruit yield and taste (Table 5, Figure 3) suggesting its importance to food security and income generation. Short trees with dense crown cover and characteristics of earliness in fruiting are preferred traits. Kwesiga et al. (2000) and Kadzere et al. (2006) reported that preferred traits for improvement are mostly related to fruit size and yield. 34% of the respondents preferred size and 41% preferred taste (sweetness) as the fruit quality parameters that need improvement (Figure 3). This agrees with earlier information in this report indicating that *U. kirkiana* needs to be promoted for fruit not wood utilization. The results may mean that people like the aroma and colour but wanted the seed number to decrease in order for the size to make significance contribution to the edible fruit pulp. Maghembe et al. (1998) in a farmers' priority setting reported that taste, size and pulp ratio were important fruit quality attributes that needed to be studied in detail. Shelf life is the least proposed fruit quality parameter preferred for improvement. This might not be a priority as the fruits are not in abundance but could still be a factor

Table 5. *U. kirkiana* tree and community preferred fruit improvement traits.

Tree traits	Community preference	Fruit	Community preference
Height	Short	Size	Large
Crown covers	Dense	Taste	Sweet
Fruit yield	High	Number of seeds	Less (2)
Disease resistance	High	Colour	Light brown
Pest tolerance	High	Flavour	Same
Fruiting age	3 years	Shelf life	Long

to consider as Kadzere et al., (2006) reported that this was an important trait as the fruits degrade in quality within a short period.

Propagation information

Ninety percent of the respondents indicated that they would consider planting *U. kirkiana* trees. 88% preferred planting around the farming area. This does emphasize the importance of ownership and stewardship of *U. kirkiana* trees by the respondents. In Mzimba people did not intend to plant the trees in their farming area an indication that they were satisfied with the forest trees. 72% knew that *U. kirkiana* trees regenerates through seeds though some indicated that suckers also contribute to regeneration. There is a great value attached to the *U. kirkiana* trees as 65% of the respondents indicated that they retain the seedlings found in their gardens and that 88% of the respondents would plant the seedlings if provided. Communities further indicated that they protect naturally occurring *U. kirkiana* seedlings though the seedlings do not usually survive which is attributed to the differences in soil type between their natural habitat and the gardens. The respondents related the difficulties in establishment to earlier work of pines that had same difficulties until soil from pine forest reserve was used in establishing the trees. This is in agreement with earlier work that suggested that *U. kirkiana* seedlings require mycorrhizae in order for the seedlings to survive (Mwamba, 1995). Recent efforts on mass propagation and grafting will facilitate the efforts of domestication (Akinnifesi et al., 2007) though they are still a lot of challenges in production of plantlets.

Ecological and biodiversity information

U. kirkiana trees are predominantly found in the forest (76%), farming area (14.8%) and rarely in the homesteads (7.4%) (Figure 4). Government policy protects trees in the forest reserves which can be explained by the 76%. Studies by Malembo et al. (1998) and Gowela et al. (2005) support that indigenous trees are mostly found in the forest areas. However, there are a low percentage of trees found in farming areas indicating the importance of

agriculture over and above the safety-net of indigenous fruit trees. Mwase et al. (2006) in their report supported this as anthropogenic activities on customary land affected population of *U. kirkiana*. People would like to have sole ownership of trees as 88% of the respondents wanted to plant in their farming area. This would assure them maximum utilization and protection. A survey report in Malawi and Zimbabwe however reported consumer preference strongly favouring exotic fruits in order of priority *Mangifera indica*, *Citrus sinensis*, *Malus domestica* followed *U. kirkiana*, *Ziziphus mauritana*, *Adansonia digitata*, *Azanza garceana* and *Strychnos occuloides* (Mmangisa, 2006). Out of the promising indigenous fruits *U. kirkiana* is the only indigenous fruit that is most favoured even in Zimbabwe (Ramadhani, 2002).

51% of the respondents indicated that *U. kirkiana* is dominant in the hilly mountainous areas, whilst 45% of the respondents indicated that it is found in the plain areas or low land forest (Figure 4). This is in agreement with results that the species is mostly found in hilly and mountainous areas that are marginal areas to the local communities (Ngulube et al., 1995; Malembo et al., 1998). The plain areas are associated with lowland forest from Lilongwe (Dzalanyama Forest Reserve), an area that is mostly plain but has the forest reserve both in the plain and hilly areas. Dzalanyama Forest Reserve is a government forest reserve that is protected by government but surrounded by villages explaining the abundance of *U. kirkiana* in such an easily accessible area.

58% of the respondents reported that they collect fruits about 10 km away from their villages while 42% collect from 1 - 5 km which is mostly in the northern region. The distance at which many travel to collect the fruits also supports the information that most of the people collect fruits from mountainous/hilly areas.

Information collected reveals that *U. kirkiana* fruits are more scarce (35%) now than they were five years ago, although in some cases they are commonly found, especially in the forest reserves (29%) of the Central and Northern regions. Scarcity of *U. kirkiana* could be related to the fact that *U. kirkiana* trees are not found in the homesteads or farming areas but in the forests that are mostly mountainous and far from the village. Unfortunately, domestication of the species has been slow due

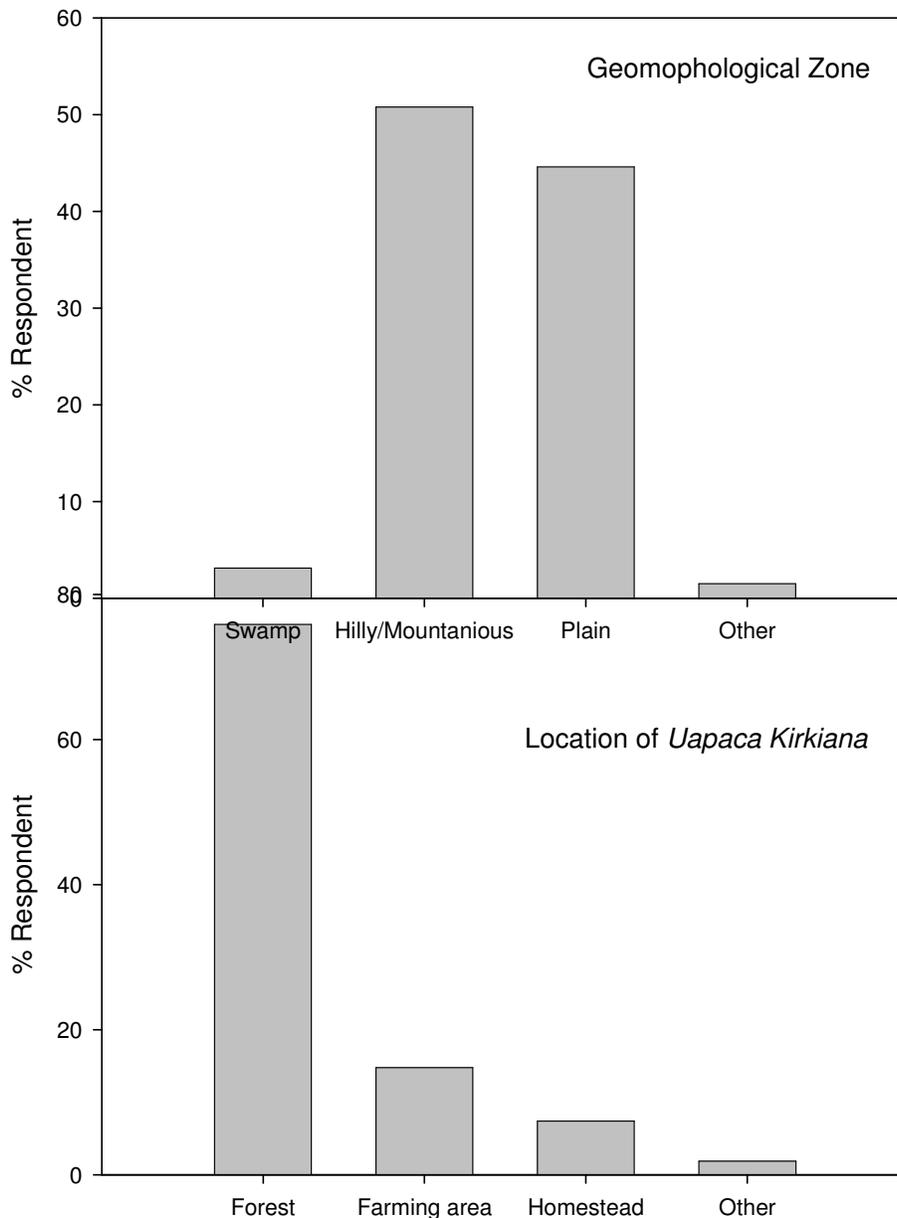


Figure 4. Responses of communities on geographical and main location of *Uapaca kirkiana*.

to problems of propagation and establishment in farmers' fields. This problem in particular affects the Phalombe district (southern region) where very few or no trees can be found on the farming area (Maliro and Kwapata, 2004). The communities have mixed knowledge with respect to climatic conditions under which *U. kirkiana* thrives. 40% of the respondents indicated that *U. kirkiana* is usually found in a warm climate whilst 31% indicated that the trees are found in the cold climate. Literature indicates that most of the tropical forests are found in warm areas with temperatures ranges of 18 - 29°C in hot season and 12 - 24°C in winter (Ngulube et al., 1995). This is an indication that local communities are not very knowledgeable about the climatic conditions of *U.*

kirkiana. The indication that they are found in cold areas could be attributed to the fact that in the hilly areas where there are a lot of trees it tends to be cooler than the lowland areas where communities live. The communities indicated that the trees are found in sandy (42%) and clay (31%) soils.

Most of the respondents (85%) know that *U. kirkiana* grows in association with mushrooms and communities of *Brachystegia-Julbernardia* species. In agreement an earlier study by Ngulube et al. (1995), reported that the species grow in association with mushrooms. The associated woody species include the genera *Albizia*, *Anisophyllea*, *Brachstegia*, *Burkea*, *Isorberlinia*, *Julbernardia*, *Manotes*, *Parinari*, *Protea*, *Pericopsis*, *Ptero-*

carpus, *Ochna* and other *Uapaca* species. Respondents specifically mentioned that *U. kirkiana* is mostly found where other fruits like *Azanza garckeana* and *Flacourtia indica* are also found. Apart from *U. kirkiana*, the respondents in the survey preferred the following indigenous fruit trees to be planted in their farm gardens: *Azanza garckeana*, *Annona senegalensis*, *Adansonia digitata* and *Parinari curatellifolia*. This is in agreement with priority studies by Minae et al. (1995), which documented these species as some of the important indigenous fruit trees preferred by communities. Malembo et al. (1998), in a household survey also reported *U. kirkiana* as the most preferred species followed by *Parinari curatellifolia*, *Strychnos cocculoides*, *Flacourtia indica*, *Azanza garckeana*, *Annona senegalensis*, *Vangueria infausta*, *Syzigium owariense*, *Adansonia digitata* and *Ficus sycomorus*.

The high representation (52%) of *U. kirkiana* in the government reserves (protected areas) that are also on marginal land areas reveals the importance of enforcing laws pertaining to forest reserve areas. Lack of enforcement is shown by relatively high fuel wood use (27 %) of *U. kirkiana* trees (Figure 2), which is assumed to be from felled trees by fruit vendors who do not necessarily belong to the communities around especially noticed in Dzalanyama. In this study an observation in the forest reserves that are managed and owned by the community, for example Kasungu (Chimaliro), trees are not cut down. Long sticks are normally used in harvesting the fruits in all the study areas. This may be related to the fact that the communities protect their trees better than the forest guards in government owned forests. This can be a strong point to consider in decentralization of forest reserves as the government of Malawi is trying to promote decentralization in many sectors.

Conclusions

U. kirkiana tree has economic potential at national level in Malawi; the tree has become scarce in many areas due to deforestation. *U. kirkiana* fruit, though not abundant, is a food security fruit and hence valued by the communities in Malawi in all the three regions. It provides an important safety net for livelihoods of the people around the forests. This species may become rare if domestication for conservation purposes is not urgently considered. Conservation of *U. kirkiana* trees through domestication is very important as government policies on forest reserves do not promote communities stewardship resulting in felling of trees for maximum fruit collection by vendors during *U. kirkiana* fruit harvesting. Information reveals that the communities are knowledge-able about its biology, ecology, biodiversity and use. For *U. kirkiana* tree to have an impact on utilization by the local communities there is a need to provide superior plant material that could survive in a different soil from their natural habitats. Consideration of strategies to im-

proving the species is very important for the local communities. In summary, domestication of *U. kirkiana* should be accompanied by improvements of preferred tree and fruit attributes and scaling up propagation, and enhancement of field survival. The Malawi government should strengthen policy on conservation of *U. kirkiana* and other indigenous tree species.

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