Contribution of Smallholder Tree Growers to Increasing Tree Cover in Kaliro District

Derick Kisegu, David Kagaha, Cory Whitney, and John R. S. Tabuti

Abstract Many stakeholders including the Ugandan government are growing trees and contributing to increasing tree cover in Uganda. Whereas the contribution of large-scale tree growers to increasing tree cover has been documented, that of smallholder tree growers (STGs) is not known. But because STGs make up the majority of tree growers, it is possible that their contribution to tree cover in the country is significant. In this study we have addressed this gap for Kaliro District. We have also explored the factors that influence tree planting by STGs. Data was collected in the months of January–June 2017 using interviews with 206 tree growers. Included in the survey were all smallholder farms with 20 or more trees. The tree growers planted 39 species, in the period 1997–2016, the most popular of which were *Pinus* spp., *Eucalyptus* spp., *Grevillea robusta* and *Maesopsis eminii.* Few STGs planted trees in that time (n = 206) and those who did tended to plant few trees (median 175 trees). Despite the average low contribution by STGs, tree cover is increasing due to a few STGs who planted very many trees. Growers who planted the most trees were male or engaged in small-scale business, possessed a university degree and received support from the government. New approaches may be necessary that provide better access to a greater diversity of smallholder farmers such as women and those without low income and education access. STGs affiliated to tree-growing associations appear to have planted fewer trees than those outside tree-growing associations. Tree growers associations should be redesigned to provide maximum benefit to STGs and local ecology. Income generation was cited as the STGs planters' main motivation for planting trees. However, the key immediate benefit was firewood. These may be important points to consider when developing interventions that target tree planting in the region and throughout Uganda. We conclude that the contribution of STGs to tree growing in Kaliro District is low and that

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tree planting campaigns should be inclusive and focus on STGs perceived benefits in order to achieve successful reforestation.

Keywords Reforestation · Smallholder tree growers · Afforestation · Tree planting · Incentives

1 Introduction

Native forests and other forested areas are declining rapidly in Uganda. According to the National Forestry Authority (2009), Uganda's annual forest loss over a 15-year period 1990–2005 was nearly 90,000 ha/year resulting in a reduction of forest cover from an estimated 4.9 in 1990 to 3.6 million ha in 2005 in the country. This loss was fastest in land outside protected areas where forest area declined from 3.46 million ha in 1990 to 2.3 million ha in 2005. The underlying causes of forest area loss in Uganda is the rapid population growth (3.2% per annum) and low levels of economic development and high levels of poverty. These factors lead to clearing of forests for agricultural land and/or degradation of forests through fuelwood production and timber harvesting. Fuelwood is used by over 90% of the Ugandan population. The demand for timber is high, and it is estimated that Uganda will require 150,000 ha of well-managed timber plantations by 2020 (Jacovelli 2009).

To counter deforestation and bridge the demand gap for timber and other resources, the Uganda Government and bilateral partners have supported tree growing by private tree planters, government organisations and civil organisations. National institutions actively involved in tree planting are the Uganda Wildlife Authority (UWA), the Forest Sector Support Department (FSSD) and the National Forestry Authority (NFA). Two important government interventions for tree planting are the Sawlog Production Grant Scheme (SPGS) and the Farm Income Enhancement and Forest Conservation (FIEFOC). For example, the SPGS founded in 2003 provided grants to people establishing tree plantations primarily for timber production, and by 2009, over 10,000 hectares had been established through its support (Jacovelli 2009).

Because there are very many smallholder tree growers (STGs) in Uganda, it is possible that their contribution to increasing tree cover through tree growing is significant in the country. However, this contribution has not been documented and is missing from the national records. In order to understand their contribution, it is important to determine how many of these tree growers are in operation and determine which species they are interested in, how many trees they have planted and what motivates them to plant trees. We undertook this study with the main objective of documenting the contribution of STGs to tree planting in Kaliro District; the secondary objective was to characterize the tree growers. We selected Kaliro District because it is one of the districts with the fastest loss of tree cover in Uganda and also because it is a rural area and agriculture is culturally important.

2 Study Area and Methods

Kaliro District is located in the Eastern Region of Uganda occupying an area of about 1000 km^2 (N 00° 54.694′ and E 033° 28.043′). The region is generally flat and at an altitude of 1045–1075 m a.s.l., with scattered rocky outcrops that are not suitable for crop agriculture but serve as important habitats for plants. The vegetation is classified as moist *Combretum* wooded grassland and dry *Combretum* wooded grassland (van Breugel et al. 2015). The district has two Central Forest Reserves (CFRs), the Kaliro CFR and Namalemba CFR, and one Local Forest Reserve (LFR) Namukooge. The agroecological zone of Kaliro is classified as the Banana/Millet/Cotton system. The climate is hot and dry, and rainfall averages 1430 mm per annum (International Food Policy Research Institute (IFPRI) and Datawheel 2017). There are two wet seasons, March to June and August to October. The region's soils are considered to be of low productivity are dominated by the Mazimasa complex of catenas derived from ancient lake deposits. This soil type is a shallow grey or brown sandy loam on laterite base rock (Ollier and Harrop 1959). The other types are mineral hydromorphic soils influenced by permanent or seasonal waterlogging and organic hydromorphic soils (Department of Lands and Survey 1962). Kaliro District has four major land use/land cover categories: (i) non-uniform small-scale farmland (67%), (ii) wetlands (16%) dominated by *Cyperus papyrus*, (iii) woodlands (4%) and (iv) bushlands (1%). Other land uses include settlements.

Kaliro is an agricultural community with 76% of the people practicing subsistence agriculture as their main source of livelihood (Kaliro District Local Government 2012). Agricultural practices consist of fallow cultivation and permanent cultivation farming systems. Average landholdings in the region are approximately 2 ha per homestead.

The district has about 42,000 homesteads and an estimated 236,199 people. The population density is high 303 people per km^2. The population growth rate is 3.5% per annum. The majority of the people (64%) are below 20 years of age (UBOS 2016); many (40%) are illiterate (UBOS 2016). People of eastern Uganda, including Kaliro District, are among the poorest in Uganda (UNDP 2007), and according to the Kaliro District statistical abstract of 2011/2012, 42% of the population is below the poverty line. The Uganda National Household Survey from the Uganda Bureau of Statistic (UBOS 2016) indicates that 27% of Uganda's population (ten million people) live in poverty. This is severe in eastern Uganda where poverty has increased by 27% since 2013.[1]

The residents and institutions of Kaliro depend heavily on wood products, e.g. for fuelwood, construction poles, etc. (Tabuti 2007). Firewood is the principal fuel used for cooking in 97% of the households and organisations such as prisons, police stations and schools (Tabuti 2007). Kaliro District is urbanizing, and this is creating

[1] Oketch, M.L. 2017. 3.4 million more Ugandans slip into poverty. http://www.monitor.co.ug/News/National/34-million-Ugandans-poverty-income-prices/688334-4115106-mulfd7z/index.html

new and acute pressures for production of tree products. The rural community of Kaliro District is experiencing rapid woody vegetation loss arising mainly out of land use conversion and over-exploitation. The underlying factors for tree loss are the rapidly growing population and the accompanying high levels of poverty. Trees have been rampantly destroyed mostly because of increasing crop agriculture and charcoal production. In the period between 1990 and 2005, Kaliro District lost more than 86% of its tree stock (from 29 tons per ha to just above 4 tons per hectare) (National Forestry Authority 2009). Creation of space for commercial sugarcane production is also a new risk to trees in Kaliro. A new sugar factory was recently established in the district, and sugar cane is now intensively grown and is expected to affect tree cover negatively in Kaliro District.

As is the case throughout Uganda, Kaliro does not have sufficient extension staff to oversee tree growing. Kaliro has an estimated 20 agricultural extension workers (AfranaaKwapong and Nkonya 2015), which leaves an urgent gap for active interventions to promote tree growing.

2.1 Data Collection

According to Mercer (2004), there are many factors that influence attitudes concerning tree growing, which include household attributes, resource endowments and institutional frameworks. Household attributes that influence tree planting include age, education, gender, off-farm or paid labour and anticipated benefits, while resource endowments or the assets available to farmers for investing in tree growing include land, labour available for tree growing and savings. Institutional frameworks on their part include arrangements to access seedlings, technical support and information.

We developed hypotheses following a human ecology theoretical approach (cf. Whitney et al. 2018a, b) and based on the above literature and our experience in the field. Our hypotheses were that household attributes (age, gender, education, source of livelihood/labour) and institutional frameworks (access to seedlings, technical support and information) influence the number of trees planted by a tree planter.

Selection of respondents was done purposively. With the help of the local chairperson and regional officers, we identified and interviewed all smallholder tree growers who had planted 20 or more trees and had managed them for at least 1 year. Interviews took place throughout Kaliro District (Fig. 1) between the months of January–June 2017, with a total of 206 tree growers including 16 institutions, 25 women and 164 men. We restricted our survey to a 20-year time period, i.e. from 1997 to 2016.

During the interviews, we documented socio-economic information including gender, age, employment, level of education, household size, land tenure and membership in any tree growers associations. We also documented silvicultural practices, including the number and species that were planted, the year of planting, the number that survived and sources of planting materials. We also sought to learn the

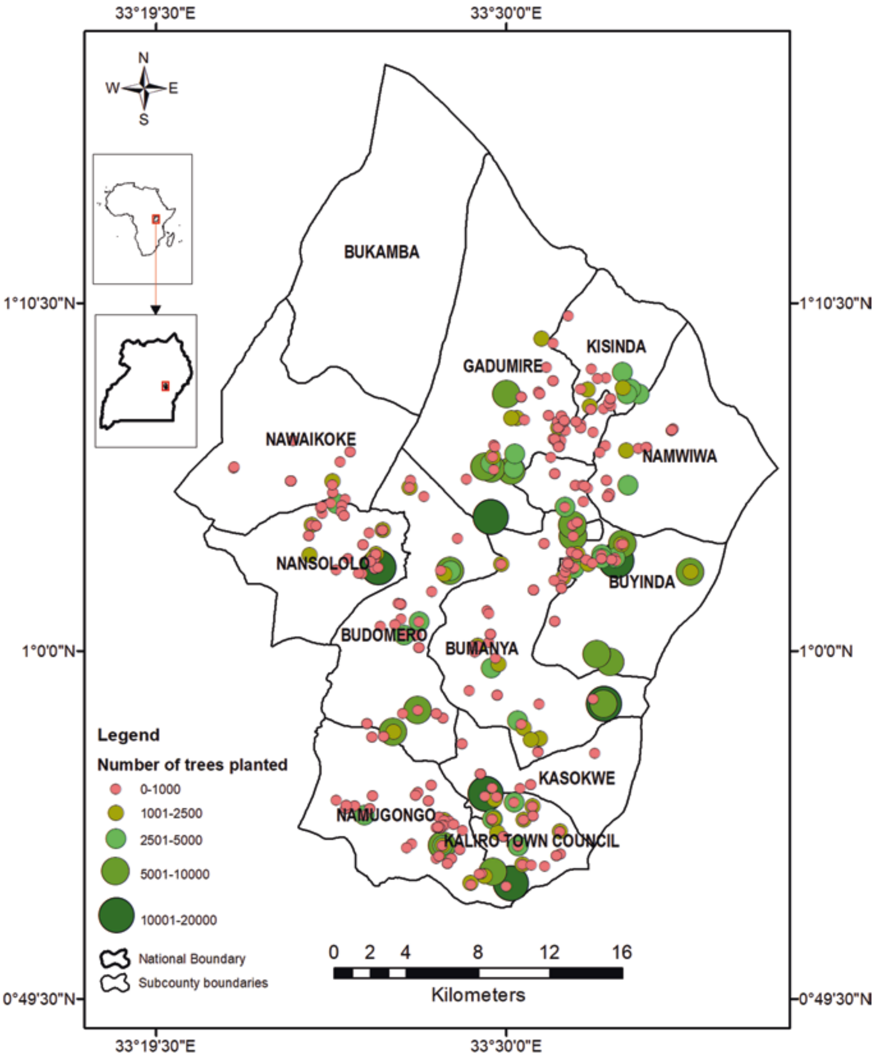

Fig. 1 Map of the Kaliro District generated using data from this survey. The map shows the locations of the tree gardens/plantations and the number of trees planted for the smallholder tree growers. Insets of Africa and Uganda are shown

tree growers' motivations for planting trees, as well as perceived benefits from trees, sources and forms of technical support concerning tree planting, management plans and the risks and challenges for tree planting. The survey included observations on the general condition of the trees and the tree plantation including the quality of the maintenance.

The average number of people in the homestead was eight (ranging from one to 29 people). Almost all tree growers, whether individuals or institutions, owned the

Table 1 Social economic attributes of the tree growers

Attribute	Number
Gender	
Female	25
Male	164
Education	
None	4
Primary level	33
Lower secondary level	81
Upper secondary level	6
Tertiary/vocational certificate	22
University degree	40
Occupation	
Farmer	107
Civil servant	68
Business man	34
Artisan	13
Politician	9
Other (priest 2, crime preventer 1, student 1)	4
Affiliated to tree-growing association	
No	176
Yes	25
Affiliated to institution	
Individual	189
Institution	16

land on which they grew trees, and only two rented the land (NFA reserves) they used for planting trees. Only 25 tree planters were affiliated to a tree-growing association (Table 1). The respondents had an average age of 49 years (range 21–85) and were employed as farmers (107), civil servants (68), business men (34) and artisans (13). One respondent was still a student. The majority had attained up to lower secondary level education (i.e. 11 years of formal education; 40 of the tree planters had a university degree).

2.2 *Data Analysis*

We used the Wilcoxon rank sum test with continuity correction and Kruskal-Wallis sum test to test for differences between the independent variables in relation to the number of trees grown by individual tree growers. Specifically, the Wilcoxon test was used to test for differences in tree growing observed between gender and affiliation to a tree growers association. We also used the same to test whether being an individual or an institution influenced the number of trees grown.

The Kruskal-Wallis sum test was used to test for differences between livelihood activity, education level, source of seedlings and institutional support. We also tested for associations using the generalized linear model (GLM) and chi-squared contingency table tests. All analyses were performed in the R programming language (R Core Team 2017). Statistical level of significance was set at 95%.

3 Results

Altogether 206 tree growers took part in the study, including 189 individuals and 16 institutions across Kaliro District (Fig. 1). Trees were planted in configurations of small woodlots and sometimes in mixtures with crops. The interviewed tree growers reported that they had planted a total of 457,763 trees since 1997, and that of these 314,388 were still surviving on their farms (a survival rate of 61%). The average (median) number of trees planted per tree grower was 175 (range 1–15,500), and the median number of trees surviving was 74.5 per grower. There were wide variations in the reported numbers of trees planted by tree growers. A few growers planted very many trees, up to 15,500 in some instances (Fig. 2).

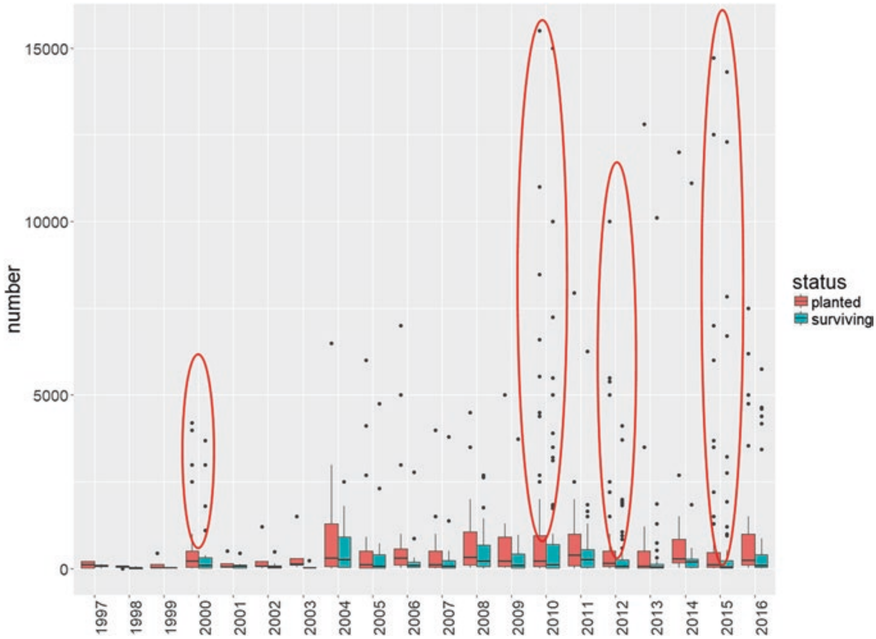

Fig. 2 Tree planting by smallholder tree growers in Kaliro District between 1997 and 2016. Shown are number of trees planted (red boxplots) and those surviving (blue boxplots) by year. Peaks (outliers) of intensive tree-planting farmers in tree growing in the years 2000, 2010, 2012 and 2015 highlighted by the red ellipses corresponding to the time when Farm Income Enhancement and Forest Conservation and a local NGO SUPD were active

The absolute number of trees planted by tree growers in Kaliro District was found to have increased over the selected time period, from a low of 427 trees planted in 1997 to 44,142 in 2016. It peaked in 2010 (92,656 trees), then in 2012 (53,094 trees) and 2015 (62,958 trees). (Fig. 2). In the years 2010 and 2012, the government provided free seedlings for tree planting under the Farm Income Enhancement and Forest Conservation (FIEFOC); again between 2014 and 2017, a local NGO Sustainable Use of Plant Diversity (SUPD) facilitated tree planting by providing free seedlings, tree propagation materials and training to tree growers to propagate and grow trees. These interventions resulted in a weak but significant relationship between increased availability of seedlings to tree growers and number of trees planted ($R^2 = 13.7$, $p < 0.05$). (Fig. 2).

The type of livelihood/activity, education level, source of seedlings, institutional support, gender and affiliation to a tree-growing association was found to influence the number of seedlings planted by tree growers (Table 2). Those planters whose

Table 2 Influence of intrinsic and extrinsic household factors on the success of tree growing. Influence of livelihood/activity, education level, source of seedlings and institutional support analysed using Kruskal-Wallis, gender and affiliation to a tree growers association analysed using Wilcoxon rank sum test with continuity correction

Variable	Median
Livelihood/activity (chi-squared = 74.708, df = 4, *p*-value = 0.05)	
Artisan	300
Business man	1000
Civil servant	350
Farmer	100
Student	183
Education level (chi-squared = 35.725, df = 2, *p*-value = 0.05)	
Skilled artisan	100
Secondary or lower	123
University degree	500
Source of seedlings (chi-squared = 25.882, df = 3, *p*-value = 0.05)	
Civil society organization	60
District	200
Propagated by self	245
Other	100
Institutional support (chi-squared = 14.355, df = 2, *p*-value = 0.05)	
District	500
Other	183
Self	100
Gender (W = 8552.5, p-value = 0.05)	
Female	100
Male	200
Affiliation to a tree growers association (W = 22,367, *p*-value = 0.05)	
No	220
Yes	60

Table 3 Numbers of different tree species planted by smallholder tree growers in Kaliro District, Uganda. *Tectona grandis* is not listed here since it was planted by few growers

Species	Total number of trees	Median number by tree grower	No. (%) of tree growers
Pinus caribaea Morelet	208,374	755	113 (53%)
Eucalyptus grandis W. Hill	90,968	500	62 (29%)
Eucalyptus unnamed hybrid	61,604	3626	14 (7%)
Eucalyptus camaldulensis Dehnh.	26,287	200	35 (17%)
Grevillea robusta A. Cunn. ex R. Br.	26,101	100	85 (40%)
Maesopsis eminii Engl.	15,349	100	70 (33%)

main occupation was small-scale business owner, or who possessed university education, or received support from the district (government) planted a significantly larger number of seedlings than for other levels of these factors (Table 2). Gender was found to be an important factor, as men tended to plant more trees than women. People affiliated to tree-growing associations tended to plant fewer seedlings than those outside tree-growing associations; however they planted more species (median = 5) than non-affiliates (median = 3); $W = 12{,}004$, p-value = 0.0003.

Tree growers in the survey planted 39 different tree species (Appendix 1). The most popular of these, by proportion of tree growers planting the species and by number of trees planted, are *Pinus caribaea* Morelet (53%), three *Eucalyptus* spp. (53%), *Grevillea robusta* A. Cunn. ex R. Br. (40%) and *Maesopsis eminii* Engl. (33%) (Table 3). The most popular species were fast-growing timber trees (Fig. 3).

Tree growers reported that tree seedlings were acquired through purchases using personal funds (40%) or were provided free of charge by the district (34%) or by NGOs (8%). Most plantations were found to be poorly managed but still had trees with good boles. Most tree growers (89%) did not have management plans for their plantations, and management activities were limited to thinning, slashing/weeding and pruning. Tree growers stated that they acquired awareness to promote tree planting and technical information about tree growing and management from the District Forestry Office (DFO), local non-governmental organizations and civil society organizations.

Tree growers cited several sources of motivation that inspired them to plant and manage their trees. The most important motivations included future and current sources of income (42% and 25%, respectively), land tenure (i.e. secure land rights, 21%), environmental protection and restoration (20%), firewood (11%), timber (10%), windbreak (9%) and shade (7%). There were also additional incentives including firewood and timber (Fig. 4).

There was a slight difference between the most important incentive and most important benefits. Unlike the incentives that motivate tree growers, where income was the most important value, the most frequently cited actual benefits enjoyed were firewood mentioned by 61% of the tree growers, shade for people and animals

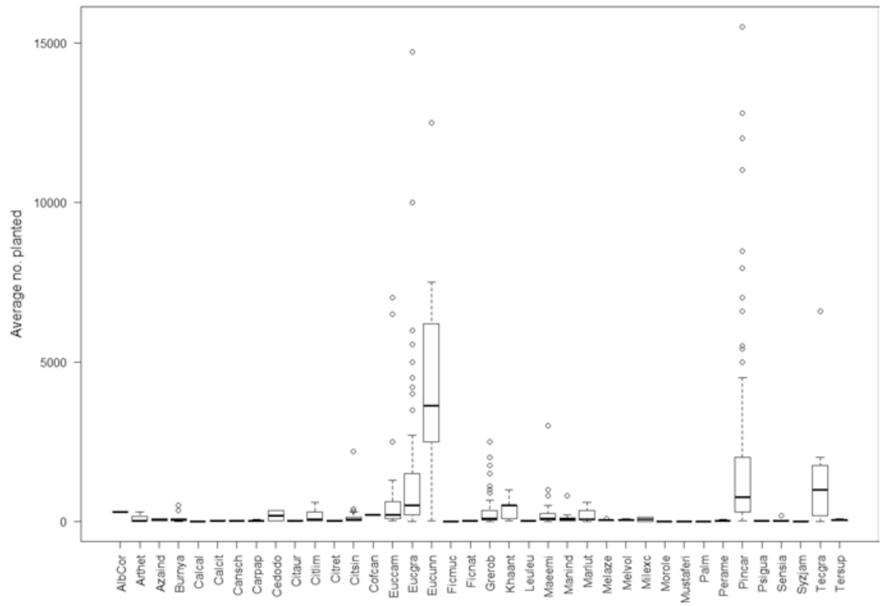

Fig. 3 Box plot of average numbers of individual trees of tree species grown by tree growers in Kaliro District, Uganda. *Eucalyptus* spp. (Euccam, Eucunn, Eucgra), *Pinus caribaea* (Pincar) and *Tectona grandis* (Tecgra). Albcor (*Albizia coriaria* Welw. ex Oliv.), Arthet (*Artocarpus heterophyllus* Lam.), Azaind (*Azadirachta indica* A. Juss.), Burnya (*Burtdavya nyassica* Hoyle), Calcal (*Calliandra calothyrsus* Meisn.), Calcit (*Callistemon citrinus* [Curtis] Skeels), Cansch (*Canarium schweinfurthii* Engl.), Carpap (*Carica papaya* L.), Cedodo (*Cedrela odorata* L.), Citlim (*Citrus limon* [L.] Osbeck), Citaur (*Citrus aurantiifolia* [Christm.] Swingle), Citret (*Citrus reticulata* Blanco), Citsin (*Citrus sinensis* [L.] Osbeck), Cofcan (*Coffea canephora* Pierre ex A. Froehner), Euccam (*Eucalyptus camaldulensis* Dehnh.), Eucgra (*Eucalyptus grandis* W. Hill), Eucunn (*Eucalyptus* unnamed hybrid), Ficmuc (*Ficus mucuso* Welw. ex Ficalho), Ficnat (*Ficus natalensis* Hochst.), Grerob (*Grevillea robusta* A. Cunn. ex R. Br.), Khaant (*Khaya anthotheca* (Welw.) C. DC.), Leuleu (*Leucaena leucocephala* (Lam.) de Wit), Maeemi (*Maesopsis eminii* Engl.), Manind (*Mangifera indica* L.), *Marlut* (*Markhamia lutea* (Benth.) K. Schum.), Melaze (*Melia azedarach* L.), Melvol (*Melia volkensii* Gürke), Milexc (*Milicia excelsa* [Welw.] C.C. Berg), Morole (*Moringa oleifera* Lam.), Mustaferi, Palm (Palm not identified), Perame (*Persea americana* Mill.), Pincar (*Pinus caribaea* Morelet), Psigua (*Psidium guajava* L.), Sensia (*Senna siamea* [Lam.] H.S. Irwin & Barneby), Syzjam (*Syzygium jambos* [L.] Alston), Tecgra (*Tectona grandis* L. f.), Tersup (*Terminalia superba* Engl. & Diels)

(30%), followed by income generation and windbreak (27% each) (Fig. 5). Other key benefits were windbreak, mentioned by 27% of the respondents, environmental restoration and secure land tenure (18% each). Taking the incentives and realised benefits together, the most important tree values in Kaliro appear to be income, firewood, security of land tenure, windbreaks, shade and to support a good environment.

Tree growers reported several important challenges that impact tree growing. The most important of which was the loss of seedlings and trees to pests (75%) and

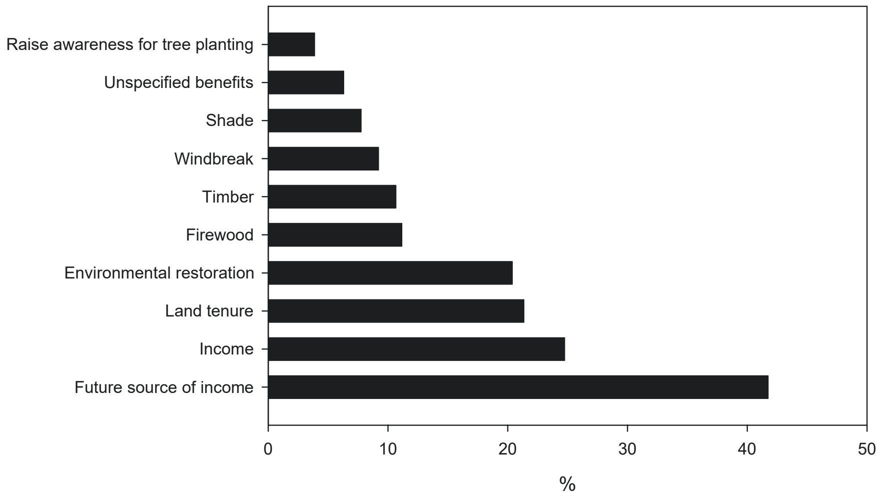

Fig. 4 Incentives for tree planting cited by tree growers in Kaliro District, Uganda

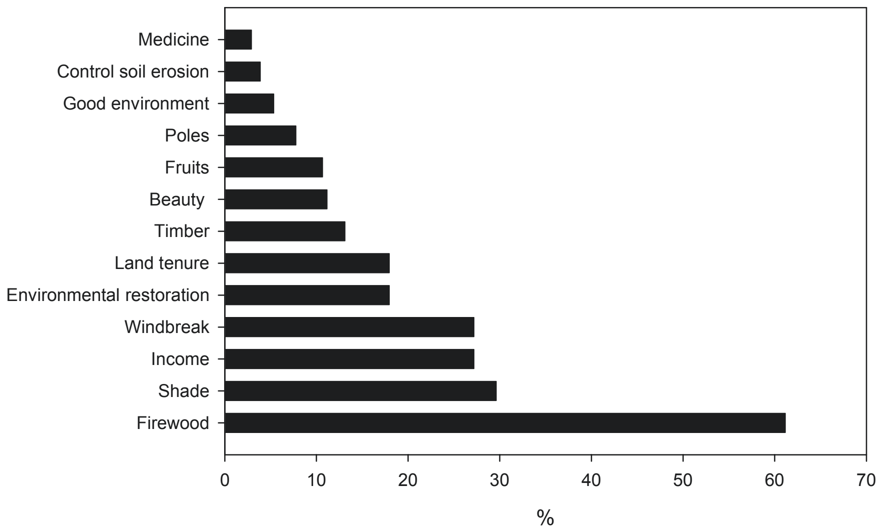

Fig. 5 Benefits from trees cited by tree growers in Kaliro District, Uganda

livestock damage (51%). The most commonly known pests are termites mentioned by 90% of the respondents that mentioned pests as a problem. Drought was also a major issue, mentioned by 49% of the planters. Other problems reported were vandalism from other community members (33%) and theft of seedlings and tree products (namely, firewood, edible fruits, bark for repelling mosquitoes, etc.) (Fig. 6).

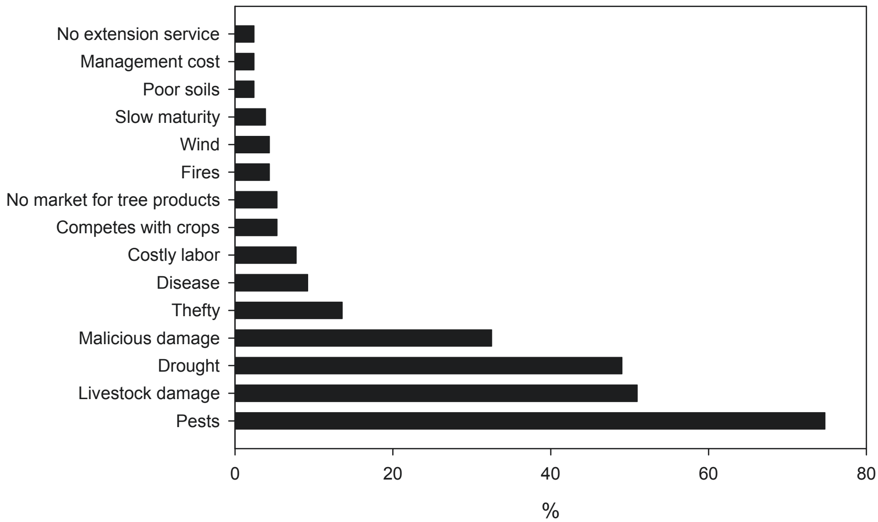

Fig. 6 Challenges, cited by tree planters, that hamper tree planting in Kaliro District. The main pests that were mentioned were termites

4 Discussion

The tree planting effort in Kaliro District appears to be low with only 189 participating tree growers (or homesteads), and 16 institutions, out of the estimated 42,000 homesteads in Kaliro District, and with tree growers planting an average of 175 trees per tree grower. If we assume that a hectare can be planted with 900 trees, then every tree grower has planted on average 0.2 hectares. This notwithstanding, tree cover appears to be increasing because of a few tree growers who plant very many trees. Some of these tree growers have planted in excess of 15,000 seedlings.

Planters with the most trees have the attributes of being male and having attained university level education. Education enables higher incomes with which planters can afford to access the necessary resources including land, equipment, labour and materials such as pesticides that are required to manage the plantation. People with sufficient financial resources are not constrained by the long periods required for the trees to mature before they can be sold for cash income (Kallio et al. 2011). On the other hand, poor tree growers who depend on cash incomes from the farm often rely on short-maturing crops that can be harvested in a single season and sold for cash (Kallio et al. 2011).

Planters involved in business as a livelihood occupation also planted more trees than other tree growers, who were involved in other livelihood activities such as farming. It is not clear why businessmen were more active in tree planning than others. We can speculate, however, that the current wood supply gap in Uganda, due to the increased demand of tree products (FAO and DFID 2016), is driving business-minded persons to invest in tree planting.

Contrary to what is known from the literature that affiliation to tree planting associations promotes tree growing (e.g. Kallio et al. 2011), affiliation to tree growers associations in our case had a negative effect on tree growing. Planters in tree-growing associations planted fewer trees than those outside of these associations. They on the other hand planted more species than those outside of tree-growing associations. That tree growers affiliated to tree-growing associations planted fewer number of trees than those not affiliated to associations is surprising, as it is widely believed that affiliation to groups should improve the success of an activity as it improves access to resources and technical skills among other benefits. This aspect needs further exploration to determine the reasons why tree growers in associations planted fewer trees.

Tree planting has changed with time and a number of historical factors may have influenced these shifts. For example, in the years 2010 and 2012, government provided free tree seedlings under the Farm Income Enhancement and Forest Conservation (FIEFOC) project. Then, between 2014 and 2017, the local NGO Sustainable Use of Plant Diversity (SUPD) facilitated tree planting by providing free seedlings and tree propagation materials and trained tree growers to propagate and grow trees. This support by government and CSOs resulted in a small but statistically significant increase in the number of trees grown. It appears, therefore, that institutional support in the form of easing access to seedlings (whether sold or otherwise) is important for successful tree growing and suggests that institutions are important for tree growing. Furthermore, institutions can raise awareness about the need for and benefits of tree planting. However, it is important to note that planters were active players who to a very large extent (40%) invested their own funds to buy seedlings.

Results of this study seem to agree with the Induced Innovation Theory and the Livelihood Strategy Theory described in Scherr (1995). Briefly, the Livelihood Strategy Theory proposes that farmers' or tree growers' tree-growing strategies are determined by their overall household livelihood strategies and resource base, e.g. tree growers may grow timber trees as a form of saving if they have no superior strategy for saving. On the other hand, the Induced Innovation Theory asserts that farmers tree growing can be induced by historical changes in socio-economic conditions that include (1) declining access to tree products, (2) increasing demand for tree products, (3) declining farm sizes that create a need for planting fences or boundary markers and (4) declining land quality that causes the planting of trees to restore soil fertility, for example. We see this in the nature of species selected by tree growers for planting, the motivations for planting and benefits realised from the planted trees. For instance, the most frequently grown and thus the most preferred species in Kaliro District (Table 3) are fast-maturing pole and timber species, e.g. *Eucalyptus* spp. that are much in demand and have a ready market. With four out of the six priority species being species that produce poles and timber for sale, the implication is that the primary incentive for tree planting is income generation. Indeed, when asked why they planted trees, most tree growers reported income generation more frequently than other factors.

There appears to be a difference between the incentives that motivate tree planting and the benefits that are actually realised from trees. Whereas the key incentive was income, it turns out that the most frequently mentioned benefit was firewood and income generation coming second. We can speculate that even though income is the key motivating factor, but that during the period it takes for trees to mature to a stage where they can provide commercial products, people harvest and utilize firewood from them. Firewood is becoming increasingly scarce and a critical resource in this rural and poor community that people are now forced to buy it (SUPD unpublished report). So firewood has now moved beyond a subsistence product in this community to a marketable product.

The main challenges cited by the planters were biophysical in nature. These included pests, drought and livestock damage. There were also a number of socio-economic problems such as vandalism and theft. These are common challenges to tree planting that have been widely cited in the literature.

It is important to note that lack of market was not one of the challenges mentioned by tree growers. We can speculate that the market for timber and poles is well established and the demand is high. However, the market for horticultural crop products (e.g. mangoes and oranges) is not that well developed and that people are not aware of its potential. This may explain why few fruit trees were planted by tree growers in this study. There is a need therefore to create awareness about the market potential of horticultural crops.

5 Conclusion and Recommendations

This study suggests that the contribution of SHF smallholder tree growers to tree planting is very low at an average of 175 trees per tree grower and with only 206 tree growers (individuals and institutions). There is a need, therefore, to promote more tree growing. This notwithstanding, tree cover has increased in Kaliro District since 1997 because of a few farmers who planted more intensively. Characteristics that differentiate tree growers are that they are men, who are mostly engaged in business, have a university degree and are not affiliated to a tree growers association. For interventions aimed at promoting tree growing to succeed in Kaliro District, institutional support is needed that promotes access to seedlings and increases awareness and skills for tree planting. New approaches may be necessary that provide better access to a greater diversity of smallholder farmers such as women and those with low levels of access to other sources of income and to education. The structure and functions of tree growers associations may need to be revisited to ensure that it provides the maximum benefits to members and local ecology.

The cited difference between realized or anticipated benefits and motivating incentives is an important insight gained through this study. Whereas the key incentive for tree planting is primarily cash incomes, the key benefits were firewood. It is important that these benefits are considered when interventions for tree planting are being designed. Interventions should make available materials necessary for planting, e.g. seedlings, pesticides, etc. and also avail skills for propagating seedlings and also raise awareness about the value of tree management. Additional recommendations from this study are that tree growers should be made aware about the potential market for horticultural crops, because this will not only stimulate tree growing but also alleviate poverty.

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Appendix 1

Tree species planted by smallholder tree growers in Kaliro District, Uganda from 1997–2017 sorted by number of farmers that planted the species

Species	Total trees	Median	# of famers
Pinus caribaea Morelet	208,374	755	113
Eucalyptus grandis W. Hill	90,968	500	62
Eucalyptus unnamed hybrid	61,604	3626	14
Eucalyptus camaldulensis Dehnh.	26,287	200	35
Grevillea robusta A. Cunn. ex R. Br.	26,101	100	85
Maesopsis eminii Engl.	15,349	100	70
Tectona grandis L. f.	12,469	1000	8
Citrus sinensis (L.) Osbeck	5147	60	28
Khaya anthotheca (Welw.) C. DC.	2700	500	7
Mangifera indica L.	2160	55	19
Burtdavya nyassica Hoyle	1411	50	13
Citrus limon (L.) Osbeck	1080	70	6
Markhamia lutea (Benth.) K. Schum.	674	70	3
Artocarpus heterophyllus lam.	517	21	6
Terminalia superba Engl. & Diels	384	37	10
Cedrela odorata L.	363	181.5	2
Melia azedarach L.	308	50	7
Albizia coriaria Welw. ex Oliv.	300	300	2
Senna siamea (Lam.) H.S. Irwin & Barneby	262	20	6
Melia volkensii Gürke	240	40	5
Persea americana Mill.	219	20	7
Coffea canephora Pierre ex A. Froehner	200	200	1
Milicia excelsa (Welw.) C.C. Berg	135	67.5	2
Azadirachta indica A. Juss.	125	62.5	2
Carica papaya L.	83	10.5	4
Citrus reticulata Blanco	77	13	4

Species	Total trees	Median	# of famers
Callistemon citrinus (Curtis) Skeels	61	30.5	2
Ficus natalensis Hochst.	42	21	2
Psidium guajava L.	30	30	1
Leucaena leucocephala (Lam.) de Wit	21	21	1
Citrus aurantiifolia (Christm.) Swingle	20	20	1
Canarium schweinfurthii Engl.	15	15	1
Syzygium jambos (L.) Alston	13	6.5	2
Moringa oleifera Lam.	6	6	1
Calliandra calothyrsus Meisn.	5	5	1
Ficus mucuso Welw. ex Ficalho	5	5	1
Mustaferi	5	5	1
Palm not identified	3	3	1

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