Evaluative report on CIFOR-ICRAF programming with refugees and hosts in northwestern Uganda

Prepared by Sarah Juster for CIFOR-ICRAF, Uganda

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Cover photos: Refugee with harvested CIFOR-ICRAF poles (left); refugee family enjoying shade from *Senna siamea* (top right); host national with *Ximenia americana* fruits (lower center); host woman and baby eating mango fruit (lower right).

All photos by Sarah Juster

CIFOR
Jl. CIFOR, Situ Gede
Bogor Barat 16115
Indonesia
T +62 (251) 8622622
F +62 (251) 8622100
E cifor@cifor-icraf.org

ICRAF
United Nations Avenue, Gigiri
PO Box 30677, Nairobi, 00100
Kenya
T +254 (20) 7224000
F +254 (20) 7224001
E worldagroforestry@cifor-icraf.org

cifor-icraf.org

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Sarah Juster

Virginia Polytechnic Institute and State University

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Acknowledgements

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I am grateful to the refugee and host communities in Imvepi and Rhino Camp Refugee Settlements in the West Nile region of Uganda for welcoming me and providing in-depth insights. CIFOR-ICRAF team members deserving my appreciation for helping with this study include particularly Adriko Joel, Tiko Gertrude, Osidi John, and Rhino Camp and Imvepi Community-based Facilitators. I thank Cathy Watson of CIFOR-ICRAF and Professor Mike Gold of the University of Missouri for enabling this collaboration. CIFOR-ICRAF Country Director Dr Erik Acanakwo, Dr Joel Buyinza of the Uganda National Agricultural Research Organization, and Dr John Munsell of Virginia Polytechnic Institute and State University reviewed evaluation materials and made important recommendations to guide the evaluation design and implementation.

Executive summary

The following evaluative report provides insight on the outcomes of an agroforestry programme implemented by CIFOR-ICRAF with refugees and hosts in two refugee settlements within the West Nile subregion of Uganda. The programme mission sits squarely at the intersection of multiple global challenges: mass refugee displacement, energy access, malnutrition, deforestation and biodiversity loss. By introducing the practice of agroforestry, or the intentional integration of trees with livestock and/or crops, the programme addresses significant human welfare challenges within the refugee-hosting context. Simultaneously, the programme recognizes the need to protect and enhance the natural resources upon which refugee and host livelihoods and well-being depend.

The following report highlights some of the important strengths, challenges, and opportunities for CIFOR-ICRAF agroforestry programming with refugees and hosts in northwest Uganda. Results suggest that the programme has contributed to significant re-greening in the settlement, reductions in firewood harvesting, and modest income gains among participants. A low survival rate for planted seedlings planted, particularly on refugee plots, is among the greatest challenges hindering programmatic success. Participants offer a wide range of solutions to address programme challenges, pointing to cost-effective measures such as provision of training and group-based programme implementation for improved results moving forward.

In the following pages, this report dives into these topics and more, and highlighting hints of positive impact while underscoring programmatic shortfalls and areas for future improvement.

1. Introduction

Since 2018, World Agroforestry (ICRAF), which merged with the Center for International Forestry Research (CIFOR) to become CIFOR-ICRAF in 2019, has promoted agroforestry through programming with hosts and refugees in the West Nile sub-region of northwestern Uganda. The project, today often referred to simply as 'GlobalGiving,' (the name of the crowdfunding site from which mast of its funding has come) is a response to urgent landscape and human health needs resulting from the ongoing mass displacement of refugees, largely from South Sudan, into Uganda. On the landscape level, deforestation and the associated loss of ecosystem services and biodiversity are of utmost concern, stemming from the steep rise in population demand on forest resources (Bernard et al. 2022). At the same time, poor nutrition and poverty are pervasive human welfare issues among both refugees and host communities (Bohnet and Schmitz-Pranghe 2019).

Towards addressing environmental and human welfare challenges in the Imvepi and Rhino Camp settlements, the GlobalGiving project raises tree seedlings for distribution to participants while providing agroforestry training and support through a staff of field assistants and community-based facilitators (CBFs). The project has distributed hundreds of thousands of seedlings and registered more than 1000 participants since its inception. Seedlings raised at the CIFOR-ICRAF learning centre are a mixture of indigenous and exotic species, reflecting simultaneous project goals of restoring landscape biodiversity while addressing participant needs for the short-term production of fruit, timber, and firewood products.

1.1 Purpose of study

When ICRAF began working in the refugee area, it undertook a preliminary study to explore agroforestry opportunities for addressing deforestation and tree product demand among hosts and refugees. The study gauged refugee and host preferences for tree species, planting layout, and support required for successful agroforestry engagement (Duguma et al. 2019). In 2021, 40 CIFOR-ICRAF participants were interviewed as part of another research study on opportunities and challenges across three dimensions of agroforestry: livestock rearing, crop production, and tree planting (Grosrenaud et al. 2021).

The purpose of this present study conducted in 2022 is to provide current, evaluative data on the GlobalGiving project. This data includes quantitative measurements as well as qualitative insights on project impacts. A secondary purpose is to highlight future directions and opportunities for CIFOR-ICRAF programming in the refugee-hosting context.

Specifically, the study asks:

- How is CIFOR-ICRAF programming contributing to landscape restoration and re-greening in the Imvepi and Rhino Camp settlements?
- How is CIFOR-ICRAF programming contributing to improved human welfare among participants?
- Based on existing programmatic strengths and weaknesses, which future directions are most promising for CIFOR-ICRAF programming?

2. Methodology

2.1 Data collection and analysis

Based on the questions listed above, a questionnaire was developed and administered to a total of n=80 CIFOR-ICRAF refugee and host participants across six zones in the Imvepi and Rhino Camp refugee settlements between February and April of 2022. The questionnaire took approximately 20 can be replaced throughout the document during the layout stage–30 minutes to complete. Questionnaire responses were collected on tablets using Kobocollect. Data analysis was performed using SPSS V29.

Given limited time and resources, sampling strategies for identifying research participants varied. In Imvepi refugee settlement, every fourth participant was selected from a list of total participants in the three zones of programme operation. In the Rhino Camp refugee settlement, it was more difficult to implement a randomized sampling strategy due to staff turnover and the far distances between households. Instead, participants were purposively selected by CBFs based on their proximity of location, while aiming to achieve targeted numbers of host and refugee participants.

This evaluative project received formal written approval through the Office of the Prime Minister (Appendix 1). Participants were made aware of their rights as study participants through a written informed consent process conducted before each interview.

2.2 Measurements and limitations

This evaluation was not intended to precisely measure the impact of CIFOR-ICRAF programming in the Imvepi and Rhino Camp refugee settlements. Rather, the intention was to identify markers of progress and/or lack thereof towards achieving the dual programmatic goals of improving environmental and human welfare conditions in the refugee settlements. Descriptive statistics were collected for the following environmental indicators: number of trees maintained per participant plot, tree seedling survival rates, tree species diversity and use on plots, and off-plot tree use. On the human welfare side, descriptive statistics were collected for the following indicators: household income attributed to the sale of tree products, nutritional benefits derived from trees, environmental services provided by trees at the household level, and the involvement of women in agroforestry activities.

Indications of progress and programmatic impact were identified through comparison of results between participants with less than one year of CIFOR-ICRAF engagement and participants having one or more years. Tree seedlings distributed by CIFOR-ICRAF require at least one year to produce beneficial products such as poles, fruits, or firewood, so participants with up to one year of participation are considered new and unlikely to benefit from their agroforestry involvement to the extent of those participants with one or more years of experience. More rigorous impact analysis would have required a larger sample size of recruited participants and complete randomization of selected participants.

2.3 Demographics

Of the n=80 total participants, 56 (70%) were refugees while 24 (30%) were Ugandan host nationals. These proportions reflect the national guidelines within Uganda for a minimum of 30% host national inclusion within all humanitarian activities. Refugees were entirely from South Sudan although they represented more than six mother tongues: Kakwa, Keliko, Kuku, Pojulu,

Muru, and Mundo. N=38 participants were female while n=42 were male. The average household size was 8.34. N=27 participants were new to CIFOR-ICRAF programming, with less than one year of participation, while n=53 participated for one or more years (Figure 1).

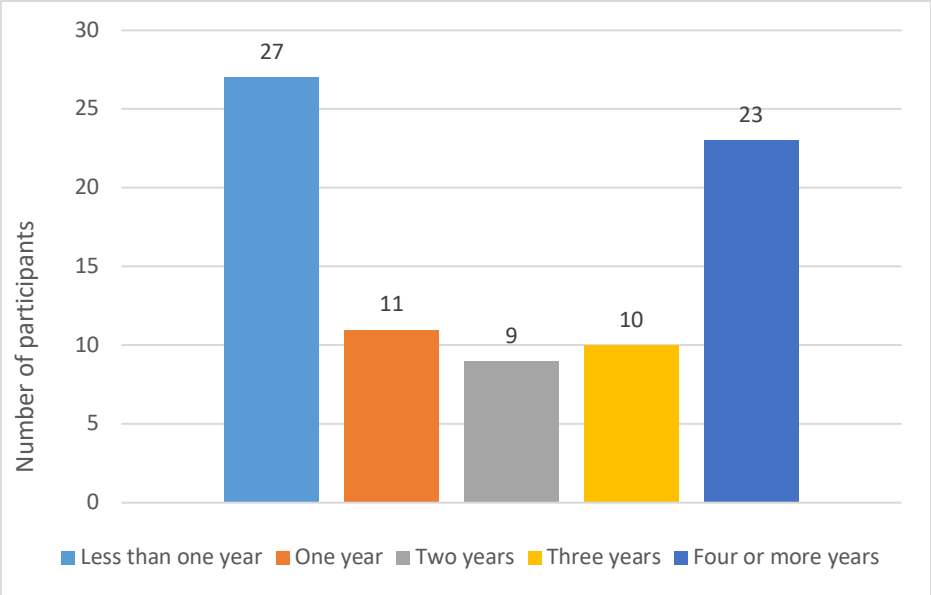

Figure 1. Duration of CIFOR-ICRAF beneficiary involvement

3. CIFOR-ICRAF programme impacts on landscapes and livelihoods

3.1 Impacts on landscape restoration and re-greening

3.1.1 Number of trees maintained by CIFOR-ICRAF participants per plot

The average refugee plot size was 0.29 ha (roughly 0.71 acres). On average, refugees maintained 29 trees per plot, with a minimum of 4 and a maximum of 150. The average host land size was 18.65 ha. Hosts maintained approximately 1500 trees on their plots on average, although hosts with large landholdings were challenged to estimate trees per plot. Host landholdings are also highly variable, with the smallest plot size at 0.6 ha and largest reaching 202.3 ha.

3.1.2 CIFOR-ICRAF participation and tree cover

Among refugees, increased duration of CIFOR-ICRAF participation was significantly associated with the number of trees per participant plot. Refugees with less than one year of CIFOR-ICRAF participation maintained fewer trees on average ($M = 14.06$, std. dev. = 7.69) than those with one or more years of participation ($M = 36.13$, std. dev. = 34.26), $t(44.8) = -3.753$, $p = <0.001$. Hosts with less than one year of experience with CIFOR-ICRAF estimated having an average of 709.23 trees per plot, while hosts with more than one year of CIFOR-ICRAF experience estimated having an average of 1322.88 trees per plot. Among hosts, however, the association between duration of CIFOR-ICRAF participation and tree cover was not significant ($t(3) = -0.001$, $p = 0.999$). It is important to note that estimates of tree cover on host land were very rough and may be less reliable due to the large size of host landholdings. Accurate counting of all trees on host plots was outside the scope of this study.

3.1.3 On-plot species and purposes

Refugee and host participants were asked about on-plot use of tree species across six categories: food, fuel, timber, fodder, medicine, and charcoal. The use of trees across categories was similar between host and refugee participants, just with a higher proportion of hosts engaged in each category of use (Figure 2). Trees are primarily used for food, including fruits, seeds, leaves and nuts, followed by fuel, timber, and medicine. Few participants reported using on-plot trees for fodder and charcoal.

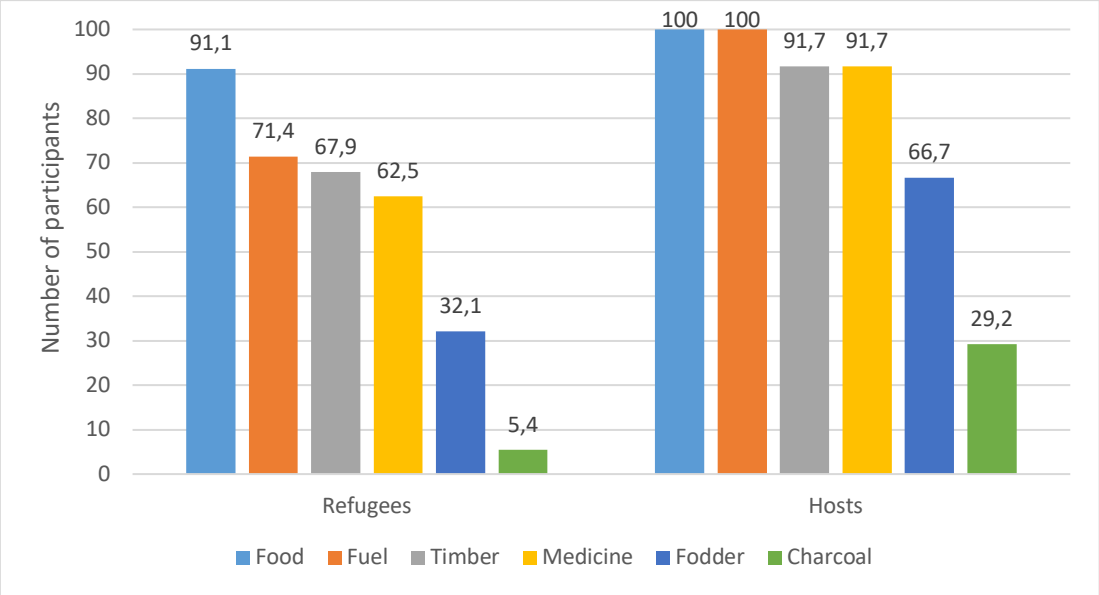

Figure 2. Refugee and host on-plot tree use

Refugees and hosts use indigenous and exotic tree species on-plot for all six categories of use. Appendix 2 contains complete data on the species utilized for each purpose. Tables 1 and 2 provide the five primary species in each use category for refugees and hosts and the average number of trees used for each category on plots. Many species are used for multiple purposes by hosts and refugees. *Azadirachta indica* (Neem), for example, is used medicinally, as fodder for animals, for home-building, and can be pruned for firewood.

Table 1. Five primary tree species used by refugees across purposes

	Food	**Fuel**	**Timber**	**Medicine**	**Fodder**	**Charcoal**
Avg. #/Plot	9	15	23	11	7	3
1	*Carica papaya*	*Senna siamea*	*Senna simea*	*Azadirachta indica*	*Melia volkensii*	*Tamarindus indica*
2	*Moringa oleifera*	*Gmelina arborea*	*Melia volkensii*	*Senna siamea*	*Combretum spp.*	*Combretum spp.*
3	*Balanites aegyptiaca*	*Azadirachta indica*	*Azadirachta indica*	*Moringa oleifera*	*Balanites aegyptiaca*	*Balanites aegyptiaca*
4	*Morus alba*	*Albizia gummifera*	*Gmelina arborea*	*Carica papaya*	*Senna siamea*	
5	*Tamarindus indica*	*Melia volkensii*	*Markhamia lutea*	*Khaya spp.* - Mahogany	*Morus alba*	

Table 2. Five primary tree species used by hosts across purposes

	Food	Fuel	Timber	Medicine	Fodder	Charcoal
Avg. #/ Plot*	48	72	371	115	75	34
1	*Tamarindus indica*	*Combretum spp.*	*Senna siamea*	*Azadirachta indica*	*Melia volkensii*	*Balanites aegyptiaca*
2	*Carica papaya*	*Melia volkensii*	*Tectonis grandis*	*Senna siamea*	*Mangiferus indica*	*Afzelia africana*
3	*Mangiferus indica*	*Azadirachta indica*	*Gmelina arborea*	*Mangiferus indica*	*Azadirachta indica*	*Combretum spp.*
4	*Balanites aegyptiaca*	*Senna siamea*	*Melia volkensii*	*Carica papaya*	*Gmelina arborea*	*Tamarindus indica*
5	*Psidium guajava*		*Azadirachta indica*	*Khaya spp.*	*Senna siamea*	*Khaya spp.* - Mahogany

*Host national trees can be difficult to inventory, particularly those species that are growing naturally and not intentionally planted. These numbers are best estimate.

3.1.4 CIFOR-ICRAF seedling survival rates

Programme participants were asked about the number of seedlings they have received from CIFOR-ICRAF and how many of these seedlings have died. Responses from new CIFOR-ICRAF participants were omitted (less than one year of involvement), given that many had not yet received seedlings. To calculate survival rates, the average number of CIFOR-ICRAF seedlings received by a participant was divided by the average number of CIFOR-ICRAF seedlings that failed to survive. This rate (the death rate) was subtracted from 100 to provide an average survival rate (Table 3).

Table 3. Seedling survival rates for hosts and refugees

	Average # CIFOR- ICRAF seedlings died	Average # CIFOR- ICRAF seedlings received	# Seedlings died/ # seedlings received	Survival rate
Refugees	26.11	55.68	46.9%	100-46.9 = **53.1%**
Hosts	73.0	390.0	18.7%	100-18.7 = **81.3%**

Seedling survival rates appear much higher among hosts than refugees, though many hosts struggled to estimate tree seedling survival due to the larger scale of tree planting. Trees are easily visible for refugees with smaller plots, making estimations of survival potentially more reliable.

Per the results in section 3.1.2., new CIFOR-ICRAF refugee participants had on average 22.07 fewer trees than participants involved for one or more years. Among hosts, this number is 613.65 fewer trees between new and more experienced host participants. To gauge the extent to which seedling distribution by CIFOR-ICRAF has contributed to overall re-greening on participant plots, the average number of trees per plot is divided by the average number of surviving CIFOR-ICRAF trees per plot (Table 4).

Table 4. Proportion of CIFOR-ICRAF trees to total trees on-plot for hosts and refugees

	Average # CIFOR-ICRAF seedlings survived	Average # trees on plot	Proportion of CIFOR- ICRAF trees to total trees
Refugees	29.57	36.13	29.57/36.13 = **81.8%**
Hosts	317	1322.88	317/1322.88 = **24%**

The results in Table 4 suggest that CIFOR-ICRAF trees account for a higher percentage of refugee participant on-plot trees (81.8%) and a lower percentage of host participant on-plot trees (24%). These findings are consistent with the large nature of host landholdings, which typically include significant areas of naturally occurring trees and shrubs, when compared with refugee plots that are often barren except for planted trees.

3.1.5 Layout of participant trees on plot

For refugee participants, food, medicine, and fodder trees were primarily planted around the home, with timber and firewood species planted most commonly as a plot boundary (Figure 3). For host nationals, food trees were also typically planted around the compound while timber species are planted in fields and woodlots (Figure 4).

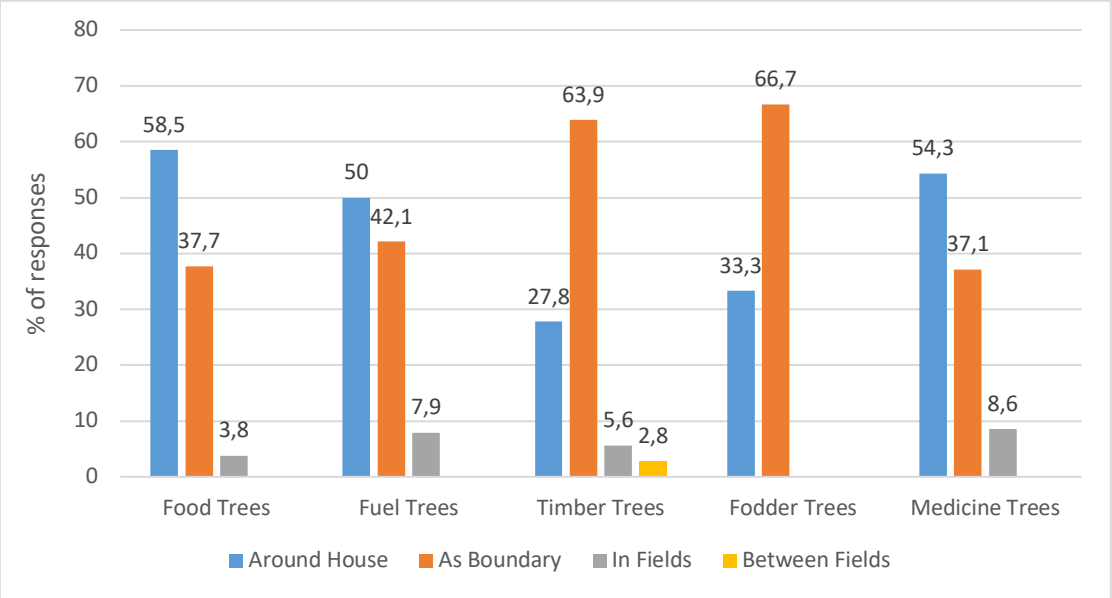

Figure 3. Where refugees plant trees for different purposes

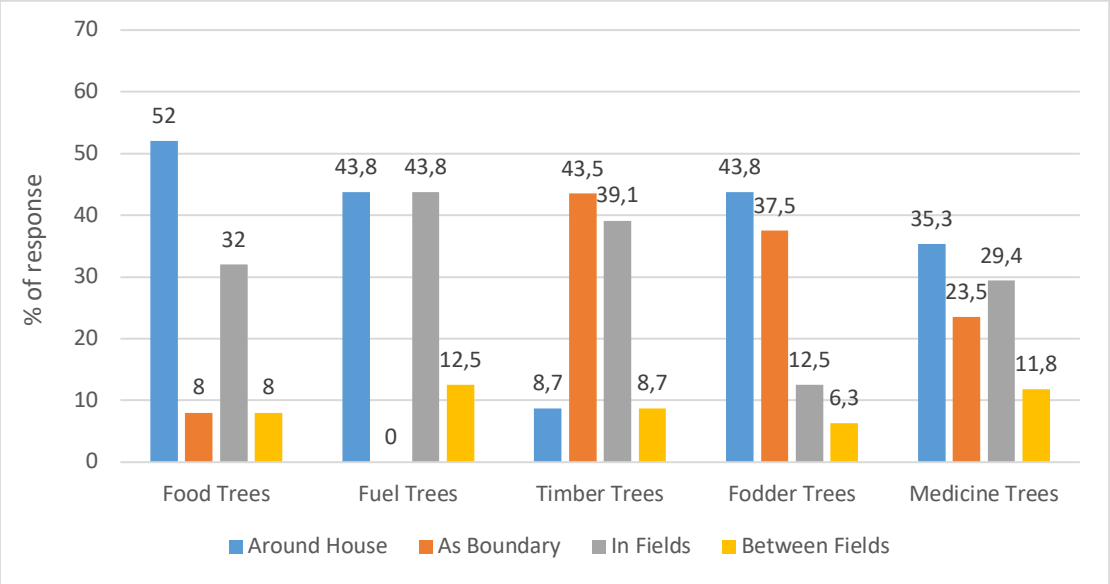

Figure 4. Where hosts plant trees for different purposes

3.1.6 Off-plot tree use

Data was collected on the off-plot use of trees among refugees in the woodlands and bush surrounding Imvepi. Most refugee participants reported significant use of trees off-plot. Off-plot tree use occurs on land owned by host community members and is often negotiated by refugees through the trade of food items, soap, or by asking permission from the landowner.

Off-plot use of firewood

Refugee participants reported sourcing 3.4 firewood bundles per month on average from their own plots, while they reported sourcing an average of 8.2 bundles per month from the bush. The average travel time reported by refugees for collecting firewood from the bush was 3.79 hours. With firewood typically cut and carried on foot, approximately 32 human labour hours per month are required for refugee households to complete firewood collection.

A significant association was found between duration of refugee CIFOR-ICRAF participation and increased sourcing of firewood on-plot. Refugee participants having more than one year of CIFOR-ICRAF involvement reported harvesting more bundles of firewood on their own plot ($M = 4.1$, std. dev = 3.17) than refugee participants with under one year of programme involvement ($M = 1.96$, std. dev = 1.72), ($t(33) = -2.154$, $p = 0.039$)

A non-significant association was also found between duration of CIFOR-ICRAF participation and reduced off-plot firewood collection among refugees. Refugee participants with less than one year of involvement with CIFOR-ICRAF reported sourcing more bundles of firewood in the bush ($M = 9.31$, std. dev = 4.73) than refugee participants with more than one year of CIFOR-ICRAF involvement ($M = 7.6$, std. dev = 5.51), ($t(44) = 1.053$, $p = 0.298$).

Hosts largely reported meeting all firewood needs on their own plots of land, and were often challenged to estimate their firewood use in terms of “bundles,” given that they simply collect small amounts of wood from trees near the home at the time of preparing food.

Tree foods and medicines

Table 5 lists the primary off-plot tree species used by participants for food and medicine. Hosts largely reported being able to harvest wild fruits and medicines on their own forested land. Overall, hosts and refugees reported using 19 different tree species (on and off plot) for medicinal purposes. Appendix 3 takes a deeper dive into the medicinal use of tree species.

Table 5. Off-plot tree species utilized for nutritional and medicinal purposes

Tree Fruits		**Tree Medicines**	
	% of responses		% of responses
Balanites aegyptiaca	–	*Azadirachta indica*	26.5
Tamarindus indica	26.2	*Khaya grandifoliola*	19.1
Borassus aethiopum	17.2	*Tamarindus indica*	11.8
Ximenia americana	8.2	*Moringa oleifera*	10.3
Sclerocarya birrea	3.3	*Balanites aegyptiaca*	8.8
Vitellaria paradoxa	3.3	*Vitellaria paradoxa*	2.9

3.2 Impacts on human welfare

3.2.1 Income generation

Among refugees, CIFOR-ICRAF participation was associated with increased income, with participants having one or more years of participation earning more annual income (M = 60,380.95 UGX, std. dev. = 55,181) than new refugee participants (M = 11,333.33 UGX, std. dev. = 8,082.90), although the results were not significant ($t(22) = -1.509$, $p = 0.146$). Similarly, host participants with one or more years of involvement with CIFOR-ICRAF also earned more income (M = 168,923.08 UGX, std. dev. = 119,370.196) than new host CIFOR-ICRAF participants (M = 108,000 UGX, std. dev. = 77,910.21), though again the association was not statistically significant ($t(16) = -1.048$, $p = 0.310$).

Timber poles and tree fruits were the primary products sold by hosts and refugees for income generation, and refugees and hosts use tree product income for similar purposes (Figure 5). Additional household income is especially useful for buying supplementary food items, household necessities such as soap, medicine, and to pay school fees.

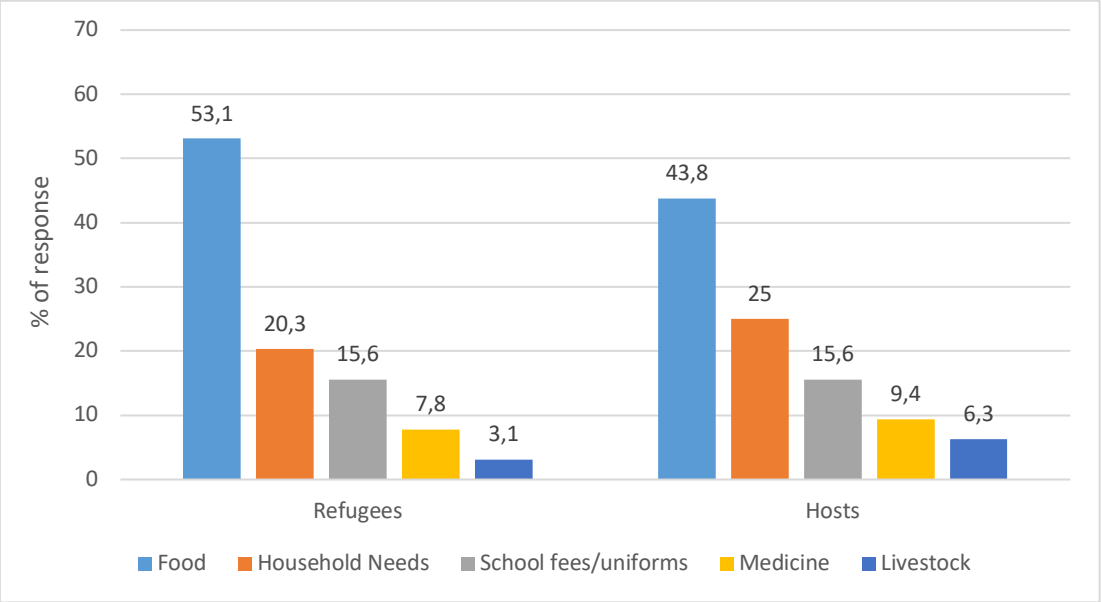

Figure 5. Uses for tree product income by hosts and refugees

3.2.2 Reduction of food insecurity

Refugee and host participants collectively cited May and June as the two most difficult months for household food insecurity (Figure 6). Reasons for hunger mentioned by refugees include the small size of food rations provided by the UN World Food Programme, insufficient space to grow crops, and poor soil fertility for crop production. Among hosts, unpredictable rainfall, drought, poor soil fertility, and the theft or spoilage of food stores were the most commonly cited causes of hunger (Figure 7).

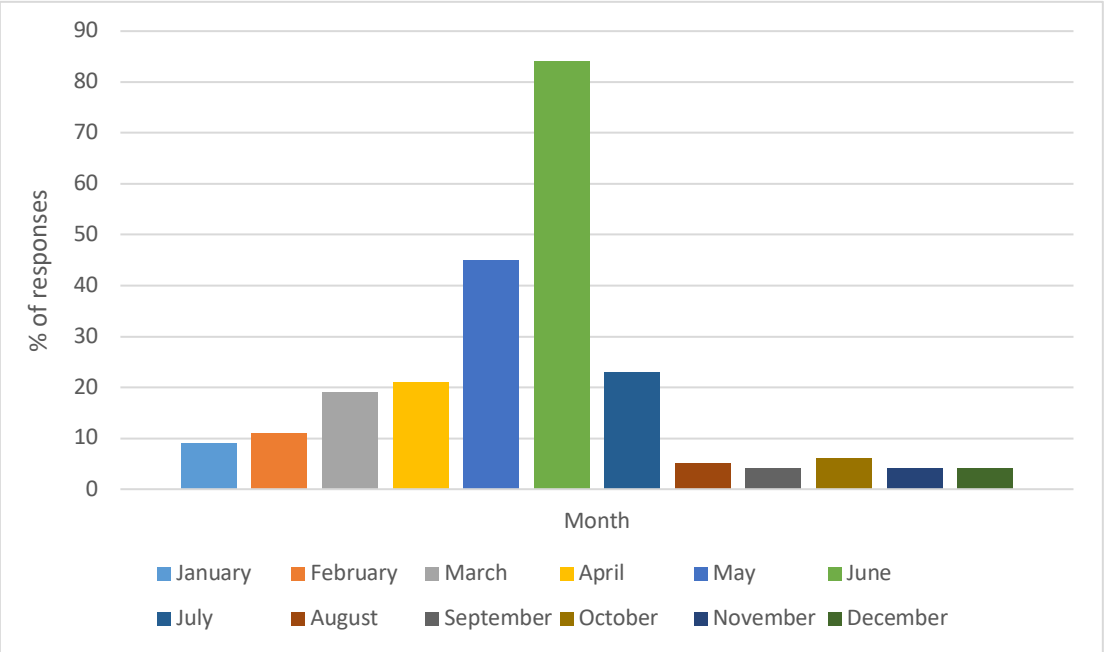

Figure 6. Worst reported months for hunger among hosts and refugees

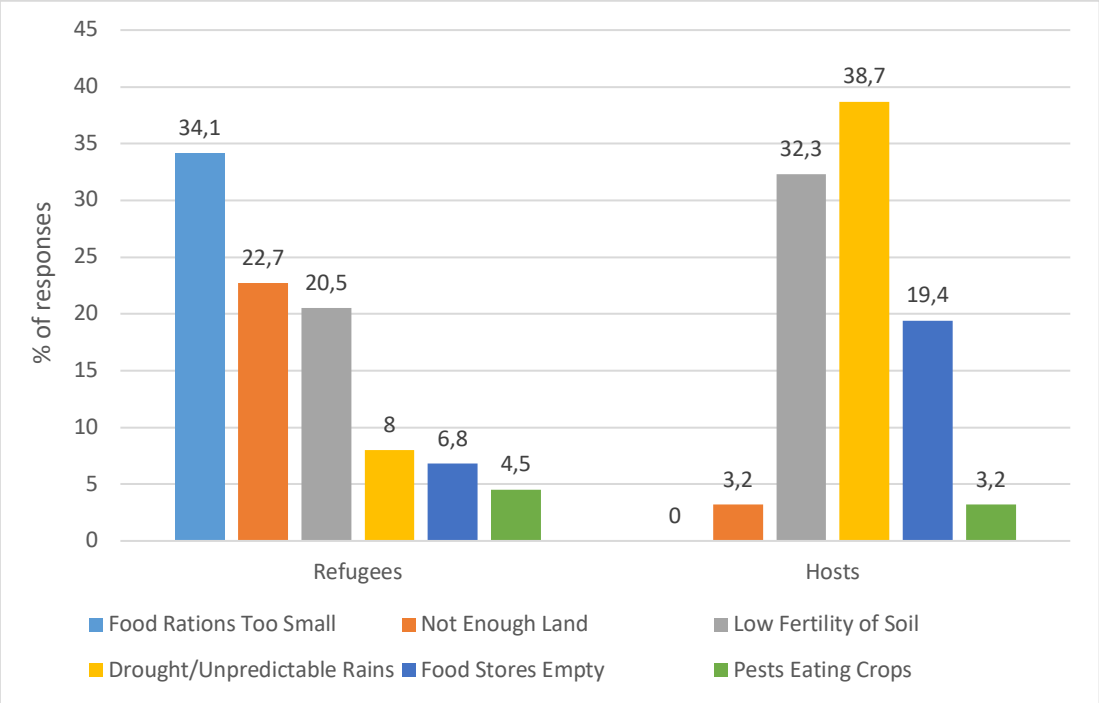

Figure 7. Causes of food shortage identified by refugees and hosts

Participants described two ways that trees can reduce household hunger. One is by directly providing food products such as fruits, leaves, and seeds. As noted above, on average CIFOR-ICRAF refugee and host beneficiaries are maintaining 12 and 49 food trees, respectively. Participants spoke particularly of the importance of *Carica papaya* and *Mangiferus indica* in helping to reduce hunger among children during the months of May and June. Some parents described feeding these fruits to children when they got home from school, so that cooked food can be saved for preparation in the evening. Two participants described planting *Borassus aethiopum* seeds and consuming the cotyledon as a nutrition source during times of hunger.

A second approach described by participants is to use income from the sale of tree products to supplement the family diet. This is reflected in Figure 5, which shows that purchase of supplementary food is overwhelmingly the primary use of agroforestry income for both refugees and hosts. Often purchased are fish or meat.

3.2.3 Environmental benefits

Participants showed awareness and appreciation for the environmental services provided by on-plot trees, especially windbreak and shade (Figure 8). Other benefits cited include the perceived ability of trees to attract rain, and soil improvements through the provision of leaves as a green manure or mulch.

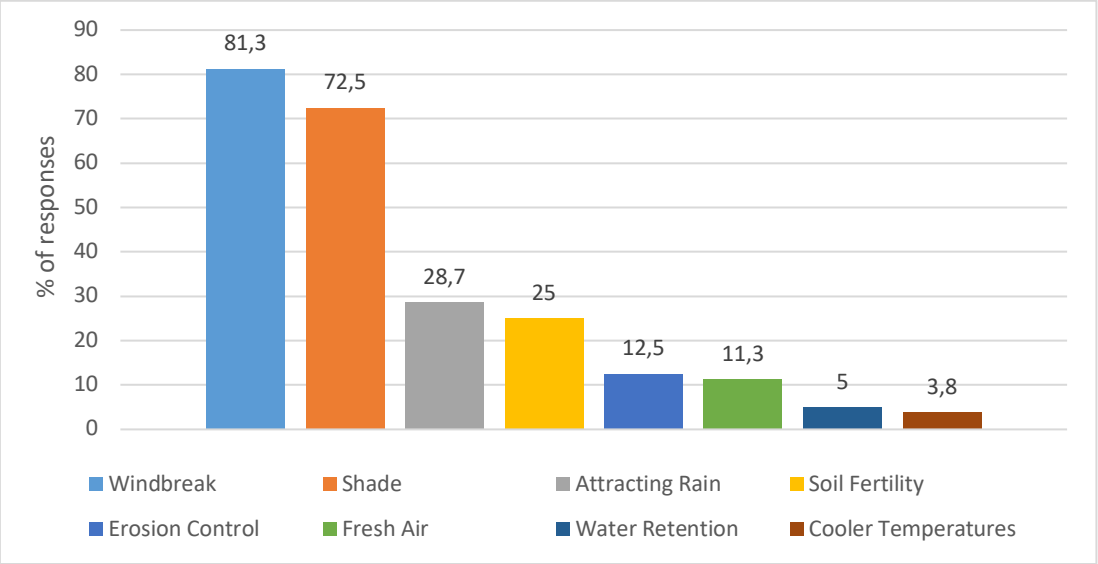

Figure 8. Environmental benefits of trees perceived by CIFOR-ICRAF participants

3.2.4 Gender benefits

Host and refugee involvement with agroforestry work and use of agroforestry income differed (Figure 9). Regarding agroforestry work, refugee women were either more involved or equally involved as men in a clear majority of cases (76%), whereas host women were never reported to be more involved in agroforestry work than men, and less than half of host participants reported equal agroforestry participation by gender (42%).

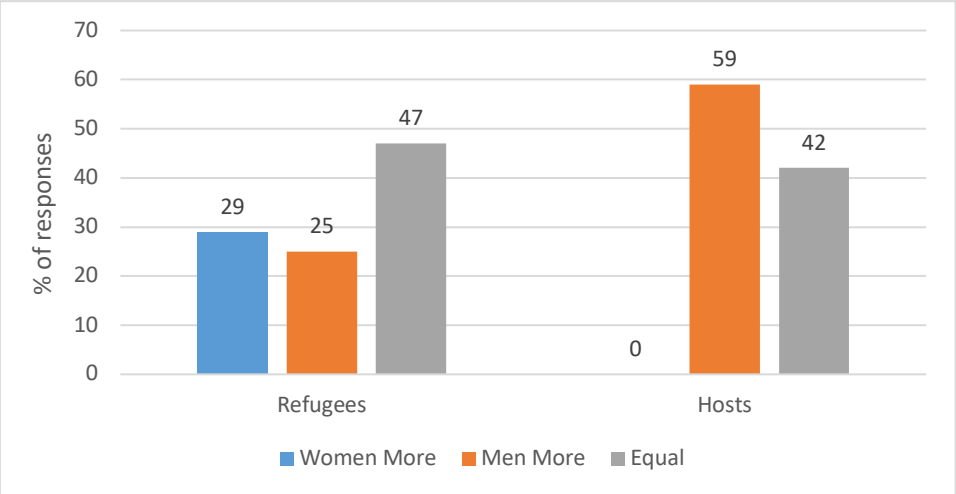

Figure 9. Participant involvement in tree work by gender

A strong majority of refugee participants (76%) reported women to have equal or greater control of income from tree products as men, whereas among hosts this proportion dropped to 65% (Figure 10). These results to some extent reflect differences in gender dynamics across the refugee and host communities. Among hosts, 91.7% of households were reportedly headed by men and only 8.3% by women. Among refugees, 53.6% of households were reportedly headed by men and 46.4% by women. Hosts are also more engaged in large-scale woodlot planting on land further from the home compound, discouraging participation by women, while refugees are more engaged in tree planting around the home compound which encourages participation by women.

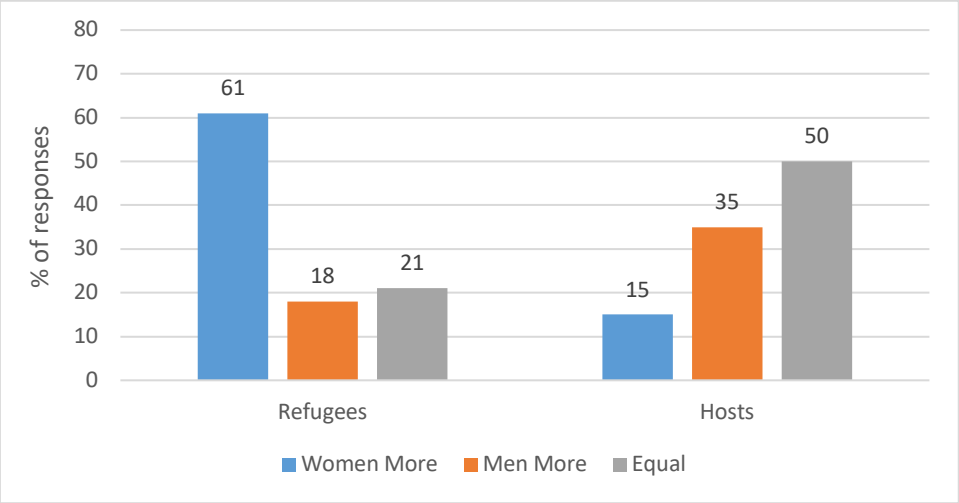

Figure 10. Host/refugee control of income by gender

3.2.5 Transfer of agroforestry skills to participants

To assess knowledge transfer through involvement with CIFOR-ICRAF, participants were asked about any formal training received on agroforestry and any forms of agroforestry management regularly practiced. Only 16 of 80 (20%) of total refugee and host participants had received formal agroforestry training. Among participants with one or more years of CIFOR-ICRAF experience, however, somewhat more (30%) had received formal training. An overwhelming 79 out of 80 participants said they would like more training; 53.3% wanted training to be held externally at CIFOR-ICRAF's learning centre, while 46.7% wanted training to be conducted at their homes or nearby in their communities. Participants living far from the learning centre and women participants were less likely to desire training that required travel. Table 6 includes a list of topics for which participants requested additional training.

Table 6. Training topics desired by participants

Tree Planting • Spacing, density, and depth • When and where to plant different species • Techniques for planting on slopes	**Management** • Termite control and pest management • Goat protection • Woodlot management • How to regenerate stumps (farmer-managed natural regeneration)
Harvest • Identifying when timber trees have fully matured • Finding markets for sale of timber and fruit products • Value-addition to tree products	**Other** • Integration of trees with crops/livestock • How to make compost • Developing tree nurseries at home • Collection of tree seeds • How to earn tree-base income through beekeeping and mushroom production

Hosts and refugees reported knowledge of and engagement with various forms of tree management (Figure 11). Refugees most commonly practice irrigation by hand-watering seedlings, followed by pruning and weeding of planted trees. Hosts most commonly engage in tree pruning among management activities, which aligns with the high proportion of hosts growing pole trees in woodlots. Refugees and hosts alike devise creative means of tree

management to protect seedlings and encourage tree growth. Appendix 4 provides examples from the field of host and refugee tree management strategies.

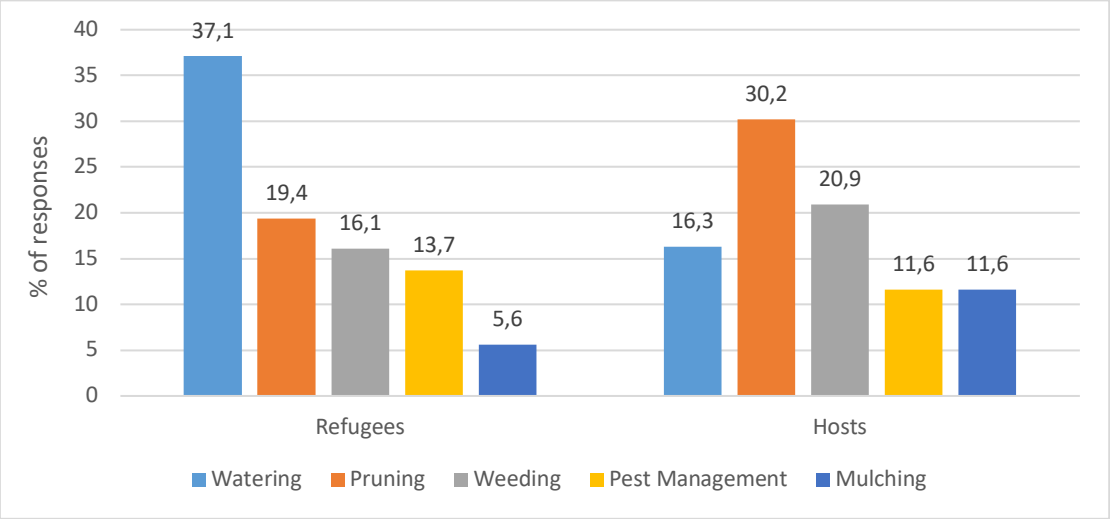

Figure 11. Forms of tree management practiced by refugees and hosts

4. CIFOR-ICRAF programme challenges and opportunities

4.1 Programme challenges

Refugees and hosts mentioned seven challenges that reduce their ability to successfully grow and maintain trees (Figure 12). These are: sun heat, lack of tools, poor soil quality, late planting of seedlings, termites, animal grazing, and chlorine in the tap water.

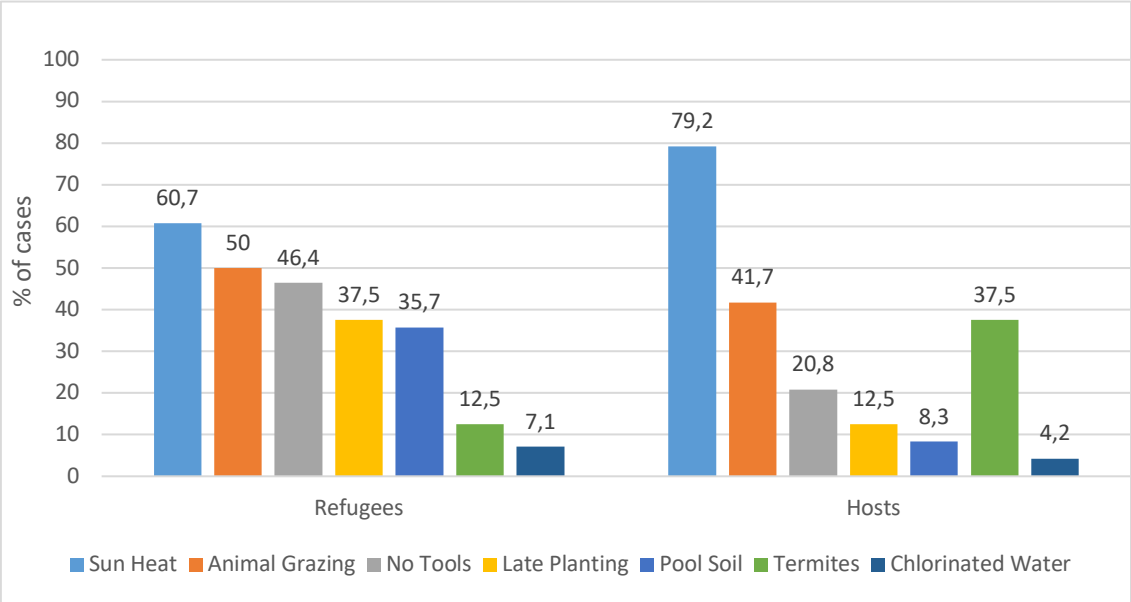

Figure 12. Host/refugee tree planting challenges

4.1.1 Growing conditions and late planting

Sun heat and poor soil were two commonly cited factors that reduce the survival rates of trees planted by hosts and refugees. Sun heat is linked to drought conditions, unpredictable rains, and the time of year when seedlings are planted. Participants reported delayed receipt of tree seedlings (from CIFOR-ICRAF as well as other organizations), leading them to plant after the bulk of yearly rainfall was already finished. Others described the challenge of growing trees amid increasingly unpredictable rainfall patterns in recent years, where periods of heavy rain are interspersed with hot sunshine. Another commonly cited challenge was the poor quality of soil in the settlements, and especially the rocky nature of soil. For example, many refugee participants in Zone 1 of Imvepi have plots located on rocky slopes and reported difficulty digging pits and planting seedlings in such conditions.

4.1.2 Browsers and pests

Goats, papaya mealy bugs, and termites were the three top predation/pest threats to tree growth. Goats can damage trees by bending or chewing stems, stripping bark, and eating tree leaves. The dry season is a particularly difficult time for protecting seedlings, as goats in the settlements are often set free to browse for food. Refugee and host strategies for preventing goat damage include fencing seedlings with thorny branches, spraying goat dung on tree leaves, and building small fences. See photos in Appendix 3.

With respect to insect threats, many participants growing *Carica papaya* reported infestations of *Paracoccus marginatus* (papaya mealy bug). On average, participants lost 8.8 papaya trees per plot to these infestations. Some participants cut down papaya trees at the first signs of a mealy bug outbreak to prevent spread to other trees. Papaya stems are not wasted, however, as they are popularly used among refugees for producing a local ash salt, called *balanabuga* in Kakwa. Participants noted that *Mangiferus indica*, *Gmelina arborea*, and *Citrus limon* trees are also highly susceptible to attack by termites.

4.1.3 Access to tools and water

Refugees and hosts alike reported having insufficient equipment to successfully grow trees. Table 7 includes a list of tools and supplies needed and/or desired by participants. Spades and double axes were especially mentioned as necessary to dig pits in rocky soil. Watering cans and pruning shears were also among the most frequently mentioned implements.

Hosts more commonly referenced a lack of water access as a hindrance to successful tree growth. Host participants reportedly live further from a nearby water source (20 minutes on average) when compared to refugees (10.49 minutes on average). A long distance to reach water undoubtedly impacts the ability of participants to irrigate trees in the dry season. Some participants expressed concern that chlorine in water at settlement taps can harm tree seedlings and hinder tree growth.

4.2 Programme opportunities

4.2.1 Recommendations by participants

Participants were asked about their overall recommendations for CIFOR-ICRAF programming. Their responses are presented in Table 7.

Table 7. Recommendations for CIFOR-ICRAF by participants

	Number	% of responses
Providing supplies to participants: • Participants especially requested items such as watering cans, pruning shears, sprayers for insect repellents, gum boots, treatments for pawpaw mealy bug disease, knives, double axes, irrigation supplies, wheelbarrows, tape measures, fencing (barbed wire and baskets), and ropes for line-planting.	25	42.4
More training • See Table 6 above for desired training topics • Train local leaders on agroforestry so they can promote tree planting in their communities and organize local trainings • More farmer-to-farmer field trips and on-site demonstrations of successful agroforestry practices • Increase CBF monitoring of seedlings after planting.	17	28.8
Provide incentives • Offer small cash grants to support tree management • Provide farmers with high seedling survival rates with cash or in-kind rewards such as poultry and livestock. • Encourage friendly competition between participants by awarding a “best farmer” for each CBF zone. • Create a certificate programme in agroforestry with training and small reward for completion	9	15.3
Encourage group-based agroforestry • Organize tree growing groups for women • Help acquire land for groups of refugees and hosts to plant trees together for firewood and poles	7	11.9
Provide seedlings on time • Provide seedlings at the beginning of the first rainy season (mid-April and May)	6	10.2
Help with labour • Provide labour assistance to elders/those who are injured • Provide labour assistance to hosts growing larger scale woodlots • Provide labour assistance when seedlings are delivered to help get them out to the fields	6	10.2
Increase/alter species offered • Especially teak, grafted mango, avocado, banana and orange	3	5.1
Increase the sustainability of CIFOR-ICRAF programming • Train farmers in seedling production and/or managing the CIFOR-ICRAF nursery in case there is loss of funding	3	5.1
Help connect CIFOR-ICRAF participants to markets for tree products • Especially timber products	1	1.7

4.2.2 Additional recommendations

In addition to the participant recommendations listed in Table 7, below are other recommendations stemming from the research findings which could be considered by CIFOR-ICRAF:

4.2.2.1 Increase agroforestry extension and training

Training stands out as a relatively low-cost and effective means of improving agroforestry implementation with hosts and refugees. A core training manual could be developed which addresses the participant topics of interest listed in Table 6. A succinct (2–3 hour) workshop curriculum based on the manual could also be developed and CBFs trained on how to deliver the information in the curriculum with proficiency to participants.

Goals could be set for a target number of trainings (such as a minimum of four per year) that each CBF offers within their designated zone of operation, and CBFs could track training attendance by participants and aim to ensure that all participants receive a minimum level of training yearly. Additional trainings could target certain populations and subjects. For instance, trainings specific for host women could go a long way to increasing their involvement and sense of authority in agroforestry activities.

4.2.2.2 Promote Lorena stove construction

A Lorena stove in a refugee kitchen.

In addition to tree planting, reducing overall refugee and host firewood consumption is critical for mitigating tree cutting and landscape degradation. Several refugee participants are using fixed-owner Lorena stoves in their kitchens. Many of these stoves were built with assistance from other NGOs and are constructed from grass and mud sourced on refugee plots. Participants reported that Lorena stoves can reduce their firewood consumption by half. One CIFOR-ICRAF CBF already knows how to construct these stoves and could be at the forefront of training other CBFs, so that eventually all CIFOR-ICRAF participants are trained on building their own stoves.

4.2.2.3 Increase demonstration of agroforestry at the CIFOR-ICRAF learning centre

Agroforestry consists of more than simply planting trees, and there is a need for demonstrations of successful, research-based, crop-tree interactions to inspire such practices on host and refugee plots. CIFOR-ICRAF could demonstrate the nitrogen fixation benefit of species such as *Cajanus cajan* (pigeon pea) for intercropping with annual crops such as maize. Other potentially beneficial combinations could be researched and demonstrated, including those developed by participants.

4.2.2.4 Encourage collaborative tree-planting between hosts and refugees

Slightly more than 64% of refugee participants reported renting land from hosts for agricultural purposes, with the average size of rental plots being 0.83 acres. Further, 70.8% of host participants reported renting out land to refugees. On average these hosts are each renting out 5.2 acres to an average of 12 refugees.

Refugees and hosts were each asked about the possibility of refugees growing trees on rented land. Feedback was largely positive from both groups for several reasons.

Refugees:

- Refugee plots are small, which limits their ability to grow trees in greater quantities.
- Refugees are growing large portions of their crops on rented land. By planting trees on that land they could more fully reap the environmental benefits of trees for crops such as improved soil fertility, windbreak, and attraction of rain.
- Refugee rental agreements with hosts are often limited to one year in duration or less. If tree planting factors into the agreement, there might be greater incentive for hosts to agree to 2–3 year agreements, providing more land access security to refugees.

Hosts:

- If refugees are eventually repatriated, trees would be left to them.
- There would be a need for agreements clearly stating the terms and time frame of tree planting and use.
- Tree planting by refugees could be a good use of otherwise unused, degraded land.

  Two refugee participants have already negotiated such tree planting agreements with hosts and each grow around 100 pole tree species on rental land. In both cases, refugees had uniquely close relationships to the host landowner, which highlights the importance of relationship development in securing refugee land access for agricultural and tree planting activities. There is an opportunity for CIFOR-ICRAF to assist in brokering such agreements or connecting participants to other organizations who are actively engaged in negotiating refugee-host land access.

4.2.2.5 Develop markets for participant agroforestry products

The CIFOR-ICRAF learning centre could develop an in-person and/or online storefront as a means of earning income and supporting participants through sale of value-added tree-based items which they produce. Sisal rope and natural insecticides made of neem and chili pepper are examples of items that could have value within the settlements. An online storefront through a web platform such as Etsy could sell refugee and host items such as baskets woven from sorghum stalk, soaps and oils made from shea nuts and *Balanites* seeds, scrubbers made from Loofa, and again sisal rope. It is possible that, if well developed, this income could increase sustainability of the project

5. Conclusion

This study provides some quantitative and qualitative indicators of the benefits of CIFOR-ICRAF agroforestry programming in the Imvepi and Rhino Camp refugee settlements of northwestern Uganda. Indications of environmental benefits include increased on-plot tree cover among participants and decreased use of off-plot firewood by refugees. Participants are also retaining and using indigenous species such as *Balanites aegyptiaca*, *Tamarindus indica* and *Combretum spp*. on their plots for fruit and firewood prunings, which supports the retention of biodiversity. Human welfare benefits include an association between increased tree-based income and CIFOR-ICRAF participation, cultivation of food trees on-plot, provision of household-level environmental services, and significant engagement by refugee women in agroforestry activities.

CIFOR-ICRAF impacts are primarily stunted by survival rates, where – among refugees – an estimated average of 46.9% of planted CIFOR-ICRAF seedlings do not survive. Seedling survival rates appear higher among hosts, but both groups report facing significant challenges to growing trees that have been documented in section 4.1. Section 4.2 offers a variety of proposed solutions which could increase survival rates and refugee/host engagement with agroforestry.

In balancing the diverse programmatic goals of landscape restoration, biodiversity conservation, and improved human welfare, CIFOR-ICRAF programming offers a unique approach among the array of environmental interventions promoted in the Rhino Camp and Imvepi refugee settlements, and within refugee-hosting Uganda generally. Participants expressed significant enthusiasm to continue tree planting, with hosts willing to plant 734 more trees on average per plot, and refugees willing to plant 59 more trees on average per plot. The recommendations and data provided in this report can inform and ideally strengthen this important initiative moving forward.

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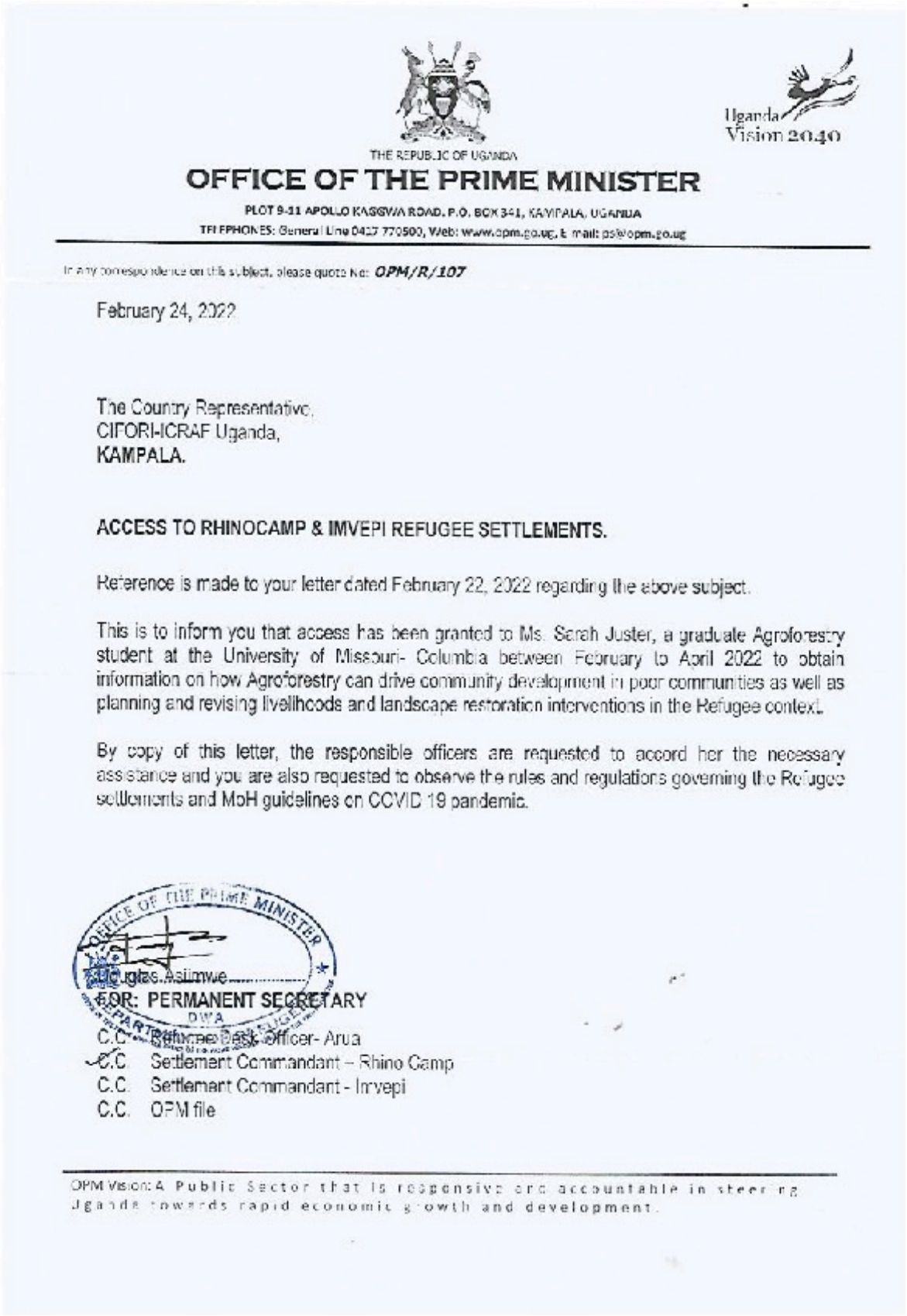
Appendices

Appendix 1. Letter of permission for research from the Office of the Prime Minister



THE REPUBLIC OF UGANDA

OFFICE OF THE PRIME MINISTER

PLOT 9-11 APOLLO KAGGWA ROAD, P.O. BOX 341, KAMPALA, UGANDA
TELEPHONES: General Line 0417 770500, Web: www.opm.go.ug, E mail: ps@opm.go.ug

In any correspondence on this subject, please quote No: **OPM/R/107**

Uganda Vision 2040

February 24, 2022

The Country Representative,
CIFORI-ICRAF Uganda,
KAMPALA.

ACCESS TO RHINOCAMP & IMVEPI REFUGEE SETTLEMENTS.

Reference is made to your letter dated February 22, 2022 regarding the above subject.

This is to inform you that access has been granted to Ms. Sarah Juster, a graduate Agroforestry student at the University of Missouri- Columbia between February to April 2022 to obtain information on how Agroforestry can drive community development in poor communities as well as planning and revising livelihoods and landscape restoration interventions in the Refugee context.

By copy of this letter, the responsible officers are requested to accord her the necessary assistance and you are also requested to observe the rules and regulations governing the Refugee settlements and MoH guidelines on COVID 19 pandemic.

OFFICE OF THE PRIME MINISTER

Douglas Asiimwe
FOR: PERMANENT SECRETARY

C.C. Refugee Desk Officer- Arua
C.C. Settlement Commandant – Rhino Camp
C.C. Settlement Commandant - Imvepi
C.C. OPM file

OPM Vision: A Public Sector that is responsive and accountable in steering Uganda towards rapid economic growth and development.

Appendix 2. On-Plot Tree Species for Different Purposes by Refugees and Hosts

On-Plot Food Tree Species Utilized by Hosts		
	Number of cases	**Percent of responses**
Tamarindus indica	21	16.7
Carica papaya	17	13.5
Mangifera indica	16	12.7
Balanites aegyptiaca	14	11.1
Psidium gujava	7	5.6
Borassus aethiopum	7	5.6
Citrus- orange	6	4.8
Citrus- lemon	5	4.0
Vitellaria paradoxa	5	4.0
Ximenia Americana	4	3.2
Artocarpus heterophyllus	3	2.4
Moringa oleifera	3	2.4
Cajanus cajan	2	1.6
Morus alba	2	1.6
Annona muricata	2	1.6
Sclerocarya birrea	1	0.8
On-Plot Food Tree Species Utilized by Refugees		
	Number of cases	**Percent of responses**
Carica papaya	45	26.3
Moringa oleifera	16	9.4
Balanites aegyptiaca	13	7.6
Morus alba	9	5.3
Tamarindus indica	9	5.3
Artocarpus heterophyllus	8	4.7
Passiflora edulis	7	4.1
Citrus orange	6	3.5
Psidium guajava	6	3.5
Cajanus cajan	4	2.3
Borassus aethiopum	4	2.3
Citrus lemon	3	1.8
Sclerocarya birrea	3	1.8
Annona muricata	2	1.2
Vitellaria paradoxa	2	1.2
Mangifera indica	1	0.6
Ximenia Americana	1	0.6
Ricinus communis	1	0.6
Ziziphus	1	0.6
On-Plot Timber Species Utilized by Hosts		
	Number of cases	**Percent of responses**
Senna siamea	14	20.9
Tectona grandis	12	17.9
Gmelina arborea	11	16.4
Melia volkensii	11	16.4
Azadirachta indica	11	16.4

Afzelia Africana	2	3.0
Khaya grandifolia	2	3.0
Grevillea robusta	1	1.5
Milicia exelsa	1	1.5
On-Plot Timber Species Utilized by Refugees		
	Number of cases	**Percent of responses**
Senna siamea	26	32.1
Melia volkensii	18	22.2
Azadirachta indica	12	14.8
Gmelina arborea	9	11.1
Markhamia lutea	7	8.6
Albizia gummifera	2	2.5
Combretum spp.	2	2.5
Tectona grandis	1	1.2
Milicia exelsa	1	1.2
Balanites aegyptiaca	1	1.2
Sesbania sesbans	1	1.2
On-Plot Fodder Species Utilized by Hosts		
	Number of cases	**Percent of responses**
Melia volkensii	6	24.0
Mangifera indica	5	20.0
Azadirachta indica	4	16.0
Gmelina arborea	3	12.0
Senna siamea	2	8.0
Combretum spp.	1	4.0
Morus alba	1	4.0
Eucalyptus spp.	1	4.0
Albizia gummifera	1	4.0
On-Plot Fodder Species Utilized by Refugees		
	Number of cases	**Percent of responses**
Melia volkensii	7	25.9
Combretum spp.	5	18.5
Balanites aegyptiaca	3	11.1
Senna siamea	3	11.1
Morus alba	2	7.4
Moringa oleifera	2	7.4
Azadirachta indica	2	7.4
Gmelina arborea	1	3.7
Markhamia lutea	1	3.7
Tamarindus indica	1	3.7
On-Plot Medicinal Species Utilized by Hosts		
	Number of cases	**Percent of responses**
Azadirachta indica	14	35.9
Senna siamea	9	23.1
Mangifera indica	3	7.7
Carica papaya	2	5.1

Khaya grandifoliola	2	5.1
Balanites aegyptiaca	1	2.6
Moringa oleifera	1	2.6
Tamarindus indica	1	2.6
Morus alba	1	2.6
Ximenia Americana	1	2.6
Ricinus communis	1	2.6
On-Plot Medicine Species Utilized by Refugees		
	Number of cases	**Percent of responses**
Azadirachta indica	32	33.0
Senna siamea	14	14.4
Moringa oleifera	11	11.3
Carica papaya	9	9.3
Khaya grandifoliola	4	4.1
Tamarindus indica	4	4.1
Morus alba	4	4.1
Balanites aegyptiaca	3	3.1
Mangifera indica	3	3.1
Psidium guajava	2	2.1
Kigelia Africana	2	2.1
Ricinus communis	2	2.1
Ximenia americana	1	1.0
On-Plot Fuel Species Utilized by Refugees*		
	Number of cases	**Percent of responses**
Senna siamea	16	16.8
Gmelina arborea	11	11.6
Azadirachta indica	11	11.6
Albizia gummifera	8	8.4
Melia volkensii	8	8.4
Combretum spp.	6	6.3
Balanites aegyptiaca	6	6.3
Markhamia lutea	4	4.2
Acacia spp.	3	3.2
Tamarindus indica	2	2.1
Morus alba	2	2.1
Tectona grandis	2	2.1
Ximenia americana	1	1.1
Vitellaria pardoxa	1	1.1
Sclerocarya birrea	1	1.1
Cajanus cajan	1	1.1
Milicia exelsa	1	1.1
On-Plot Charcoal Species Utilized by Hosts		
	Number of cases	**Percent of responses**
Balanites aegyptiaca	4	33.3
Tamarindus indica	2	16.7
Afzelia Africana	2	16.7
Combretum spp.	2	16.7

Khaya grandifoliola	1	8.3
Vitellaria paradoxa	1	8.3
On-Plot Charcoal Species Utilized by Refugees		
	Number of cases	**Percent of responses**
Tamarindus indica	2	50.0
Balanites aegyptiaca	1	25.0
Combretum spp.	1	25.0

*On-plot fuel species omitted for hosts

Appendix 3. Medicinal tree uses reported by hosts and refugees

Tree	Part	Medicinal Preparation/Ailment
Afzelia africana	Bark	• Apply as topical treatment for fractures
Artocarpus hetreophyllus	Leaves	• Boil for cough
Azadirachta indica	Fruit	• Eat to treat malaria
	Leaves	• Mix leaves with ground peanut for treating stomach pain, back pain, and typhoid • Boil leaves for stomach pain, headache, and general body ache.
Balanites aegyptiaca	Fruit	• Boil fruits for typhoid and diarrhea
	Leaves	• Boil for stomach pain
	Oil	• Treats chest pain and chaste
	Roots and bark	• Poison removal
Borassus aethiopum	Fruit	• Joint pain relief and provides vitamin B12 to blood
Carica papaya	Leaves	• Eat leaves for treating deworming and ulcers. • Boil leaves with guava and orange leaves as cough treatment
	Roots	• Crush roots with mortar and pestle as medicine for yellow fever. • Chew the roots for tooth pain. • Boil the roots for treating flu and chest pain.
	Stem	• The stalk can be burned and residual ash used to create local salt (balanabuga in Kakwa) to relieve high blood pressure.
Senna siamea	Leaves	• Boil for stomach pain and malaria
	Roots	• Boil for stomach pain, diarrhea, chest pain
Citrus lemon	Leaves	• Boil for cough.
Combretum spp.	Roots	• Boil for treating stomach pain
Kigelia africana	Bark	• Boil to treat hepatitis B
	Fruits	• Boil to treat hepatitis B and typhoid
Khaya grandifoliola	Bark	• Boiled bark can treat back pain, broken bones, stomach pain and diarrhea.
	Leaves	• Rub leaves on injuries • Drink water from boiled leaves if body feels cold
Mangifera indica	Bark	• Boil the bark to stop diarrhea.
	Roots	• Boil the roots for diarrhea treatment.
Moringa oleifera	Roots	• Boil roots for flu treatment, stomach pain, and cough.
	Seeds	• Mix with groundnut paste as a treatment for typhoid
Morus alba	Leaves	• Boil the leaves for ulcer, headache, malaria, and body pain
Piliostigma spp.	Roots	• Boil for cough. Can also mash up roots and use liquids to treat topical wounds

Psidium guajava	Fruits	• Eat fruits to treat diarrhea
	Leaves	• Boil with orange and pawpaw leaves for coughing.
Ricinus communis	Fruits	• Burnt fruits can be rubbed where a thorn is stuck in the skin, help to ease it out
	Oil	• Topical treatment for wounds
Vitellaria paradoxa	Oil	• Treats typhoid
Tamarindus indica	Fruits	• Soak fruits and make a juice to treat typhoid

Appendix 4. Photo gallery of host/refugee agroforestry management practices

Jackfruit fence tied with homemade sisal rope

Netted fence protection for Senna siamea

Wrapped Melia volkensii to prevent goat damage

Goat dung sprayed on resprouting Melia volkensii

Thorny branches spread along base of seedlings

Well-fenced jackfruit

Markhamia lutea trees grown along the inside of vegetable garden fence

A 2-year-old Mango protected with thorny branches

Mulched banana

Drip irrigated and fenced jackfruit

Mulched and protected Balanites aegyptiaca with climbing passionfruit

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