Working Paper

Restocking woody biomass to reduce social and environmental pressures in refugee-hosting landscapes

Perspectives from Northwest Uganda

Lalisa Duguma, Judith Nzyoka, Clement A. Okia, Cathy Watson, Charles Ariani

World Agroforestry

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Table of Contents

List of Tables

List of Figures

Acknowledgements

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Executive Summary

In the last decade, the influx of over a million refugees into northern Uganda, particularly from South Sudan and the Democratic Republic of Congo (DRC) has steeply increased pressure on the natural environment. The demand on woody vegetation for various uses and the need to create space for newcomers have progressively denuded the landscape. This has the potential to fuel tension between the host communities and refugees, which if left to simmer could create another conflict. Identifying strategies that are innovative to meet the demand for wood and its products in such a way that trees and shrubs, and the ecosystem services they provide, can be available and delivered to both host and refugee communities is critical.

The aim of this study was to improve understanding of the perceptions of refugee and host communities towards deforestation and the various options to address the emerging wood fuel shortage in and around Imvepi Refugee Settlements and Rhino Camp in Arua district, Uganda. A survey of households and farms was conducted to determine various viewpoints among the refugee and host communities, and their options for regaining tree cover.

About 84% of the respondents, from both communities, agreed that environmental degradation is taking place, mainly due to cutting of trees for firewood, baking bricks and extraction of timber and poles for construction. Using stump density as the degradation proxy, it was discovered that almost 60% of the tree cover had been depleted in and around settlements over the last 2-4 years.

To address the challenges of deforestation and the high demand for wood products, respondents proposed a three-pronged approach: tree planting and growing, conserving existing trees and promoting natural regeneration of trees with sprouting stumps. This study which mostly focused on planting, found that the average number of trees that refugee households were willing to plant was in the order of 50 and 32 in Imvepi and Rhino Camp, respectively. However, host community members had considerably more land and stated that they were willing to plant 863-1,249 trees per household. Further, refugee respondents indicated that they would plant 66% of the trees along the boundary of their plots, with the rest being planted inside the plot and around their houses. On their part, host community members stated that more than 66% of the trees that they had indicated they would plant would ideally be placed in woodlots.

Both communities noted that they would require support in the following: acquisition of planting materials and farm equipment, and training in the management of trees. Refugees stated that they needed additional land for trees.

Based on the study findings and expert opinion, 5-6 tree-growing options are recommended for refugees and host communities in and around Imvepi Refugee Settlements and Rhino Camp. In addition, refugees generated a visualization of how trees might be integrated into a typical refugee plot. Both communities expressed a strong preference for exotic species,

despite a high reliance on native species. This requires addressing through sensitization since, among other benefits, indigenous species provide nutrition and underpin ecosystem services and biodiversity.

Although choice of tree species is always location-specific, the results and recommendations of this study provide a valuable guide for implementing partners seeking to restore degraded environments in refugee and host community areas in Uganda and beyond.

Introduction

The socio-political crises in countries neighbouring Uganda, particularly South Sudan and the Democratic Republic of Congo (DRC), have resulted in a significant move of displaced people into the country. With the influx of over a million refugees in the last decade into northern Uganda, pressure on the natural environment increased steeply. Among the most exposed resources was the woody vegetation. The need for construction material and firewood for cooking and processing bricks, posed a severe threat to the vegetation. Further pressure arose from the need to create space for newcomers. Each arriving family was granted a plot to construct their residential space and to produce food. In most cases, this resulted in the cutting down of trees and shrubs. This clearing process as well as the demand imposed on vegetation by needs such as energy have progressively denuded the landscape.

Due to the demand, wood is particularly scarce, and people are forced to walk increasingly long distances, sometimes to the neighbouring district, to fetch firewood and harvest other wood products. This has caused some tension between the host communities and refugees, which if left to simmer could create another conflict.

Therefore, identifying strategies to meet the demand for wood and its products is critical. Options include introduction of alternative technologies, such as solar energy or clean cook stoves. Even if this is done, however, the landscape has already experienced significant changes in its woody plant stock and diversity, which will result in declining ecosystem service provision. A greener option alongside alternative technologies is to find innovative methods of restocking the woody biomass in such a way that the trees and shrubs, and the ecosystem services they provide, can be available and delivered to both host and refugee communities.

The aim of this study was to identify strategies to return multipurpose trees to the landscape by understanding the needs and priorities of both the host and refugee communities. The entire analysis hinges on the views of the communities since they are the ones to implement the strategy or approaches that they select.

This paper first presents the views of the communities on the ongoing degradation and its main causes. It then identifies practical solutions and analyzes them from the point of view of tree species selection, the functional attributes of these species, and the number of trees that the communities wish to plant. Finally, the report looks at the support required to implement the proposed solutions.

Methodology

The research adopted a cross-sectional study design, using data collection techniques that comprised both quantitative and qualitative participatory approach methodologies. A household survey was used to provide information on existing knowledge and preferences with respect to tree-based actions. It also aimed at identifying interventions that might

address environmental degradation, and the incentives and support needed to promote the tree management required to reduce loss of woody vegetation in Rhino Camp and Imvepi Refugee Settlements, and surrounding host communities. A farm survey tool was used to inventory tree types and tree-cutting intensity in farmlands.

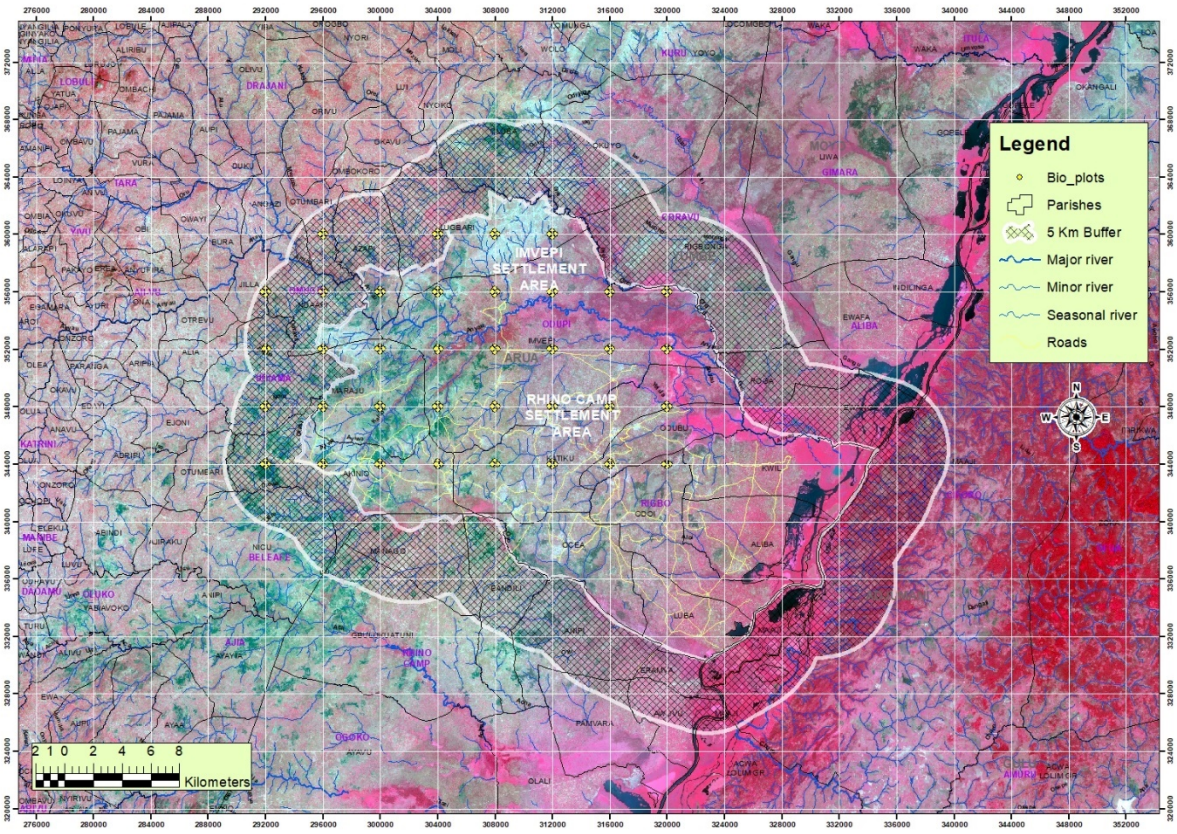


Figure 1: Map of Rhino Camp and Imvepi Refugee Settlements in Arua district

The survey focused on South Sudanese refugees and their hosts in Arua district. A total of 280 respondents (240 refugees from Rhino Camp and Imvepi Settlements and 40 members from the host community living in Uriama and Odupi) were interviewed using a semi-structured questionnaire. The questionnaire was directly administered by enumerators. Although the questionnaires were in English (for uniformity), the interviews were conducted in the local languages of the respective refugee and host communities. Common languages among refugees include Kakwa, Nuer, Dinka, Bari, Kuku, Kaliko, Pajulu and Acholi; among the host communities, Lugbara and Madi were most common.

In the refugee settlements, respondents were interviewed from 121 households in Imvepi and from 119 households in Rhino Camp. In the host communities, respondents were interviewed from 25 households in Odupi and from 15 households in Uriama. Female respondents represented over half of survey participants in Rhino Camp at 74% and Imvepi at 55%, and less than half in Uriama at 46% and Odupi at 44%. For the households in which survey questionnaires were administered, farm surveys were conducted as well, to understand the on-farm activities that relate to trees and shrubs, in particular planting and cutting.

Key Findings

Understanding landscape level degradation issues

Taking refugee and host community households together, 84% of respondents believe that the landscape is degrading; 9% think there is no change; and 7% believe there is an improvement. Significant causes of the degradation as per household recollection are cutting down of trees for firewood and burning bricks, and extraction of timber and poles for construction.

Assessment of tree cutting in residential plots of refugee communities revealed that the average stump density per hectare was 58 woody plant stumps in Imvepi Refugee Settlements and 67 in Rhino Camp. This is an indication of fast and severe degradation. However, unless they have dried, remnant stumps can potentially be regenerated.

These figures represent only stumps that are currently visible. Evidence of others that were uprooted or burnt is less easy to detect. Hence, the estimate provided here may be less than the actual intensity.

Using the current number of woody plants on farms and the stump density computed, the extent of degradation in the landscape could be estimated, particularly in the refugee areas. Average woody plant stock currently stands at 40 and 47 plants per ha in Imvepi Refugee Settlements and Rhino Camp, respectively. Then taking the current standing density and the stump density, this gave an initial tree shrub density of about 98 trees per ha across the two refugee settlements, with about 87 per ha in Imvepi Refugee Settlements and 114 in Rhino Camp. Stump density as a proportion of likely initial woody plant density was taken as the degradation proxy and was found to be at 59.5% and 58.9% in Imvepi Refugee Settlements and Rhino Camp, respectively (Table 1).

Table 1: Current woody plant/stump density and estimated initial tree/shrub density

		Current tree and shrub density per ha	Stump density of trees and shrubs per ha	Initial tree shrub density (per ha) (potential stocking)
Imvepi (n=117)	Mean	40±35	58±69	98±87
	Range	0-200	0-511	0-522
Rhino Camp (n=117)	Mean	47±51	67±95	114±108
	Range	0-278	0-425	0-489

Further to the above inquiry, respondents were asked if they could recall any woody plant they had seen on their plots when they first settled there. Table 2 presents the species that they recalled and listed most frequently by the participants. *Acacia hockii, Combretum molle* and other *Combretum* species were the most cited; these are species typically used for firewood, posts, poles, tool handles, medicine and bee forage. Second, was an intermediate

group of important "food trees" – tamarind and *Balanites aegyptiaca*. These were followed by mentions of other Acacia species and *Grewia mollis*, a tree which supplies an edible fruit and leaves for fodder, firewood, charcoal and timber. Ten households could not recall any particular standing tree. Most of these species are currently not available in the field.

Table 2: Tree species mentioned by refugees as noteworthy initially on the plots currently used by host and refugee communities

Species	Number of households reporting on species they initially saw on their land				
	Refugee		Host communities		Total
	Imvepi	Rhino Camp	Odupi	Uriama	
Acacia hockii	26	37	16	12	91
Combretum molle	40	33	7	5	85
Combretum spp	32	24	15	9	80
Balanites aegyptiaca	24	13	22	12	71
Tamarindus indica	15	22	19	7	63
Combretum collinum	26	18			44
Acacia spp	25	12	4	1	42
Grewia mollis	26	9	3	2	40
No standing tree	6	4			10

Actions to improve the state of the landscape

Participants proposed three main strategies to boost tree cover. Tree growing was almost 10 times more likely to be suggested than the second most mentioned approach – conserving existing trees. Only eight individuals cited regeneration as a possible option.

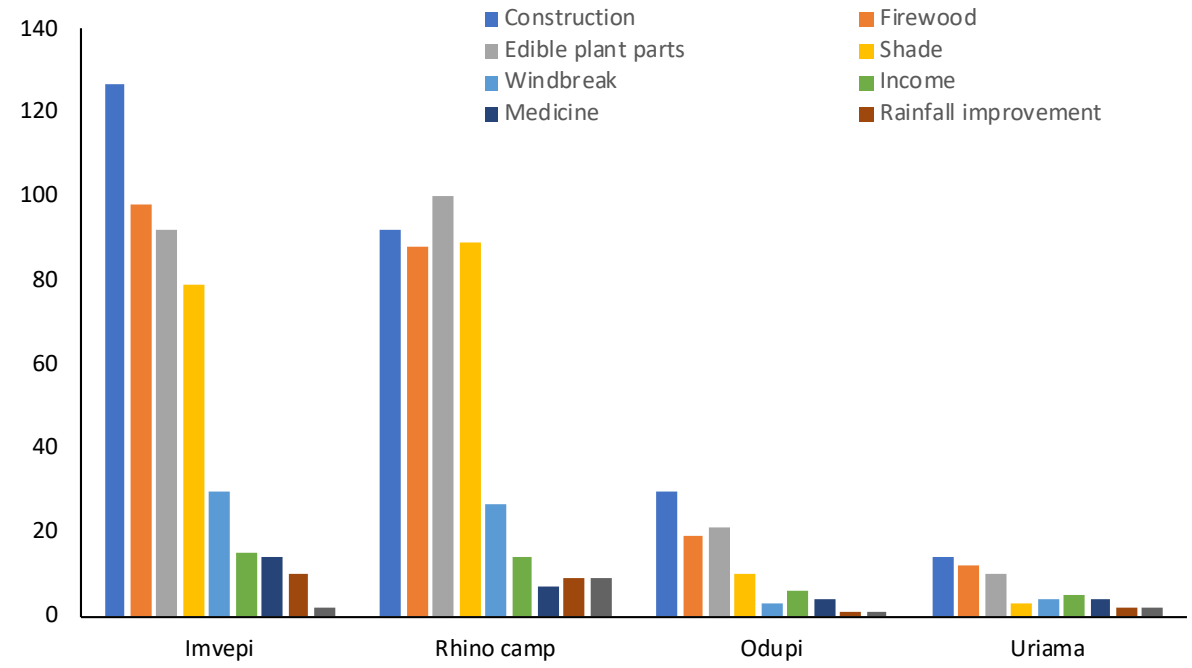
Table 3: Measures to restock woody biomass in the landscape

Actions	Frequency of mention				
	Odupi	Uriama	Imvepi	Rhino Camp	Total
Tree growing	25	15	120	117	277
Conserving existing trees	6	3	4	16	29
Promotion of regeneration	1	2	1	4	8

When respondents were asked if natural regeneration could be an option for restocking the landscape with biomass, 94% of them responded positively, stating in particular that it could be an *affordable* option. They noted that this could be done by assisting sprouting species such as Acacia and others.

Main functions of trees

Communities highlighted four key use categories of trees – construction, firewood, shade and as edible plants. A further five functions, but decreasingly less cited, were – to act as windbreaks, for income generation, for medicine, to improve rainfall and for charcoal (Figure 2).



(Numbers represent frequency of mention)

Figure 2: Preferences for tree use in the landscape

Which species serves which function?

Different species can be used for various functions. Table 4 summarizes the most preferred species in descending order for the nine functions that trees serve, in both refugee and host communities.

Table 4: Species preferences of the refugee and host communities

Functional category	Priority species	Frequency of mention				
		Refugee		Host community		Total
		Imvepi	Rhino camp	Odupi	Uriama	
Construction	*Tectona grandis*	106	73	24	11	214
	Eucalyptus spps	102	39	20	9	170
	Azadirachta indica	29	49	19	7	104
	Senna siamea	30	20	14	10	74
	Melia azadirachta	20	27	10	2	59
	Combretum molle	7	8			15
	Pinus spp	7	2	4	2	15
Firewood	*Tectona grandis*	58	44	3	7	112
	Eucalyptus spp	51	30	6	6	93
	Senna siamea	32	25	8	7	72
	Azadirachta indica	15	35	3	3	56
	Combretum molle	12	19	6	3	40

Functional category	Priority species	Frequency of mention				
		Refugee		Host community		Total
		Imvepi	Rhino Camp	Odupi	Uriama	
	Acacia hockii	8	10	7	3	28
	Mangifera indica	18	5	1	3	27
	Melia azadirachta	7	9	7	1	24
	Terminalia ivorensis	7	11			18
Food trees	*Moringa oleifera*	114	125	26	14	279
	Mangifera indica	73	83	18	10	184
	Carica papaya	44	54	14	3	115
	Persea americana	56	45	12	5	118
	Psidium guajava	39	52	4	5	100
	Citrus - lemon	28	31	8	3	70
	Artocarpus heterophyllus	22	16	9	1	48
	Citrus - oranges	15	16	5	5	41
	Grewia mollis	13	10	6	1	30
	Other citrus spp	10	10	4	2	26
	Azadirachta indica	11	7	5	2	25
	Annona muricata	14	7	1	1	23
	Balanites aegyptiaca	5	2			7
Income	*Tectona grandis*	8	10	3	3	24
	Mangifera indica	7	9	4	3	23
	Persea americana	6	3	1	2	12
	Eucalyptus spp	7	6	5	2	20
Medicinal	*Azadirachta indica*	11	6	3	4	24
	Moringa oleifera	9		1	2	12
	Persea americana	3				3
Shade	*Mangifera indica*	60	61	10	3	134
	Azadirachta indica	20	29	4	2	55
	Persea americana	28	15			43
	Psidium guajava	18	14	1	1	34
	Senna siamea	3	15	9	1	28
	Citrus limon	14	8		2	24
	Other Citrus spp	14	9			23
	Tectona grandis	4	15			19
	Artocarpus heterophyllus	11	6			17
Windbreak	*Tectona grandis*	23	12	2	2	39
	Mangifera indica	14	21	2	1	38
	Eucalyptus spp	13	12	1	1	27
	Azadirachta indica	10	11		2	23

Functional category	Priority species	Frequency of mention				
		Refugee		Host community		Total
		Imvepi	Rhino Camp	Odupi	Uriama	
Soil improvement	*Mangifera indica*	26	28	4	6	64
	Azadirachta indica	22	27	5	4	58
	Acacia hockii	17	11	5	2	35
	Persea americana	16	11		1	28
	Melia azadirachta	7	9	5	3	22

Tree-growing ambitions

Both refugees and hosts are strongly motivated to plant and grow trees. The strong interest among the host community is easy to understand given their largely secure tenure and possession of land that can easily be allocated for planting. As seen in Table 5, two-thirds of host study participants, an overwhelming proportion, sought to obtain seedlings to create woodlots. In contrast, in the refugee settlements, study participants sought largely to obtain seedlings to plant along plot boundaries with the balance sought for trees around their houses. The majority of the refugees were interested in boundary planting.

Besides seedlings for woodlots, the hosts also requested for a considerable number for boundary planting. Overall, the 278 households in the two communities sought over 50,000 seedlings, with refugees wanting about 10,000 and the hosts, 40,000. Niche planting ambition as evidenced by the number of seedlings requested is summarized in Table 5. See also Figure 3.

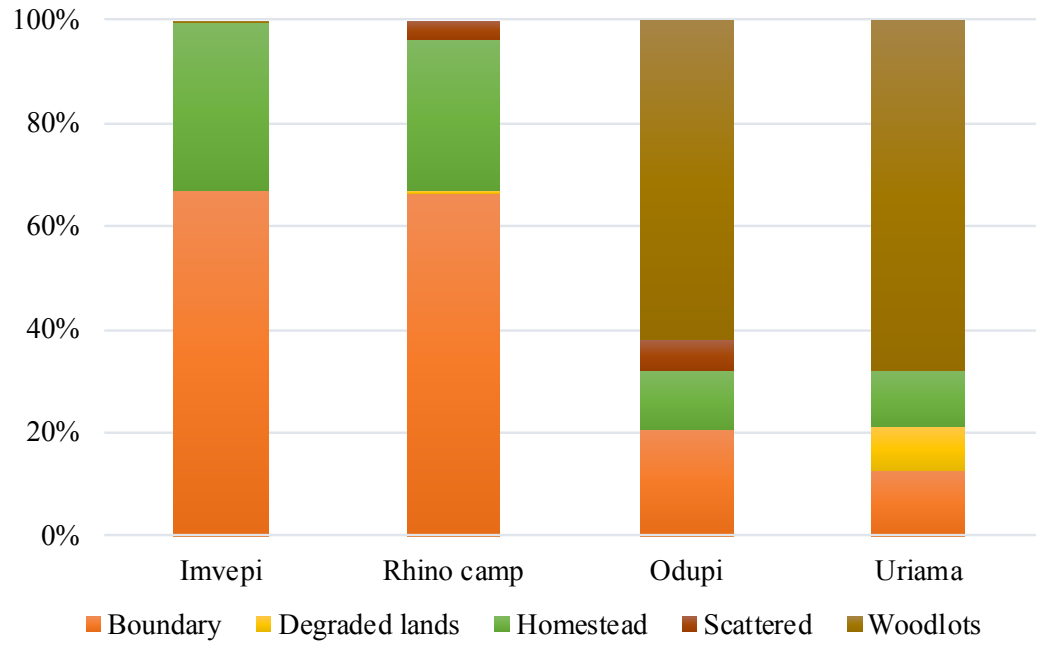


Figure 3: Ambition per niche of woody plants by relative proportion

Per household, the average number of seedlings requested by refugees for planting was about 50 in Imvepi Refugee Settlements (plots of 50 x 50 m) and 32 in Rhino Camp (plots of 30 x 30 m), while the number of seedlings host households sought to plant in Odupi and Uriama were 863 and 1,249, respectively (Table 5).

Table 5: Planting niche preferences by refugee and host communities indicated by number of seedlings sought for these areas

Planting niches	Number of tree seedlings for planting				
	Refugees		Host communities		Total
	Imvepi	Rhino Camp	Odupi	Uriama	
Boundary	4,053	2,491	4,467	2,400	13,411
Degraded lands		20		1,600	1,620
Homestead	1,974	1,101	2,404	1,980	7,459
Scattered		145	1,400	50	1,595
Woodlots	30		13,310	12,705	26,045
Grand total	6,057	3,757	21,581	18,735	50,130
Number of households	121	117	25	15	278
Average number of trees to plant per household	50	32	863	1,249	180

Table 6 presents more details on refugee plots, where the refugees believe trees could most benefit them and how many they would like to plant. Imvepi Refugee Settlements have slightly larger plots with an average perimeter of 172 m and average area of 1548 m^2. There, refugees sought to plant 34 (67%) of the 51 seedlings desired along boundaries and 16 (32%) inside the plots. In Rhino Camp, with plot perimeters of 116 m and areas of 803 m^2, refugees indicated their desire to plant 21 (66%) out of 32 seedlings along boundaries, 9 (29%) within the plot, and none as woodlots. This would give the Imvepi Refugee Settlements plots a density equivalent to 140 trees/ha and the Rhino Camp plots equivalent to 136 trees/ha.

Table 6: Tree growing ambitions among refugee households

Attributes	Imvepi (n=117)	Rhino Camp (n=117)
Plot perimeter (m)	172 ± 42	116 ± 24
Plot area (sq. m)	1549 ± 849	803 ± 407
Total planting and growing ambitions per household	51 ± 68	32 ± 29
- In boundary plantings	34 ± 55	21 ± 22
- In homestead	16 ± 31	9 ± 8
- In woodlots	0.26 ± 3	0
- In scattered on farms	0	1 ± 8
- In degraded lands	0	0.17 ± 2
Boundary planting intensity per 100 m	22 ± 34	18 ± 9
Homestead planting intensity (trees per ha)	140 ± 189	136 ± 128

Prioritization of tree species for planting purposes

Table 7 provides details on which species participants from both communities said that they wanted to plant and in what quantities. Where necessary and where they exist, English names are provided here. The preponderance of exotic timber and fruit species is worth noting. Teak, Neem and Eucalyptus are the top three for both communities.

Table 7: Species level planting ambitions among refugee and host communities

Species preferred for planting	Number of tree seedlings sought to plant				
	Refugee		Host communities		
	Imvepi	Rhino Camp	Odupi	Uriama	Total
Tectona grandis - Teak	1,361	1,057	5,995	4,580	12,993
Azadirachta indica - Neem	348	438	5,745	3,500	10,031
Eucalyptus spp	1,254	442	1,425	1,900	5,021
Pinus caribaea - Pine				5,000	5,000
Mangifera indica - Mango	631	411	981	1,275	3,298
Melia azadirachta	7	62	1,930	370	2,369
Moringa oleifera	169	131	2,375	135	2,810
Persea americana - Avocado	489	170	699	140	1,498
Citrus - Lemon	227	133	555	440	1,355
Senna siamea	95	63	480	180	818
Citrus - Orange	54	50	230	435	769
Pinus spp	218	45	200	250	713
Carica papaya - Pawpaw	226	121	182		529
Khaya spp - Mahogany	170	45	270		485
Psidium guajava - Guava	185	187	35	10	417
Gmelina arborea		56	300		356
Artocarpus heterophyllus - Jackfruit	116	55	46	105	322
Citrus spp	144	45	58		247
Combretum collinum	185				185
Albizia coriaria		55			55
Albizia gummifera			30		30
Annona muricata (Soursop)	51	0	5		56
Melia volkensii		20			20

Which trees to grow where in the landscape?

To propose a practical solution to over-harvesting of woody biomass, this assessment also examined the niches where host farmers and refugees wanted to plant the different species. Table 8 summarizes this species-niche allocation. Except for mahogany (*Khaya*) and *Combretum collinum*, which are indigenous, the high priority species for planting are all exotic to Africa. The species are also repeated in the different niches; they number just 21 without much differentiation between niches.

Table 8: Planting niches by species and number of trees

Niches	Species	Refugee		Host communities		Total
		Imvepi	Rhino Camp	Odupi	Uriama	
Boundary	*Tectona grandis*	1,351	1,036	1,255	830	4,472
	Azadirachta indica	325	372	1,705	720	3,122
	Eucalyptus spp	1,254	439	235	100	2,028
	Senna siamea	95	63	480	110	748
	Melia azadirachta	7	62	330	220	619
	Mangifera indica	162	110	10	320	599
	Khaya senegalensis	170	45	230		445
	Gmelina arborea		56	200		256
	Pinus spps	218	45			263
	Moringa oleifera	60	51		100	211
	Combretum collinum	185				185
	Persea americana	65	46			111
Degraded lands	*Eucalyptus spps*				1,000	1,000
	Tectona grandis				500	500
	Azadirachta indica				100	100
Homestead	*Mangifera indica*	459	281	701	815	2,256
	Citrus - lemon	193	119	555	440	1,307
	Persea americana	424	124	99	140	787
	Moringa oleifera	109	80	375	35	599
	Citrus - Oranges	45	27	80	435	587
	Carica papaya	191	106	60		357
	Psidium guajava	154	124	35	10	323
	Artocarpus heterophyllus	89	52	46	105	292
	Tectona grandis		21	200		221
	Citrus spps	144	45	18		207
	Eucalyptus spps		3	200		203
Scattered	*Persea americana*			600		600
	Mangifera indica		20	270		290
	Citrus - Oranges			150		150
	Melia azadirachta			100	50	150
	Azadirachta indica			100		100
	Carica papaya			100		100
Woodlots	*Tectona grandis*	10		4,540	3,350	7,900
	Azadirachta indica			3,940	2,680	6,620
	Pinus caribaea				5,000	5,000
	Eucalyptus spps			990	1,100	2,090
	Moringa oleifera			2,000		2,000

Niches	Species	Refugee		Host communities		Total
		Imvepi	Rhino Camp	Odupi	Uriama	
	Melia azadirachta			1,500	100	1,600
	Pinus spps			200	250	450
	Mangifera indica	10			140	150
	Gmelina arborea			100		100

Support required to operationalize the tree-growing ambitions

Communities in Rhino Camp and Imvepi Refugee Settlements receive support from non-governmental organizations (NGOs), agencies and government entities. On their own, they have limited capacity to operationalize their desire to plant trees. When asked about the support needed, supply of planting materials was most mentioned, followed by farm equipment. Management of planting materials ranked third; this includes training on handling seedlings. Land was ranked fourth.

Table 9: Support required by refugees for tree-growing programmes

Areas	Planting materials	Farm equipment	Management of planting materials	Land for planting trees
Imvepi Refugee Settlements	104	84	79	77
Rhino Camp	105	94	82	67
Odupi	25	19	14	7
Uriama	15	11	7	3

Management of planted seedlings is critical to success and can be addressed through training schemes that capture the diverse activities associated with planting. The study, therefore, assessed training needs. Figure 4 illustrates that the greatest concerns of both refugees and hosts include how to plant, how to manage seedlings before and after planting, and how to raise and space seedlings. Other areas such as digging holes properly, pest control and pruning intensity were mentioned, but not that frequently.

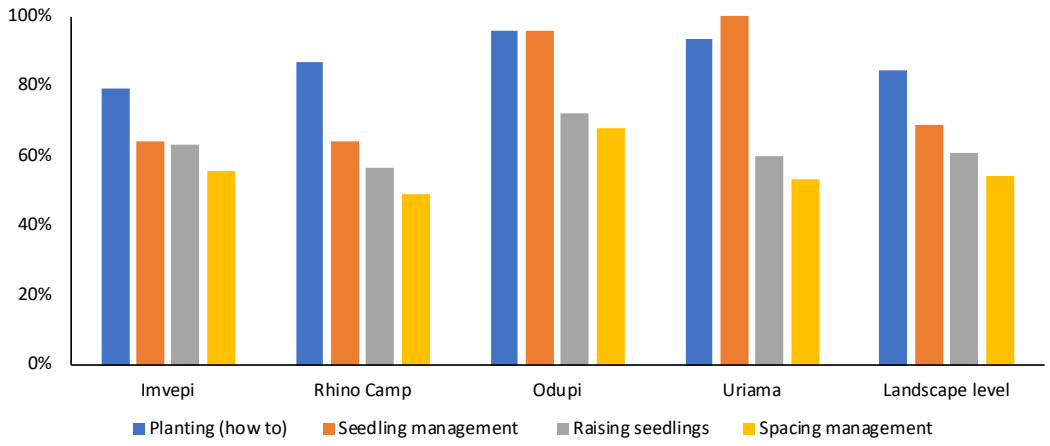


Figure 4: Types of training required to actualize tree-growing ambitions as requested by refugees and hosts

Sample farm design proposed by refugee households

Based on the species preferences and planting niche choices, refugees in different locations have developed their own views on how they could operationalize tree integration into their plots. Figure 5 presents a sample sketch developed for the villages.

Figure 5: Farm plot sketch on how trees could be integrated into the plots in Rhino Camp and Imvepi Refugee Settlements

Reflections on the refugee and host communities' preferences and perspectives

Several issues that were brought up by the communities warrant some reflection. First is the species preference. Most of the species preferred are exotics, particularly those used for construction and firewood. Typically, there is unanimous and strong preference for eucalyptus, teak and neem trees both by the refugee and host communities. This was largely influenced by familiarity of the people to those species and their fast-growing nature.

The community saw these species grown by different people and entities. For instance, in Rhino Camp, numerous teak plantations were established in the late 1990s and early 2000s. It is possible that the communities' preference for teak in this area might have been influenced by such observations. The refugees, who are mostly from South Sudan, are very familiar with teak plantations in their place of origin. The species was introduced there as early as 1919 (Adkins, 2015) and has been expanding since then. For instance, the Equatorial Teak Company located in Gbudue State (formerly Western Equatorial State) owns about 2,400 ha

of teak plantations and concessions of over 70,000 ha. Though debatable, Deng (2014) states that South Sudan had about 30,250 ha of teak forest concessions. Hence, their preference for teak is not surprising.

Eucalyptus is a widely-planted exotic species, and communities' choices might have been due to this. The preference for Eucalyptus, besides it being a familiar species, is also influenced by its fast-growing nature even under poor soil conditions and harsh climate. Nonetheless, it is important to note the ongoing debate surrounding the ecological effects of eucalyptus, such as its allelopathic effects (Moral and Muller, 1970; Al-Mousawi and Al-Naib, 1975; Lisanework and Michelsen, 1993; Zhang and Fu, 2009; Fikreyesus et al., 2011), its high moisture extraction levels, and its aggressive competition for available nutrients (Malik and Sharma, 1990; Kidanu et al., 2004). In addition, areas around Imvepi Refugee Settlements and Rhino Camp are infested with termites, which have a negative impact on the survival of eucalyptus. Hence, the choice to plant this genus must be carefully considered.

The selection of species for planting therefore needs to take into consideration the immediate needs of the communities (i.e., wood requirements for various uses) and the agroecological matching of the selected species to the local context. This balancing process requires communities to see beyond the current challenges and move the discourse to issues of resilience, which is an important outcome in such an environmentally- and climatically-constrained environment. In situations where locally adaptable species are preferred, options to complement the needs of society should be well thought through. This may involve identifying alternative fast-growing species or supplying technologies that could reduce reliance on the wood requirements of the communities. In addition to planting trees, consideration needs to be given to regeneration of trees from existing stumps, a practice now referred to as farmer-managed natural regeneration (FMNR). This practice has the advantage of giving a chance to locally adaptable tree species to re-grow through deliberate management, e.g., by pruning. The regenerating trees usually grow faster due to the well-established root system. Given its proven impacts and ready scalability, FMNR and associated soil and water conservation practices provide a potentially transformative model for natural resource management in the drylands of Africa and beyond (WRI, 2008).

The second aspect that needs attention is the type of support that the community requested. Three key support lines stood out: material support, providing planting materials, training and capacity development for resource management, and formulation and enforcement of by-laws. To date, humanitarian support schemes do not pay specific attention to such aid. However, the strong call for such support warrants a rethink of how humanitarian aid should be framed, and what kind of assistance is required in addition to the daily needs.

Emphasis on this issue, by both the refugee and host communities, clearly reveals that reducing environmental impacts of resettlement schemes should embrace these dimensions, considering the severe extraction pressure it brings to the settlement areas and their surroundings. Among the refugees, one additional support that was required is that the local governments and the Office of the Prime Minister (OPM) should help by providing additional

pieces of land where they could grow trees to reduce pressure on surrounding woodlands and to improve the microclimatic conditions of the area.

Important considerations for promoting tree-based systems

Prevailing preference for exotic species

Reasons for the strong preference for exotics, despite the heavy use of indigenous species, include cultural and social norms. These comprise the mindset that indigenous species are perceived as wild, and therefore do not need to be planted but instead grow naturally. There is a general belief that the only plantable species are the exotics. The other reason is that exotics grow much faster than indigenous species. Despite using indigenous species daily, communities do not mention them often when asked for their preferences. This implies the need for intensive awareness creation initiatives to help communities understand the importance of indigenous species in meeting their daily needs, enhancing resilience to climate change, and in conserving local biodiversity.

It is not possible to prohibit the growing of exotics. However, inasmuch as possible, species such as eucalyptus and teak, which are known to be highly extractive, should not be planted within residential areas or close to water sources. If the refugees and host communities insist, such species can be sparsely mixed with other native and less harmful species. The other practical option is to grow them as small woodlots in degraded areas or in plots that are not near residential areas. Tree-growing schemes should consider the long-term resilience of the system and also how to balance between community needs, environmental suitability of species, and biodiversity friendliness.

Alternative tree-based systems

Although refugees overwhelmingly prefer boundary tree growing and integration of fruit trees within their plots, there are also alternative tree-based systems that could be promoted. Examples include farmer-managed natural regeneration (restoring degraded areas by actively managing sprouting trees) and growing trees along riverbanks (growing trees to stabilize the riparian system).

Allocation of land for collective action

Many of the refugees proposed that Uganda's Office of the Prime Minister (the government lead on refugee response) find a way to allocate them land for tree-growing. However, with the continuing pressure on land, this resource may become scarce in the future. We propose that refugees be allocated degraded land that they could rehabilitate using the alternative tree-based systems described above. This would help to restore the environment, reduce pressure on the remaining woodlands, and also provide wood resources for the community. Tenure arrangements in such conditions can be carefully defined by explicitly stating the rights and responsibilities of refugees and the host communities.

Proposed action plan for planting trees in refugee and host community areas

Based on the study findings and expert opinion, we recommend the following tree-growing options for refugees and host communities in and around Imvepi Refugee Settlements and Rhino Camp (Table 10). This framework is a guide for general planning purposes; specific interventions in some locations have to be contextualized based on the realities of the area and actors engaged in the activity.

Table 10: Recommended tree growing options for refugees and host communities in Imvepi Refugee Settlements and Rhino Camp

	Category/ Tree growing option	Rank (1-most preferred)	Remarks
Refugees	Boundary planting	1	Use large size trees at a spacing of 2 m or more; for firewood shrubs use close spacing (0.5-1.0 m) along the line. They will also act as windbreaks. Provide a boundary between neighbouring plots by planting double line
	Homestead/ compound	2	For shade and windbreak, use suitable shade species
	Scattered in farm plot	3	Mainly fruits
	Institutions (schools, health units, common spaces)	4	Use appropriate species for boundary and compound planting such as *Azadirachta indica* and *Persea americana*. Trees that provide shade are particularly valuable for pupils and, for example, for relatives caring for patients. Secure institutional consent and commitment to plant and manage the trees
	Degraded lands in settlement	5	Use hardy species and secure community commitment to manage the planted trees
Host community	Woodlot (1-5 acres)	1	Use preferred species at spacing of 2.5 m or more for poles and firewood
	Boundary planting	2	Use large size trees at spacing of 3 m or more; for firewood or fodder shrubs, use close spacing (0.5-1.0 m) along the line
	Fruit orchards	3	This is particularly for mango, pawpaw, guava. For mangoes, ensure spacing is 8 x 8 m to 10 x 10 m. Integrate crops in first 1-3 years
	Scattered on farm	4	Use appropriate species with minimum impact on agricultural crops, including fruit trees like Jack fruit, tamarind, desert date, Vitex
	Homestead/ compound	5	For shade and windbreak. Use suitable shade species
	Degraded farms and community lands	6	Any degraded site including riverbank stabilization and water shed protection. Use appropriate species, including bamboo

Besides the choices made above, a consultation process was conducted with selected groups of people in the Imvepi Refugee Settlements area to design an annual action plan to implement the preferred choices of planting schemes. Table 11 presents details of the activities with specific time periods. Any entity hoping to implement the restocking of woody plants in the landscape can use the details in Table 11 as a reference, with the necessary adjustments depending on the local context.

Table 11: Proposed annual plan of implementation for restocking woody plants

Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seedling production	◄	=	=	►								
Training		◄	=	►								
Community mobilization		◄	=	=	=	=	=	=	=	=	=	►
Land preparation			◄	=	=	=	►					
Tree planting				◄	=	=	►					
Monitoring the planted trees				◄	=	=	=	=	=	=	=	►
Setting up environmental committee		◄	=	►								
Law and byelaw enforcement			◄	=	=	=	=	=	=	=	=	►
Implementation of improved technologies			◄	=	=	=	=	=	=	=	=	►
Land acquisition			◄	=	=	=	►					
Demonstration			◄	=	=	=	►					

Conclusion

It is important that implementing organizations in refugee settlements embed training and extension services that promote environmental management within the refugee and host communities. The refugees highlighted that despite participating in some training sessions on various issues, environment-related matters are rarely addressed. They mentioned that they would like to give back to the land that helped them build a second home. This latter sentiment is irrespective of how long they will live there. With such commitment and motivation, such initiatives could also help create jobs in the community, while addressing the environmental concerns often raised in connection with the refugee influx.

Although the host communities may have the land to plant trees, household-level labour shortage was cited as a significant limitation. This could be addressed by landowners in the host communities allowing refugees to cultivate the land in return for tree growing.

Annex: List of tree species identified as present on the landscape that locally make a contribution to human nutrition

	Species	Frequency of mention				
		Imvepi	**Rhino Camp**	**Odupi**	**Uriama**	**Total**
1	*Balanites aegyptiaca – Desert date*	103	78	23	14	208
2	*Tamarindus indica* - *Tamarind*	84	77	20	11	192
3	*Vitellaria paradoxa* - Shea	35	30			71
4	*Ximenia americana*	26	20	5	3	54
5	*Annona senegalensis*	16	10			26
6	*Vitex doniana*	13	10	1		24
7	*Carissa edulis*	12	9	1	1	23
8	*Pseudocedrela kotschyi*	9	11	1	2	23
9	*Parinari excelsa*	9	6	4	1	20
10	*Mangifera indica*		10		1	11
11	*Citrus lemon*		9		1	10
12	*Persea americana* - Avocado		8		1	9
13	*Ziziphus abyssinica*		2	4	1	7
14	*Laloko spp**	2	5			6
15	*Borassus aethiopum*	2	3			5
16	*Cocos nucifera* - *Coconut*	5				5
17	*Annona muricata*		3			3
18	*Grewia mollis*	1		1	1	3
19	*Annona spps*			1		2
20	*Canarium schweinfurthii*	1	1			2
21	*Carica papaya* - Pawpaw		2			2
22	*Psidium guajava* - Guava		1	1		2
23	*Sclerocarya birrea*	1		1		2
24	*Lemugamba* (South Sudan)		1			1
25	*Royal palm**	1				1
26	*Strychnos innocua*		1			1
27	*Syzygium cuminii*		1			1
28	*Vitex madiensis*		1			1
29	*Yoda**	1				1
30	*Ziziphus africana*			1		1

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