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THE REPUBLIC OF UGANDA

UNHCR The UN Refugee Agency

FOREST LANDSCAPE MANAGEMENT PLAN FOR THE BIDIBIDI REFUGEE SETTLEMENT, YUMBE DISTRICT, UGANDA

2023–2028

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FOREWORD

Uganda's forests supply 88 percent of the country's total energy needs, provide 61 percent of tourism income and provide jobs for about 1 million people. Despite the undisputed value of forests, Uganda is losing forest cover at an alarming rate of about 122 000 ha annually.

Forests are essential components of Uganda's prosperity and a lifeline for its people. When managed in a sustainable manner, forests provide unmatched environmental, social and economic benefits such as providing habitats for native flora and fauna species, producing wood and non-wood products, and acting as carbon sinks to foster healthy environments and help stave off effects of climate change. Uganda's forests supply 88 percent of the country's total energy needs, provide 61 percent of tourism income and provide jobs for about 1 million people.

Despite the undisputed value of forests, Uganda is losing forest cover at an alarming rate of about 122 000 ha annually. According to the Ugandan Government's 10-year plan of action for the restoration of the environment and natural resources in the country, Uganda's forest cover decreased from 53 percent in 1900 to 24 percent in 1990 and to 12.4 percent in 2017. Between 1990 and 2017 alone, the country lost 49 percent, or a total 2.4 million ha, of its forest cover (from 4.9 million to 2.5 million ha) (Uganda, Ministry of Water and Environment, 2021). However, over the past two decades, over 80 000 ha of quality forest plantations were established across the country (Howard, 2019). This milestone is a result of interventions by the Government of Uganda, development partners like FAO (which implemented Phase III of the European Union-funded Sawlog Production Grant Scheme), the private sector, the third sector and various categories of well-wishers. Nonetheless, the restoration of forests and tree cover by natural regeneration, by plantation or by agroforestry has not kept pace with the annual loss of forest cover and loss of individual trees.

Forest cover loss is mainly attributed to deforestation for biomass fuel and timber, and auxiliary drivers such as expansion of agricultural land, urbanization, poverty, industrialization and inadequate incentives for private planting of forests. The influx of refugees in Uganda has often added to existing pressure on the environment, resulting in reduced access to woodfuel for cooking and competition with host communities over the use of limited natural resources.

A key objective of Uganda's sustainable forest management is to protect and enhance the health and diversity of our forest resources, while ensuring that they continue to provide a range of environmental, social and economic benefits for present and future generations. The Ministry of Water and Environment, on behalf of the Government of Uganda, is therefore grateful for and satisfied with the development of the Forest Management Plan for the Bidibidi Refugee Settlement in Yumbe District, Uganda, 2023-2028.

With more than 1.5 million refugees and asylum seekers, Uganda is the largest refugee hosting country in Africa and the third worldwide. The Bidibidi refugee settlement hosts about 270 000 refugees, making it the largest in Uganda and one of the biggest in Africa. With the influx of refugees, this number could grow in years to come. Moreover, refugee-hosting districts face one of the fastest rates of population growth in Uganda, if not in Africa. Inadvertently, the pressure on natural resources like forests and other woodlands will be immense. The Forest Management Plan for the Bidibidi Refugee Settlement will therefore be a beacon to guide restoration efforts in the area. It will ensure that the needs of the people are addressed, and the coordinated and seamless efforts of the Government and our partners are promoted. Through the Water and Environment Sector Response Plan for Refugees and Host Communities in Uganda, the Government included refugee management and protection in its National Development Plan, shifting the focus from a solely humanitarian approach to recognizing the nexus between humanitarian work and development. This Forest Management Plan is thus a step in the right direction.

According to the Water and Environment Sector Response Plan for Refugees and Host Communities in Uganda, the country needs about USD 2 billion to finance the various multiyear integrated sector response plans in health, education, jobs and livelihood, and water and environment to support refugees. With shrinking resources nationally and globally, it is imperative to identify, allocate and use available

resources in a sustainable and efficient manner and thus ensure a lasting and meaningful impact. The Forest Landscape Management Plan for the Bidibidi Refugee Settlement will therefore be important to guide the commitment of financial and technical resources for natural resources management, based on sound evidence and avoiding ad hoc, unplanned and wasteful interventions.

The Ministry is grateful to the Food and Agriculture Organization of the United Nations (FAO), the United Nations High Commissioner for Refugees, the Office of the Prime Minister, the Yumbe District local government and all the district-level stakeholders that were involved in developing this landmark document. I am confident that this demonstration of inclusiveness will facilitate ownership and effective implementation of the proposed interventions. In the same vein, I appeal to all relevant authorities to step up the enforcement of existing laws and guidelines for the protection and restoration of natural resources, for a more environmentally secure and prosperous Uganda.

The Ministry of Water and Environment is committed and pledges its full technical support to provide an enabling environment for the implementation of this plan and subsequent interventions to develop similar plans for forest landscape management in other refugee settlements and hosting communities in Uganda.

I seize this opportunity to encourage you to protect the environment, promote commercial tree planting and engage in activities that technically and sustainably improve the livelihoods of the people of Uganda.

For God and My Country

Hon. Sam Cheptoris
Minister of Water and Environment

PREFACE

In most districts of Uganda that host refugees, both the refugee and the host community rely heavily on the environment for food, energy, shelter and income-earning opportunities. This has exacerbated existing pressures on natural resources and often leads to conflicts between refugee and host communities.

Over the years, efforts by various actors towards afforestation and reforestation within the refugee context have been hampered by a lack of forestry instruments to support implementation on the ground. Meanwhile, the impacts of climate change are creating challenges for farming systems, evidencing the need to back up Indigenous knowledge with scientific evidence to reduce the risks of failure. Specific to forestry is the long-term nature of engagement, which necessitates detailed planning to ensure that adequate resources are mobilized ahead of time.

Against this background, the Food and Agriculture Organization of the United Nations (FAO) and the Office of the United Nations High Commissioner for Refugees (UNHCR) in Uganda have joined hands to support the development of the Forest Landscape Management Plan for the Bidibidi Refugee Settlement (2023-2028).

This plan aims at providing practical guidelines and best practices to alleviate pressures on natural resources and conserve existing biodiversity through three main pathways: (1) woodlot establishment for energy purposes; (2) restoration of degraded areas; and (3) protection of special ecosystems.

The successful implementation of this plan through a people-centred approach will contribute to the realization of the aspirations of the United Nations Decade on Ecosystem Restoration (2021–2030) and contribute to the delivery of a number of Sustainable Development Goals, especially SDG 7: access to affordable, reliable, sustainable and modern energy for all; SDG 12: responsible consumption and production; SDG 13: climate action; and SDG 15: life on land.

The Forest Landscape Management Plan for Bidibidi once again demonstrates the high level of commitment by both FAO and UNHCR to strengthen environmental protection and promote the sustainable use of natural resources within displacement settings, as well as to support the mainstreaming of innovative standard procedures for a greener humanitarian response. We hope that the plan will provide general guidance for forestry and landscape interventions in Bidibidi and in other areas facing similar problems.

Antonio Querido
FAO Representative in Uganda

Matthew Crentsil
UNHCR Representative in Uganda

ACKNOWLEDGEMENTS

The development of the Forest Landscape Management Plan for Bidibidi has been a pilot activity in the refugee context of Uganda. The delivery of this work would not have been possible without the technical support from the Food and Agriculture Organization of the United Nations (FAO) and the financial support from the United Nations High Commissioner for Refugees (UNHCR). The plan was developed based on a highly consultative process that engaged all stakeholders at the settlement, district and national levels.

The plan marks an important step forward by the Ministry of Water and Environment (MWE) to formulate concrete pathways to realize the targets for the environment and natural resources of the Water and Environment Sector Response Plan for Refugees and Host Communities in Uganda (2019) and the Ten-Year Plan for the Restoration of the Environment and Natural Resources in Uganda, 2021–2031. This plan aims to ensure the sustainable utilization of natural resources and thus promote the peaceful coexistence of refugee and host communities in line with pillar 1 (land management) , pillar 4 (peaceful coexistence) and pillar 5 (protection of the environment) of the Settlement Transformation Agenda II (2022–2025).

I am grateful for the collaboration from the Office of the Prime Minister (OPM), the Yumbe District Local Government, local landowners (landlords), community leaders and refugee welfare councils whose ideas, suggestions and experiences were instrumental in developing this plan.

I would like to express my particular appreciation for the support and contributions of Arturo Gianvenuti, Nelly Grace Bedijo, Walter Mapanda, Leonidas Hitimana, Andrew Akasiibayo, Zuzhang Xia and Sven Walter (FAO) on the technical aspects of this work. The geographic information system and remote sensing analysis was carried out by Fred Lali (Earth Consult, Uganda) and Antonello Salis, Edwin Beinomugisha, Atwiine Praise and Enok Kaluuba (FAO).

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The Forest Landscape Management Plan for the Bidibidi Refugee Settlement will henceforth act as a guide for forestry interventions by implementing partners. We appeal to all other United Nations agencies and development partners to refer to this plan during their planning for forest landscape management or rehabilitation interventions in Bidibidi, and to support the replication of this excellent work in other refugee settlements and hosting communities around the country, where possible.

Finally, I thank and congratulate the team at the Forest Sector Support Department of the Ministry of Water and Environment for their high level of commitment and for the guidance rendered throughout the implementation of this project. Your unwavering support and team spirit displayed is commendable.

Alfred Okot Okidi
Permanent Secretary, Ministry of Water and Environment

ABBREVIATIONS AND ACRONYMS

AGB	above-ground biomass
BFAST	Breaks for Additive Seasonal and Trend
FAO	Food and Agriculture Organization of the United Nations
FSSD	Forest Sector Support Department
LULC	land use and land cover
MWE	Ministry of Water and Environment
NGO	non-governmental organization
NWFP	non-wood forest product
OPM	Office of the Prime Minister
REDD+	Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
UNDP	United Nations Development Programme
UNHCR	Office of the United Nations High Commissioner for Refugees

EXECUTIVE SUMMARY

Background

The influx of refugees in Uganda has often added to existing pressure on the environment, resulting in reduced access to woodfuel for cooking and competition with host communities over the use of limited natural resources.

A planned approach for the management of natural resources in displacement situations, in both the short and the long term, is crucial to minimize the environmental impact of displacement and increase the resilience of refugee and host communities to climate and other shocks. It is also a fundamental step to ensure sustainable livelihood opportunities through innovative and resilient forest value chains, including market access and social protection, while at the same time promoting a safer and more efficient use of natural resources, such as the use of sustainably produced woodfuel for cooking and heating, and access to alternative energy sources.

This Forest Landscape Management Plan builds on the work started in 2019 by the Food and Agriculture Organization of the United Nations (FAO), in collaboration with the Office of the United Nations High Commissioner for Refugees (UNHCR), the Office of the Prime Minister, the Ministry of Water and Environment, the Yumbe District Local Government, local landlords and refugee welfare councils. It reflects the most recent changes, including both non-spatial and spatial data and trends that have occurred in and around the Bidibidi refugee settlement. This plan is expected to support the Government of Uganda in its efforts to regulate the implementation of environmental and natural resource management interventions in the Bidibidi refugee settlement. It is envisaged that the Forest Landscape Management Plan will also guide efforts by UNHCR, FAO and other partners involved in supporting environmental and energy interventions in the target area.

Objectives

This document is aimed at providing practical guidelines to alleviate pressure on the environment and natural resources, ensure sustainable access to biomass for cooking, and contribute to building the resilience of both refugee and host communities. The specific objective of the plan is to highlight interventions that will lead to: (a) sustainably supplying fuelwood, timber and non-wood forest products (NWFPs); (b) protecting and maintaining forest resources with their ecological functions and processes; (c) promoting the conservation of biodiversity; (d) improving the quality of life for refugee and host communities; and (e) promoting a more active role for refugee and host communities in the management of forest resources, through the development of mutually beneficial arrangements.

The guidelines focus on three main strategies to achieve these objectives: (a) the establishment of energy woodlots; (b) the restoration of degraded environment and natural resources; and (c) the conservation of intact or partially intact natural forests and other sensitive ecosystems.

Baseline situation

Based on the geospatial analysis conducted to update this Forest Landscape Management Plan, the highest woody biomass losses between 2018 and 2021 are observed in land classified as subsistence farmland, for both the area within the Bidibidi settlement and a 5 km buffer zone around the settlement boundary, with a total annual biomass loss of about 68 383 tonnes. This is followed by tropical high forest (low-stocked and plantation) broadleaved forest plantation at 7 349 tonnes and 1 613 tonnes, respectively. The total biomass losses within the settlement and within the 5 km buffer stood at 39 297 tonnes and 39 518 tonnes, respectively, corresponding to approximately 9 800 tonnes per year in each area.

The total annual demand for woodfuel for cooking for the refugees and host communities settled in Bidibidi is estimated at 146 871 tonnes per year (based on the registered refugee population data from July 2022). The total above-ground biomass stock is estimated at 735 948 tonnes within the settlement area, while above-ground biomass growth is estimated at 121 794 tonnes per year within the settlement. Considering these figures and assuming that the biomass harvested by refugees and hosts settled in Bidibidi is sourced within the settlement area, the annual deficit of woody biomass growth is equal to 25 077 tonnes, with an average annual biomass loss of 3.4 percent. The main goal of establishing woodlots for energy is to close this gap by supplying sustainable woodfuel in combination with energy-efficient technologies and practices. Importantly, field observations have revealed that there are numerous other types of demand for wood, namely for construction, as a source of energy for commercial and agricultural activities, as well as losses to fire. These types of demand all contribute to the overall demand for woody biomass, but are not included in the calculations in this report.

Proposed management strategies

Establishment and management of dedicated woodlots for biomass energy production

The establishment and management of woodlots for energy boosts biomass production within a short period of time and increases tree density to reach the optimum growth per unit of area. It enables fuelwood demand to be met in a sustainable

manner, while at the same time providing other forest products for the refugee and host communities. Fast-growing indigenous and exotic tree species should be planted and short-rotation coppice management should be adopted to enable early harvesting of fuelwood. In addition, the use of multipurpose species, which provide other benefits as well, can increase people's motivation to manage trees effectively.

To compensate fully for the estimated annual loss of biomass (based on the analysis of woodfuel demand) and balance the estimated woodfuel supply and demand for cooking by refugees and host communities within the settlement boundary (considering the current deficit of 25 077 tonnes/year), it would be necessary to harvest 929 ha of dedicated tree plantations every year, which means a total of about 2 786 ha of woodlots with a rotation length of three years.

A number of incentive schemes for both refugee and host communities can be explored to ensure the successful plantation of woodlots for energy. These include cash for work, income from seedlings, performance-based payment for trees, partnerships with local non-governmental organizations (NGOs) and training in agroforestry systems.

Restoration of degraded forests and other land

The restoration of degraded forests and other land in and around Bidibidi can be a relatively cost-effective means of sustainably managing native forest resources. It is a way of restoring forest land through natural regeneration and assisted natural regeneration of indigenous tree species, and of productive farmland through agroforestry and agroecological techniques. The harvesting of forest wood and NWFPs will be controlled and regulated through site-specific harvesting plans. According to the type of land use and land cover (LULC), specific ecological restoration strategies will be implemented with the support of the local population. Efforts to restore degraded land are aimed at addressing soil conservation, carbon sequestration, biodiversity conservation, watershed conservation, and maintenance of cultural services and cultural values.

The recommended ecological restoration interventions would mainly target the tree cover loss on farmland, which is the main degraded LULC class, with woody biomass loss driven by agricultural expansion, overharvesting of fuelwood, fires and other destructive agents. The restoration interventions will also target degraded natural forests, riparian corridors, woodlands and bushlands.

A total of 6 846 ha of degraded land where woody biomass loss has recently occurred (between 2018 and 2021) has been identified for potential restoration.

This intervention proposes the following approaches:

- natural regeneration
- assisted natural regeneration
- reforestation of biological corridors
- agroforestry
- silvopastoral systems

Conservation of intact or partially intact natural forests

This approach will be aimed at maintaining undisturbed or partially disturbed (relative to a reference ecosystem) woodlands and bushlands, and protecting these ecosystems from fuelwood harvesting, livestock grazing and other destructive agents, such as fires. The interventions to conserve remaining pockets of closed natural forests and other woodlands are aimed at protecting biological diversity, ecosystems and natural resources, especially soil and water, and promoting aesthetic, cultural and spiritual values. The objective of protecting, preserving and managing ecosystems and natural habitats is to ensure that they are healthy and functional. This is done by evaluating human impacts on biological diversity and developing practical approaches to prevent the extinction of species and maintain the integrity of ecosystems.

The objective of the management of these indigenous forests is primarily to protect them from unregulated harvesting of forest products. Closed natural forest belts in Bidibidi are largely on host community land, with some pockets of forests along riverbanks. These native forests are sources of NWFPs and timber products. Intact natural forests must not be cleared and replaced by woodlots. They serve as natural barriers, wildlife corridors and special management zones for biodiversity conservation. Such areas must be surrounded by firebreaks.

1 INTRODUCTION

In the context of refugee settlements in Uganda, forest resources play a significant role in supporting refugees and host communities as a source of shelter, food, feed, energy for cooking and income-earning opportunities.

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1.1 Background

In July 2022, more than 1.5 million refugees and asylum seekers had been forcibly displaced to Uganda (mostly from South Sudan and the Democratic Republic of the Congo, followed by Burundi and Somalia), making Uganda the largest refugee host country in Africa.

In the context of refugee settlements in Uganda, forest resources play a significant role in supporting refugees and host communities as a source of shelter, food, feed, energy for cooking and income-earning opportunities. Ongoing and recurring conflicts in South Sudan and the Democratic Republic of the Congo have led to the establishment in Uganda of some of the world's largest refugee settlements.

The Bidibidi refugee settlement, located in Yumbe District, is the largest in Uganda, with a population of 224 048 as at the end of July 2022 (Office of the United Nations High Commissioner for Refugees [UNHCR], 2022).

The influx of refugees has often added to existing pressure on the environment, resulting in reduced access to woodfuel for cooking and competition between refugee and host communities over the use of limited natural resources (Food and Agriculture Organization of the United Nations [FAO] and World Bank, 2019).[1]

A planned approach for the management of natural resources in displacement situations, in both the short and the long term, is crucial to minimize the environmental impact of displacement and increase the resilience of refugee and host communities to climate-related and other shocks and stresses. It is also a fundamental step to create sustainable livelihood opportunities through innovative and resilient forest product value chains, including market access and social protection. For example, a planned approach can promote a safer and more efficient use of sustainably produced woodfuel for cooking and heating.

It is expected that wood will continue to be part of the energy mix for cooking, and that the gap between demand and sustainable supply will increase unless measures are taken. It is therefore crucial to plan and implement site-specific forest resource management interventions, including but not limited to forest restoration/reforestation, the protection of existing forests and afforestation.

The Forest Landscape Management Plan for the Bidibidi refugee settlement will support the Government of Uganda in its efforts to regulate the implementation of environmental and forest resource management interventions in the Bidibidi refugee settlement. The plan builds on work that started in 2019 under a multistakeholder approach. Participants were FAO, UNHCR, the Office of the Prime Minister (OPM), the Ministry of Water and Environment (MWE), the Yumbe District Local Government, landlords and refugee welfare councils. The plan reflects the most recent changes, including both non-spatial and spatial data and trends that have occurred in and around the Bidibidi refugee settlement. It is envisaged that the Forest Landscape Management Plan will also guide the work of UNHCR, FAO and other partners involved in supporting environmental and energy interventions in the target area.

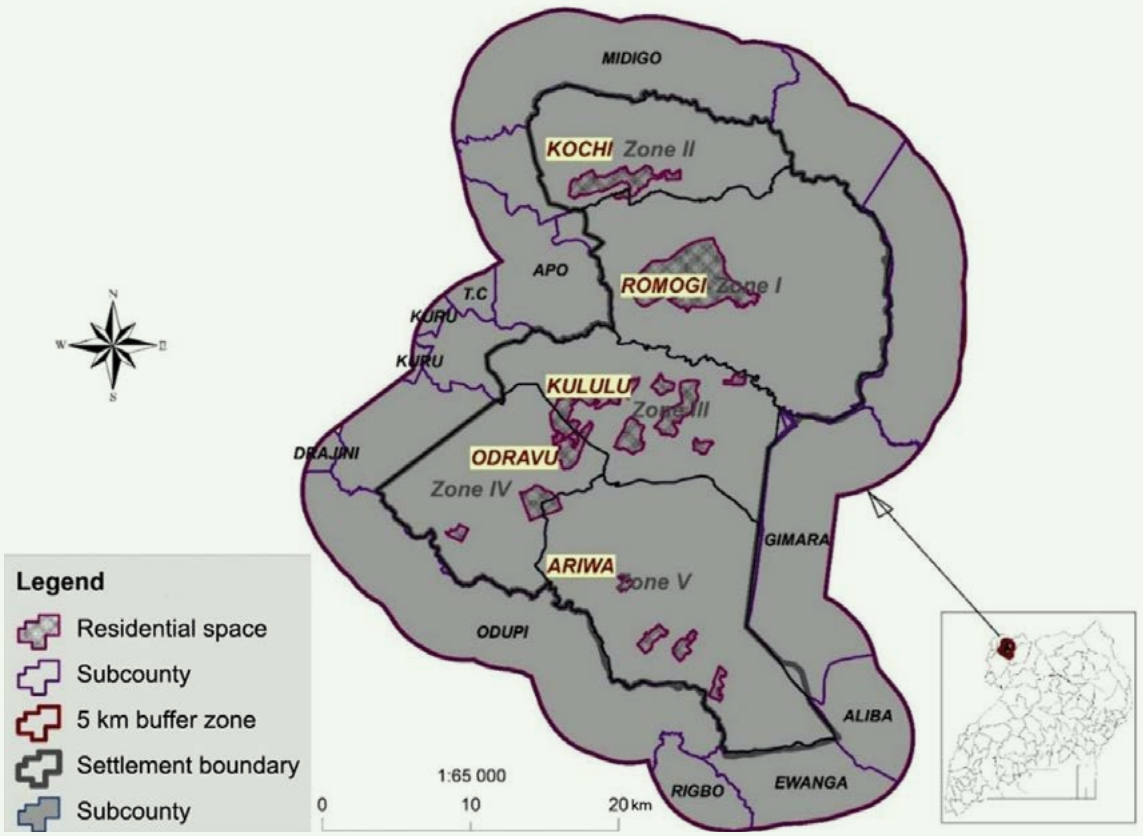
1.2 Area of interest

The primary area of interest of the Forest Landscape Management Plan for the Bidibidi settlement is located in Yumbe District, West Nile subregion. Bidibidi is located in the Upper Nile Water Management Zone, in line with the demarcations made by MWE to manage water resources at catchment level.

The area of interest (see Figure 1) comprises the land within the settlement boundary and a buffer zone surrounding it, within 5 km of the settlement boundary, which is the assumed limit for routine fuelwood collection by refugees. The total area within the Bidibidi boundary is 798 km^2, of which approximately 234 km^2 is residential or taken up by agricultural plots. The settlement area is divided into five zones: Zone 1 is located in Romogi subcounty, Zone 2 is in Kochi, Zone 3 is in Kululu, Zone 4 is in Odravu, and Zone 5 is in Ariwa. The area of the 5 km buffer zone brings the total area of interest to 1 617 km^2.

1. In the terminology used by FAO, "woodfuel" is a category of biofuels where the original composition of the wood is preserved. For the purpose of this study, only fuelwood and charcoal are considered as subcategories of woodfuel. "Fuelwood" is equivalent to "firewood".

Figure 1. Area of interest: Bidibidi settlement and 5 km buffer area around the settlement boundary



Note: The administrative boundaries of the subcounties in this map were last updated in 2019 and might not reflect the most recent changes.
Source: UNHCR, n.d. *Bidibidi boundary* (unpublished), Geneva.

1.3 Objectives of forest resource management

The primary objective of this short- to medium-term Forest Landscape Management Plan is to provide practical guidelines to implement site-specific forestry interventions aimed at alleviating pressure on the environment and natural resources, ensuring sustainable access to biomass for cooking and strengthening the resilience of both refugee and host communities.

The specific objectives of the plan are to implement interventions that will lead to:

- sustainably supplying fuelwood, timber and non-wood forest products (NWFPs);
- protecting and maintaining forest resources with their ecological functions and processes;
- improving the conservation of biodiversity;
- improving the quality of life of refugee and host communities; and
- promoting a more active role of refugee and host communities in the management of forest resources through the development of mutually beneficial arrangements.

In order to achieve these objectives, the plan provides recommended actions to implement interventions for the establishment of energy woodlots, restoration of the degraded environment and natural resources, and conservation of intact forests or partially intact natural forests.

The beneficiaries of these interventions include both refugee and host communities within the target areas, as well as institutions such as churches, mosques, schools and health facilities.

The recommended interventions are based on the results of previous assessments conducted by FAO, UNHCR and the World Bank and through a consultative process with the Government of Uganda and local stakeholders. These assessments were primarily intended to generate evidence-based information to enhance the understanding of the environmental impacts of the refugee influx, with a focus on forest resources, management challenges, identification of possible intervention strategies and practical proposals for interventions.

1.4 Time frame

The plan is to be carried out over a period of five years, which will include a woodlot rotation period of three years and five years of restoration and protection interventions.

The proposed activities and technical specifications may be improved over time based on experiences, lessons learned and feedback from MWE, the Yumbe District Local Government, OPM and other national and international agencies involved in forest resource management.

1.5 Stakeholder coordination

The implementation of forestry interventions inside the area of the Bidibidi refugee settlement will be under the authority of OPM and the Yumbe District Local Government. The District Natural Resources Department, represented by the district natural resources officer, the district forest officer, the district land officer, the district environment officer and the forest ranger, as well as subcounty officials, will play monitoring and supervisory roles, together with OPM settlement commandants, refugee welfare councils and the environment protection committees, under the supervision of UNHCR.

Technical support will be provided by the Forest Sector Support Department (FSSD), the District Forestry Service and other partners, such as FAO. The specific tactical plans (three to five years) and the annual plan of operation should be validated by MWE and OPM. FAO and other development partners will provide technical support through training on best operating practices and standards for sustainable forest management, tree nursery development, the restoration of degraded forests, and afforestation and reforestation.

In the area targeting the host communities, the district officials, in close collaboration with FSSD (under MWE), are to monitor and supervise the implementation of forestry interventions in collaboration with landlords, local leaders, the National Environment Management Authority and technical agencies. The landlords will be responsible for preparing the annual plan of operation, and managing budgets and operations related to the implementation of multipurpose forest plantations in order to meet the set plans.

The stakeholders responsible for maintenance and harvesting are the refugee leaders, local leaders, OPM, FAO, UNHCR, the District Forestry Service and FSSD. Harvesting activities for refugee woodlots will be contracted out to refugee settlement contractors, which will create employment for refugees. FAO will provide technical information, skills training and capacity building.

Detailed implementation arrangements based on the parish development model will be defined during the implementation of the specific interventions recommended in this Forest Landscape Management Plan. The specific roles and responsibilities of the different key stakeholders will be determined when the detailed implementation modalities are defined, based on a validation process among stakeholders.

2 BIOPHYSICAL CHARACTERISTICS

Yumbe District experiences two seasonal rainfalls between March and October: light rains between March and May, and the wettest months between August and October, with more than 120 mm of rainfall per month

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Climatic factors play an important role in site-species matching and consequently the growth performance of the trees planted. The climate in Bidibidi is purely tropical due to its location within the eastern topographical rainfall zone. Climatic extremes have become common in the past two decades, characterized by prolonged dry spells and floods that result in damage and loss of crops, livestock and facilities.

2.1 Precipitation, temperature, humidity and winds

Yumbe District receives an average annual total rainfall of 1 250 mm. The area experiences two seasonal rainfalls between March and October: light rains between March and May, and the wettest months between August and October, with more than 120 mm of rainfall per month. The period from December to February is dry, with less than 60 mm per month. The rain is associated with the northern and southern movements of the intertropical front. Due to high temperatures, mean monthly evaporation ranges from 130 mm to 180 mm, which limits the quantity of water available to plants.

Temperatures are generally high (36 o^C to 39 o^C) during the day in the dry season from December to March. Meanwhile, during wet seasons, temperatures are high during the day and fairly low during the night (16 o^C to 18 o^C). The prevailing wind is from the east, with frequent windstorms occurring during the dry season.

For tree planting, the first planting season (March and April) is the best season for planting; seedlings planted during this time have a better chance of survival, as their growth is reinforced during the second rainy season before the onset of the longest dry spell (Uganda, Yumbe District Local Government, 2013).

2.2 Soil characteristics

Soil types in Yumbe District include:

- Yellow-red sandy clay loams and latosols varying from dark grey to dark brown, which are slightly acidic and mainly derived from granite, gneiss and sedimentary rocks. They occur on gently undulating topography.
- Brown-yellow clay loams with a laterite horizon with the variation of dark brown to dark greyish brown. They are slightly acidic and occur on flat ridge tops or on top of undulating topography.
- Light grey mottled loamy soils with a laterite horizon ground (water laterite) and structureless loamy sands. These are acidic to alkaline and are found mainly on lower and bottom slopes (Yumbe District Local Government, 2013) (see Figure 2).

Soils are predominantly ferralitic and some areas have ferrisols with sandy loam and vertisols (heavy clay soils). These soils are finely textured with loose structures that are erodible and easily leached. Most soils are acidic.

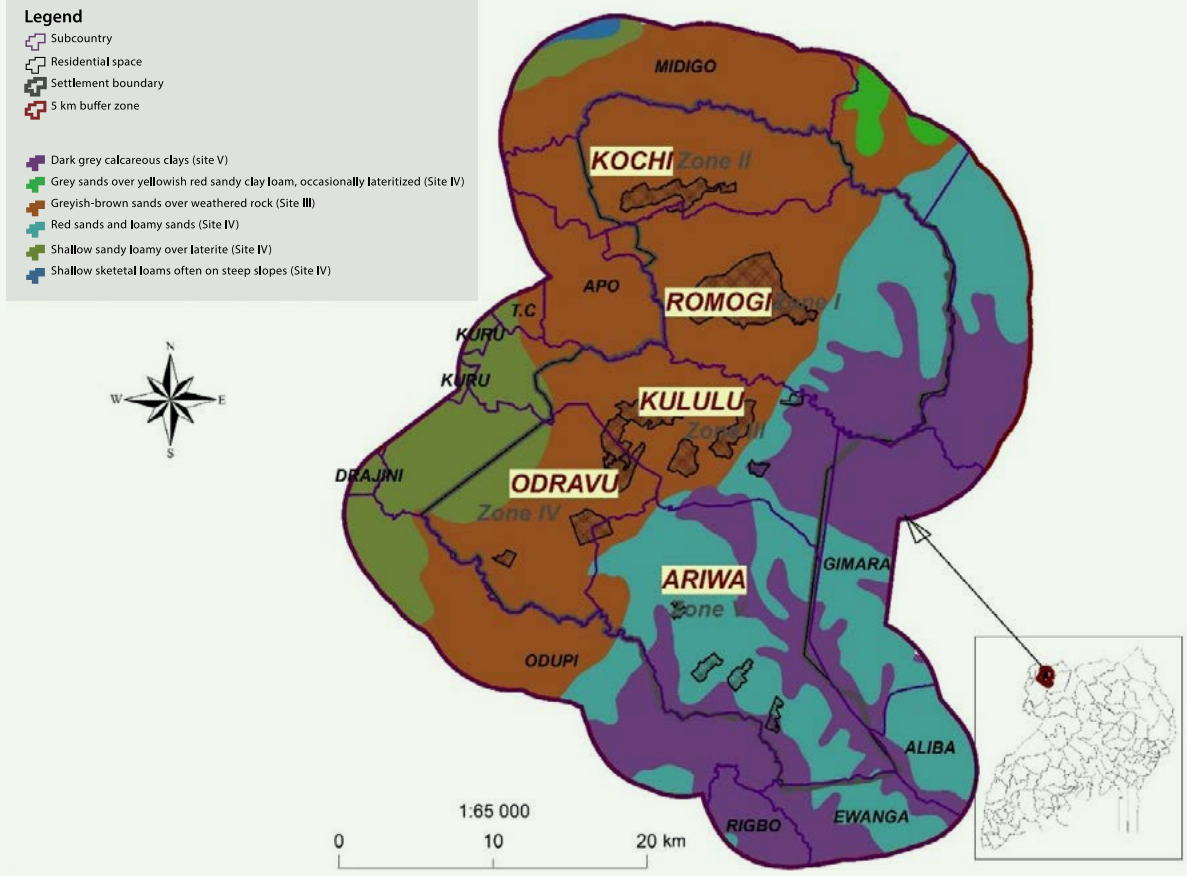
Vertisols are found in the northwestern parts of Yumbe District. They have poor drainage and thus easily become waterlogged.

There is a lateritic layer in most soils, which reduces the rooting depth and moisture conditions where it is close to the surface, making the land difficult to cultivate (Uganda, Yumbe District Local Government, 2014).

Gravels are evident in some isolated parts of Kululu, Romogi and Odravu subcounties. The eastern part of the district along the Nile basin is sandy. Most parts of the district are agriculturally productive, except the eastern part of Romogi, Kululu and Odravu subcounties.

Generally, soils in Yumbe District are loamy and fairly fertile, especially along valleys. Some alluvial deposits are found on the lower portions of the slopes and are relatively more fertile.

Figure 2. Soil types in the area of interest



Note: The administrative boundaries of the subcounties in this map were last updated in 2019 and might not reflect the most recent changes.
Source: Based on FAO. 2022. Harmonized World Soil Database data v.1.2 In: *Soils portal.* Rome. Cited 20 November 2022. www.fao.org/soils-portal/data-hub/soil-maps-and-databases/harmonized-world-soil-database-v12/en/

2.3 Natural vegetation

The natural vegetation in Bidibidi is characterized by open savannah woodland with trees of 5 to 10 m high and grassland with scattered trees of 2 to 5 m high dominated by Combretum adenogonium, Combreum collinum, Combretum fragrans, Lannea schweinfurthii, Grewia mollis and Acacia hockii, with larger species of Afzelia bipindensis and Borassus aethiopum further away from the Bidibidi settlement. Afzelia africana, Craibea grandiflora and Acacia polyacantha dominate the riverine landscape. The dominant tree species in the Bidibidi settlement are Acacia hockii, Combretum collinum, Grewia mollis and Combretum fragrans (FAO and UNHCR, 2017) (see Annex 2).

Grasslands are an ecosystem where the dominant vegetation cover consists of grass and herbaceous species.

The grasslands in Bidibidi mainly comprise Loudetia superba and Hyparrhenia figariana, which are mostly used for thatching and broom making.

There are several fragile areas where there are signs of soil erosion due to the loss of vegetation cover. Good land management practices are essential to control negative factors such as soil erosion arising from seasonal torrents.

2.4 Non-wood forest products

There are hundreds of NWFPs that contribute to diets and livelihoods in the Bidibidi area. Multiple assessments conducted between November 2018 (FAO and UNCHR,) and December 2019 (using FAO's Resilience Index Measurement and Analysis methodology) identified wild fruits as the most

commonly consumed food group (consumed by 95 percent of households), followed by wild vegetables (88 percent), edible insects (84 percent), medicinal and aromatic plants (82 percent), honey (63 percent), wild terrestrial meat (61 percent) and wild nuts and seeds (49 percent). The main wild products consumed are Vitellaria paradoxa (shea), Tamarindus indica (tamarind fruit), Balanites aegyptiaca (desert date), Ximenia americana var caffra (sourplum), leafy greens and medicinal plants (Abelmoschus esculentus or okra, Amaranthus dubius or red spinach, Vigna unguiculata or cowpea, Cassia obtusifolia or sicklepod), edible insects (Ruspolia differens or grasshoppers and Macrotermes spp. or termites) and mushrooms (mainly Termitomyces spp.). Moreover, the gathering of NWFPs is a mode of food acquisition for an average 25 percent of host households across 11 districts in northern Uganda (n = 1 747). This proportion reaches 40 percent in some districts, indicating that NWFPs are significant elements in the customary diet (FAO, 2019).

Field market surveys have revealed the presence of dozens of wild products on local markets, contributing in varying degrees to people's income. Sheanuts, for example, are typically processed into sheanut oil or butter, the main local use of which is cooking. Sheanuts have become an important export commodity for Uganda due to the growing demand for chocolate and cosmetic manufacturing worldwide. Local value chains for sheanuts are relatively well structured, although lacking in adherence to national and international product standards. Overexploitation of shea trees for fuelwood, timber and charcoal, however, has led to its current status of a vulnerable species. Moreover, its slow growth and long gestation period have made domestication a challenge. Balanites aegpytiaca (desert date) is similarly used locally to produce cooking oil and has few competing uses; it is also widely scattered across the West Nile subregion.

If they are to stand any chance of success, efforts to rehabilitate, restore and conserve land and trees must carefully consider community uses and preferences for species in addition to ecological suitability, so as to ensure continued and improved benefits for nutrition, food security and income (Sacande and Muir, 2022). Priority should be given to conservation and sensitization (see Section 5.3), particularly for vulnerable species, to guarantee continued availability for subsistence and supplementary incomes. Opportunities for sustainable use and value chain development should also be assessed when selecting useful species for rehabilitation/ restoration. This should be done in consultation with communities, keeping in mind the importance of conducting biological and social risk assessments tailored to the local context (Schindler et al., 2022).

2.5 Wetlands, rivers and riparian zones

The definition of wetland developed by Cowardin (Cowardin et al., 1979) will be used as the working definition to identify and delineate wetlands. In this system, wetlands are defined as lands that are transitional between terrestrial and aquatic systems; the water table is usually at or near the surface or the land is covered by shallow water. For an area to be classified as a wetland, it must meet at least one of the following criteria:

- At least periodically, the land supports predominantly hydrophytes.
- The substrate is predominantly undrained hydric soil.
- The substrate is non-soil, and saturated with water or covered by shallow water at some time during the growing season.

In ecological, social and economic terms, wetlands are among the most valuable and productive ecosystems on Earth, providing important opportunities for sustainable development.

Bidibidi has several rivers, including the Jure in Odravu subcounty, the Atu and the Kochi in Drajini subcounty, and the Kochi and the Kenya in Romogi subcounty. There are also several swamps in the settlement.

Wetlands in the Bidibidi settlement are being rapidly degraded as the community uses them to collect fish, gather rattan for construction purposes, and mine clay for pots and bricks. In addition, grazing of domestic animals is a common practice in wetlands in the dry season due to the availability of water and palatable grass.

A riparian zone may be defined as the area bordering a wetland (a stream, sponge or marshland). Riparian zones play a key role in maintaining optimal water production and purifying water; in addition, they are a haven for biodiversity. Natural vegetation in riparian zones is comprised of riparian forest, riparian woodland and grassland.

Given the extent of water bodies and wetlands in Bidibidi, riparian zones account for a significant share of the total area and should be protected for their ecological functions.

2.6 Slopes

The entire Bidibidi area is a flat plain with undulating hills of short trees and grass. There are no steep slopes, which limits the chances of soil erosion. However, erosion is very much evident near river and stream banks; these areas will be protected and not planted (Uganda, Yumbe District Local Government, 2014).

2.7 Wildlife corridors

These are continuous stretches of vegetation that shelter animals when migrating. Wildlife corridors must not be fragmented, and they must be wide (a minimum of 20 m). Wildlife corridors must connect different ecosystems to enable wildlife to move safely in search of food.

2.8 Areas of special interest

These areas include forests or special trees where the community performs cultural rituals, as well as waterfalls and graveyards. However, during the site assessment survey in Bidibidi, the host community did not raise any issues about its cultural attachment to the forests or other areas demarcated for protection. The following cultural sites are found in the area of interest: the town of Totoro and the Agbinika waterfalls in Limidia parish, and natural spring waters in Bidibidi (Romogi subcounty); the village of Tritri in Yoyo parish (Kululu subcounty); and Urekenga on the River Kochi. These sites are of particular interest and are protected by dedicated management prescriptions (Uganda, Yumbe District Local Government, 2014).

2.9 Road construction

The settlement's road network may represent a significant challenge in terms of implementing forestry interventions. The road network is important for silviculture practices, fire protection and harvesting operations. Some of the areas identified for possible interventions are well served by a good feeder road network. For example, the areas identified for woodlot establishment can generally be accessed by roads from the settlement zones.

Bidibidi has several rivers, including the Jure in Odravu subcounty, the Atu and the Kochi in Drajini subcounty, and the Kochi and the Kenya in Romogi subcounty. There are also several swamps in the settlement

3 SOCIOECONOMIC CONSIDERATIONS

The Office of the Prime Minister leads the mobilization and coordination of national strategic and political resources, while operational support for implementing refugee response and protection activities is co-led by OPM and UNHCR and supported by other United Nations agencies and partners.

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3.1 Refugee response and protection: institutional framework

OPM leads the mobilization and coordination of national strategic and political resources, while operational support for implementing refugee response and protection activities is co-led by OPM and UNHCR and supported by other United Nations agencies and partners.

The Secretariat of the Comprehensive Refugee Response Framework supports the application of the framework, serves as a knowledge hub and platform for strategic discussions, streamlines information flows and links, and supports coordinated planning, programming and resourcing to roll out the framework's road map (including the development of the Water and Environment Sector Refugee Response Plan and the Jobs and Livelihoods Response Plan).

In October 2017, the government-led multistakeholder Steering Group for the Comprehensive Refugee Response Framework was set up, bringing together humanitarian and development actors, government agencies, and refugee and private sector representatives to engage various actors and provide guidance on refugee affairs. The group (co-chaired by the Ministry of Disaster Preparedness and Refugees, under OPM, and the Ministry of Local Government) ensures government ownership of the framework and optimizes coordination at both central and local levels within the existing legal frameworks. Stakeholders of the framework in Uganda include United Nations agencies and non-governmental organizations (NGOs) working closely with the Government. The United Nations agencies support the broader humanitarian–development nexus needs for the refugee response, recognizing their collective responsibility in leaving no one behind in achieving the Sustainable Development Goals. In addition to the United Nations, bilateral partners and international financial institutions (in particular the World Bank) are actively supporting the implementation of the framework through humanitarian and development channels.

OPM and the UNHCR-led Refugee Coordination Model, together with actors in the environment and energy sectors (such as government agencies, NGOs, development partners and other United Nations agencies), have established the Working Group on Energy and Environment. The Working Group is chaired by OPM and UNHCR; its mandate is to support the technical oversight, monitoring, reporting and coordination of over 40 actors across the refugee response. The National Forestry Authority, with oversight from FSSD, also joined the refugee response in 2019 in partnership with OPM and UNHCR. To date, it has undertaken restoration activities in five Central Forest Reserves, namely Eria, Era, Kulua, Bugoma and Rwensambya, including establishing new bamboo plantations, scaling up its community tree planting programme, and raising seedlings for planting within and around the refugee settlement (with support from UNHCR) to increase the availability of indigenous fruit tree seedlings for refugee-hosting communities.

3.2 Regulatory and policy framework for the forest sector

Uganda has a well developed legal and regulatory framework for environmental management, aimed at promoting sustainable economic and social development. The Uganda Forestry Policy (2001) provides overall direction for the sustainable development of the forest sector (Uganda, Ministry of Water, Lands and Environment, 2001). A description of the laws and plans specifically related to forest resource management is found below.

The National Forestry and Tree Planting Act (Uganda, 2003) is the primary law governing forestry in Uganda. The act provides for the conservation, sustainable management and development of forests, and establishes the National Forestry Authority. It defines forest reserves and specifies what actions can and cannot be carried out within them. The act commits the Government to protect and sustainably manage the forest estate, to set aside areas for the conservation of biodiversity and environmental services, to ensure the sustainable use of forest resources and the enhancement of the productive capacity of forests, to promote tree planting, and to consolidate laws relating to the forest sector and trade in forest products. In particular, the act grants power to the minister responsible for forestry to declare an area to be a community forest.[2] The law further allows the minister to confer responsibility for the

2. According to Section 17 of the National Forestry and Tree Planting Act, the minister responsible for forestry declares an area as community forest after consultation with the District Land Board and the local community, and upon approval by the District Council. A dedicated body is responsible for the management, maintenance and control of the community forest. Areas that may be registered as community forests include former public land held by the District Land Board, land designated as a fragile ecosystem by the National Environment Management Authority, areas to be planted as community-managed plantations, and woodland/pastoral areas used by a community (Uganda, MWE, 2015). Qualified applicants for community forest status include (groups of) forest-adjacent communities, forest user groups, communal land associations, cooperative societies, farmers' groups and NGOs that draws their membership from the local community.

management of a community forest to a local body made up of residents. However, this provision in the act for a localized forest management mechanism is not yet backed up by a suitable regulatory framework. Noteworthy is the Collaborative Forest Management framework,[3] which is referred to in the act, and from which lessons can be drawn for community forest management. Furthermore, the National Forestry and Tree Planting Regulations (Uganda, 2016) provide principles for sustainable forest management; they prohibit cutting, disturbing, damaging, destroying, removing, purchasing, selling, donating, acquiring or disposing of any protected tree or reserved species without a license.

The National Forest Plan 2011/12–2021/22 (Uganda, Ministry of Water and Environment, 2013) sets out the following strategic objectives for the forest sector: (a) raise household incomes through forest-based initiatives; (b) increase economic productivity and employment in forest industries; and (c) restore and improve ecosystem services derived from sustainably managed forest resources. The plan's goal of an integrated forest sector that achieves sustainable increases in the economic, social and environmental benefits derived from forests and trees by all the people of Uganda (especially the poor and vulnerable) is a driving force in itself towards sustainable management.

The National REDD+ Strategy and Action Plan of Uganda (Uganda, MWE, 2017) identifies eight strategic options to support the sustainable management of forests, including with the aim of reducing greenhouse gas emissions from deforestation and forest degradation.[4]

The National Environment Act (2019) provides for the management of the environment for sustainable development; confirms the role of the National Environment Management Authority as a coordinating, monitoring, regulatory and supervisory body for all activities relating to the environment; and provides for emerging environmental issues, including climate change (Uganda, 2019).

3.3 Land tenure

The land in Bidibidi where refugees are settled is community land. Land in Yumbe District is customarily owned by clans, and the entire clan has a say over the land. This communally owned land is highly fragmented.

OPM works with local leaders to identify land for settling refugees. Landlords with large pieces of land are requested to offer part of their land to settle refugees. The land acquisition process is concluded by signing a memorandum of understanding.

About 75 percent of land allocated to refugees in the region is used for residential purposes, while the remaining 25 percent is distributed between agricultural use and public services (United Nations Development Programme [UNDP], 2018).

The refugee community's interest in using the land allocated for agriculture was low because of the long distance to access the land and its unsuitability for agriculture (UNDP, 2018). Therefore, part of the land was reassigned to establish woodlots and to restore degraded land, in consultation with the host landlords. Further updates are necessary to assess their current availability.

During the field consultations conducted in 2019 by FAO, members of the host community interested mainly in woodlot establishment offered their land for consideration under this management plan. These offers were made through a designated land committee composed of staff of the District National Resources Department (comprising the district natural resources officer, the district forest officer, the district environment officer and the district land officer), the Secretary for Production, Marketing and Natural Resources of the district, the Office of the District Chairperson Local Council V, the Office of the Chief Administrative Officer, Muni University as the main landlord, OPM through the settlement commandant, and subcounty leaders in refugee-hosting areas (the chairman of Local Council III and the subcounty chiefs). However, given the nature of land tenure (i.e. communal ownership at the clan level) there is a need to verify the consent of clan members for all the landlords who have offered land for forestry engagements in order to avoid future conflicts. Additional land for tree planting interventions can be secured from the existing gazetted government forest reserves in the district and on other public land.

3.4 Access to forest products

It is reported that the local demand for fuelwood, fencing poles and construction poles is rising, while sources of supply are dwindling. A 2019 assessment of NWFPs in the area of the Bidibidi settlement notes that 100 percent of host community households collect NWFPs for both domestic consumption and to sell (FAO and World Agroforestry, 2019)

3. The Collaborative Forest Management framework foresees mutually beneficial arrangements whereby a forest user group and a responsible body share roles, responsibilities, rights and returns (benefits) in (part of) a forest reserve.

4. REDD+ = Reducing Emissions from Deforestation and Forest Degradation in Developing Countries.

District local governments, together with OPM and UNHCR, and with technical support from FAO, should coordinate and regulate the harvesting of forest products (fuelwood, construction poles and NWFPs) by refugees. This should be done in collaboration with refugee leaders. For example, the quantities of wood forest products that can be harvested, as well as the timing of the harvesting, must be agreed upon for specific areas. This process should be monitored and documented to ensure the sustainability of harvesting through a community forest management approach. In addition, the Yumbe District Local Government needs to enforce the already existing regulatory framework for the harvesting of forest products, to avoid the overexploitation of remaining forest resources.

3.5 Gender

Gender relations play a role in forest management and in the use of forest products. Understanding and taking into account differences between men and women in terms of their interaction with forests is essential not only for sustainable forest management, but also for increasing the contribution of forests to sustainable livelihoods.

The implementation of sustainable forest management projects with an explicit gender lens can help reduce the vulnerability of both women and men by enhancing their socioeconomic empowerment and reducing the informal production and marketing of forest products. The active participation of both women and men in forest management projects is essential to guarantee the holistic, multidisciplinary and intersectoral approach needed to safeguard the environment for future generations.

District local governments, together with OPM and UNHCR, and with technical support from FAO, should coordinate and regulate the harvesting of forest products (fuelwood, construction poles and NWFPs) by refugees. This should be done in collaboration with refugee leaders.

4 BASELINE SITUATION: WOODY BIOMASS RESOURCES AND LAND USE

An average 97 percent of households across the refugee and host communities use fuelwood for cooking

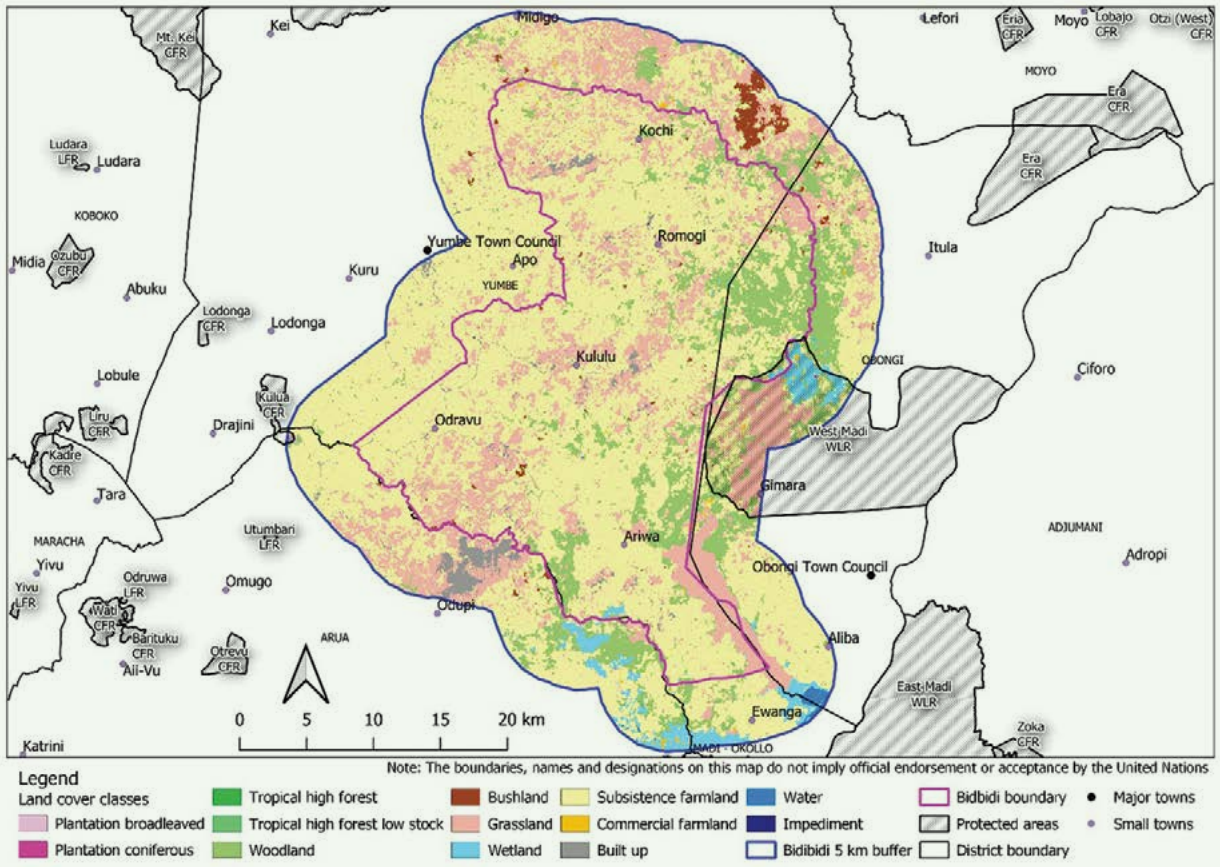
©FAO/Nelly Bedijo

4.1 Land use and land cover

A geospatial analysis was undertaken to provide updated information on the status of land use and land cover (LULC), biomass stock and stock changes over the period 2018–2021.

Figure 3 shows the spatial distribution of LULC classes inside the settlement and within the 5 km buffer zone around the settlement boundary in 2019. Table 1 shows the areas calculated for each LULC class.

Figure 3. Land use and land cover in Bidibidi settlement and 5 km buffer zone, 2019



Sources: Uganda, National Forestry Authority. 2019. Land cover map. Kampala (unpublished).
Office of the United Nations High Commissioner for Refugees. N.d. *Bidibidi boundary.* Geneva (unpublished).
Uganda Bureau of Statistics. 2016. *District boundary* and towns. Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary* and towns. Kampala (unpublished).

Table 1. Area under each class of land use and land cover in the Bidibidi settlement area and 5 km buffer zone around the settlement boundary

Land use and land cover class	Within the Bidibidi settlement area (ha)	Within the 5 km buffer zone (ha)
Plantation broadleaved	2.6	36.8
Plantation coniferous	1.3	4.7
Tropical high forest – well stocked	4.5	1.7
Tropical high forest – low stocked	7.9	93.7
Woodland	9 810.2	10 195.2
Bushland	256.8	1 158.3
Grassland	18 284.9	19 469.2
Wetland	205.1	3 118.7
Cropland	49 964.2	45 761.0
Commercial farmland	49.2	213.8
Built-up area	1 333.3	1 669.2
Water	3.2	296.5
Impediment	5.8	4.5
Total	**79 929**	**82 023.3**

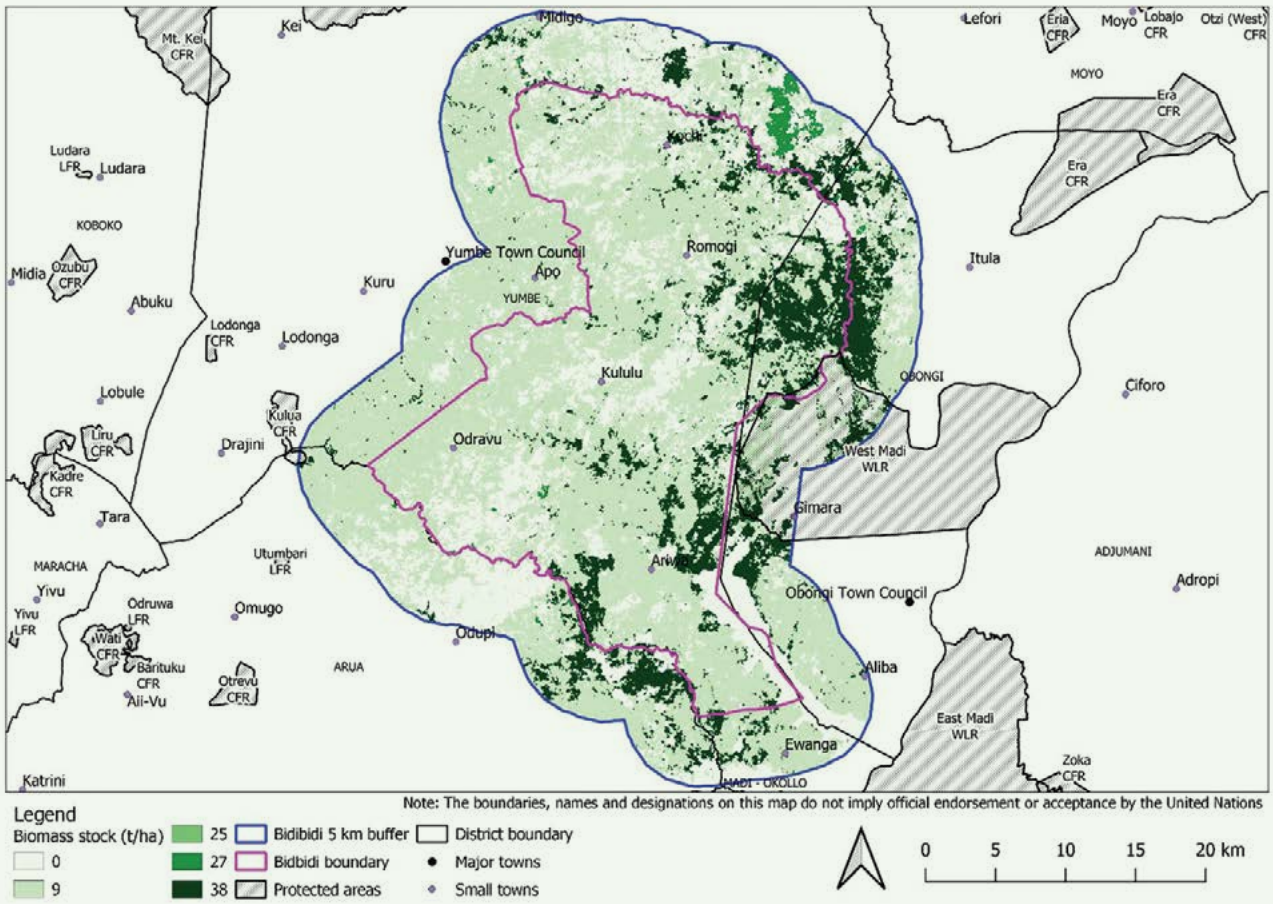
Sources: Uganda, National Forestry Authority. 2019. *Land cover map.* Kampala (unpublished).
United Nations High Commissioner for Refugees. N.d. *Bidibidi boundary.* Geneva (unpublished).
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary and towns.* Kampala (unpublished).

4.2 Biomass mapping

To estimate and map the available wood resources, the mean above-ground biomass (AGB) figures from the National Forestry Authority's 2019 national forest inventory were applied to each LULC class. Figure 4 shows the spatial distribution of the biomass stock. Table 2 shows, for each LULC class, the area inside the settlement boundary and in the 5 km buffer zone, as well as the biomass stock. Average annual biomass increments for each LULC class were obtained from the 2002 national biomass study (Uganda, Ministry of Water, Lands and Environment, 2002), as indicated in Table 3.

It is important to note that field observations have revealed numerous other demands for forest products: for construction, energy for economic activities (including commercial and agricultural activities), as well as losses to fire. These types of demand further contribute to the overall demand for woody biomass but are not included in the calculations in this report.

Figure 4. Biomass stock within the Bidibidi settlement area and the 5 km buffer zone, 2021



Sources: SEPAL (System for Earth Observations, Data Access, Processing and Analysis for Land Monitoring). N.d. *Bfast Explorer.* In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
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Uganda, National Forestry Authority. 2019. *Land cover map.* Kampala (unpublished).
Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
United Nations High Commissioner for Refugees. N.d. *Bidibidi boundary.* Geneva (unpublished).

Table 2. Area, mean and total above-ground biomass in 2019, by land use and land cover class

LULC class	Area within the settlement boundary (ha)	Area within the 5 km buffer zone (ha)	Average AGB (t/ha)	AGB stock within the settlement (t)	AGB stock within the 5 km buffer zone (t)
Plantation broadleaved	3	37	90.6	235.6	3 334.1
Plantation coniferous	1	5	53.9	70.1	253.3
Tropical high forest-well stocked	5	2	273.3	1 229.9	464.6
Tropical high forest-low stocked	8	94	127.6	1008.0	11 956.1
Woodland	9 810	10 195	12.6	123 608.5	128 459.5
Bushland	257	1 158	7.6	1 951.7	8 803.1
Grassland	18 285	19 469	5.3	96 910.0	103 186.8
Wetland	205	3 119	1.6	328.2	4 989.9
Subsistence farmland	49 964	45 761	10.1	504 638.4	462 186.1
Commercial farmland	49	214	10.1	496.9	2 159.4
Built up	1 333	1 669	4.1	5 466.5	6 843.7
Water	3	296	0	-	-
Impediment	6	5	0.7	4.1	3.2
Total	**79 929**	**82 024**	**N/A**	**735 947.8**	**732 639.8**

Notes: Due to rounding, some totals may not correspond with the sum of the separate figures.
AGB = above-ground biomass; LULC = land use and land cover.

Sources: SEPAL (System for Earth Observations, Data Access, Processing and Analysis for Land Monitoring). N.d. *Bfast Explorer.* In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
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Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
United Nations High Commissioner for Refugees. N.d. *Bidibidi boundary.* Geneva (unpublished).

Table 3. Annual increment (air-dry matter), national averages

LULC class	Annual increment (t/ha)	Annual AGB growth within the settlement (t/year)	Annual AGB growth within the 5 km buffer (t/year)
Plantation broadleaved	13	33.8	478.4
Tropical high forest – well stocked	15	67.5	25.5
Tropical high forest – low stocked	11	86.9	1 030.7
Woodland	5	49 051	50 976
Bushland	1	256.8	1 158.3
Grassland	1	18 284.9	19 469.2
Wetland	-	-	-
Subsistence farmland	1	49 964.2	45 761.0
Commercial farmland	1	49.2	213.8
Built-up area	3	3 999.9	5 007.6
Water	-	-	-
Impediment	-	-	-
Total		**121 794.2**	**124 120.5**

Notes: Due to rounding, some totals may not correspond with the sum of the separate figures.
AGB = above-ground biomass; LULC = land use and land cover.

Sources: Uganda, National Forestry Authority. 2019. *Land cover map.* Kampala (unpublished).
United Nations High Commissioner for Refugees. N.d. *Bidibidi boundary.* Geneva (unpublished).
Uganda, Ministry of Water and Environment. 2002. *National biomass study.* Technical report. Kampala. www.nfa.go.ug/images/reports/drafttechnicalreport.pdf

4.3 Biomass stock changes 2018–2021

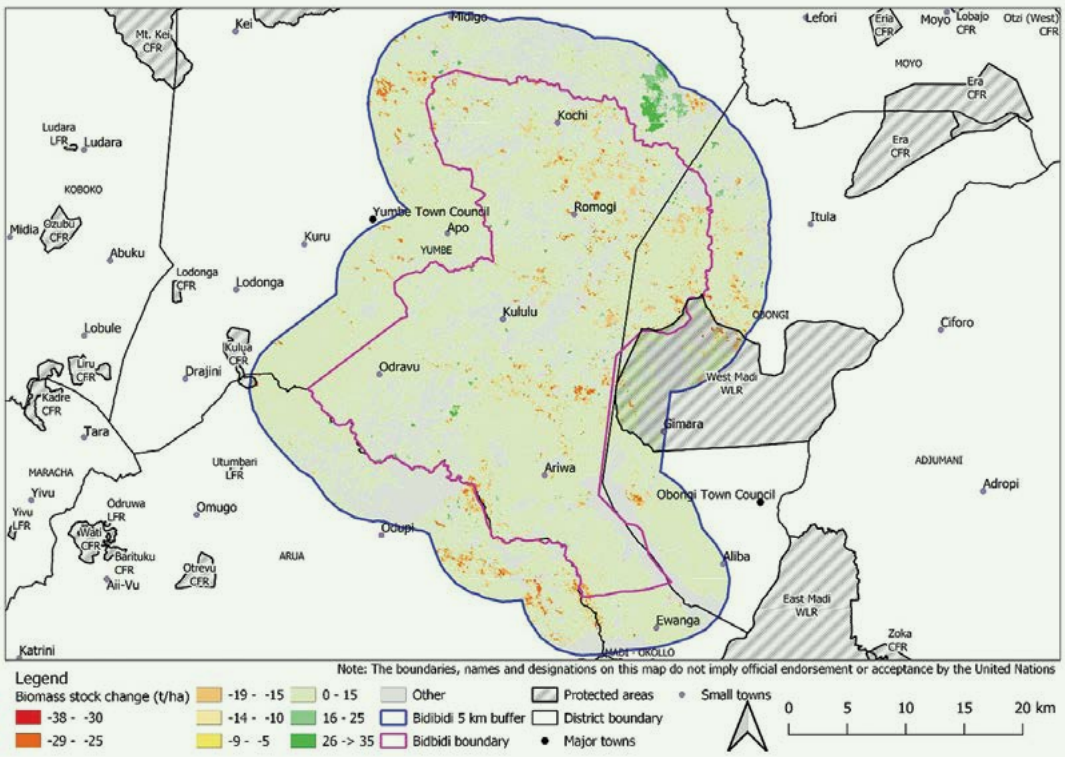
The map presenting biomass stock changes between January 2018 and November 2021 (see Figure 5) shows losses scattered across the entire area, especially in the northwestern and southern parts of the area of interest.

Biomass stock changes within the settlement area and the 5 km buffer zone around the settlement boundary were mapped by using the LULC map of 2019 and clipping to the area of interest a "degradation/loss mask" obtained from the Breaks for Additive Seasonal and Trend (BFAST) algorithm to detect vegetation cover changes.[5] The results were used to create the biomass stock change map for 2018–2021, applying the biomass stocking factors from the 2019 national forest inventory.

The results of the analysis show that the highest AGB stock losses between 2018 and 2021 concern subsistence farmland, for both the settlement area and the 5 km buffer zone, with a total AGB stock loss of about 68 383 tonnes. This is followed by tropical high forest – low stocked and plantation – broadleaved areas at 7 349 tonnes and 1 613 tonnes, respectively (see Table 4). Total biomass losses within the settlement and the 5 km buffer amounted to 39 297 tonnes and 39 518 tonnes, respectively, or approximately 9 800 tonnes per year in each area.

Proposals for land restoration interventions within the refugee settlement and host community areas (see Section 5.2) are based on the biomass stock change map (see Figure 5).

Figure 5. Biomass stock changes in the area of interest, 2018–2021



Sources: SEPAL N.d. *Bfast Explorer*. In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary and towns*. Kampala (unpublished).
Uganda, National Forestry Authority. 2019. *Land cover map*. Kampala (unpublished).
Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
UNHCR N.d. *Bidibidi boundary*. Geneva (unpublished).

5. The biomass stock change was mapped by using the existing land use and land cover map (2019) and clipping to the area of interest a "tree cover loss mask" obtained from the Breaks for Additive Seasonal and Trend (BFAST) algorithm of 2010. The BFAST algorithm of 2010 was used to detect tree cover changes for the monitoring period January 2018–November 2021. The results were used to create a biomass map for 2018–2021 (see Figure 5), applying the biomass stocking figures from the most recent national inventory taken by the National Forestry Authority.

Table 4. Biomass stock changes per land use and land cover class, 2018–2021

LULC class	Area of loss within the settlement (ha)	Settlement AGB loss (t)	Area of loss within the 5 km buffer zone (ha)	5 km buffer AGB loss (t)
Plantation – broadleaved	2	182	16	1 431
Plantation – coniferous	1	36	4	228
Tropical high forest – well stocked	4	980	0	115
Tropical high forest – low stocked	5	639	53	6 710
Woodland	7	87	6	74
Bushland	12	94	1	4
Subsistence farmland	3 691	37 279	3 080	31 104
Total	**3 722**	**39 297**	**3 147**	**39 518**

Note: AGB = above-ground biomass; LULC = land use and land cover.

Sources: SEPAL N.d. *Bfast Explorer*. In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary and towns*. Kampala (unpublished).
Uganda, National Forestry Authority. 2019. *Land cover map*. Kampala (unpublished).
Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
UNHCR N.d. *Bidibidi boundary*. Geneva (unpublished).

4.4 Woodfuel demand for cooking

An assessment carried out by FAO and the World Bank in northern Uganda in 2019 provides estimates for woodfuel consumption by the refugees and host communities (see Table 5) (FAO and World Bank, 2019). An average 97 percent of households across the refugee and host communities use fuelwood for cooking. Refugee households are more likely to use charcoal than host communities (8 percent versus 4.7 percent). Notably, the daily fuelwood consumption of refugee households in the Bidibidi settlement has declined significantly since a previous assessment conducted in the settlement in March 2017, from 3.5 to 1.6 kg per person per day. A possible reason is a move from a diet dominated by dry beans to a more diverse diet with more fresh food, which cooks faster. It was also observed that refugees were using more dry wood in 2018 than in 2017, when green wood was often collected and burned. A slight increase in charcoal consumption and a greater use of improved stoves were also observed in 2018.

Table 5. Refugee and host communities' woodfuel demand in the Bidibidi settlement area

	Population using fuelwood (%)	Average fuelwood consumption (kg/cap/day)[a]	Population using charcoal (%)	Average charcoal consumption (kg/cap/day)[b]	Total woodfuel consumption (kg/cap/day)[c]
Refugees	98.9	1.57	8.0	1.40	1.66
Hosts	96.5	2.13	4.7	1.25	2.11

a. Kilograms of fuelwood per person per day are expressed on an air-dry basis.
b. Expressed in fuelwood equivalent, assuming a 20 percent conversion rate of fuelwood to charcoal by weight.
c. Woodfuel demand takes into account the rate of consumption of both fuelwood (expressed on an air-dry basis) and charcoal (expressed in fuelwood equivalent, assuming a conversion efficiency of 20 percent).
d. The host community living within the Bidibidi settlement boundary was estimated based on the WorldPop 2020 population dataset.

Note: Due to rounding, the overall sum is slightly different from the sum of the separate figures.
Source: Based on FAO and World Bank. 2019. *Rapid assessment of natural resource degradation in refugee impacted areas in northern Uganda.* Rome, FAO and Washington, DC, World Bank. www.fao.org/3/CA7656EN/CA7656EN.pdf

4.5. Linking woodfuel demand and supply

Table 6 shows the estimated woodfuel supply and demand for the Bidibidi settlement and the 5 km buffer zone around the settlement boundary. Taking into account the average fuelwood and charcoal consumption for cooking per person and the total number of refugees and hosts within the Bidibidi settlement, the estimated total woodfuel consumption is calculated at 146 871 tonnes per year (including charcoal in fuelwood equivalent. Meanwhile, the total estimated AGB stock within the settlement is 735 948 tonnes, with an annual increment of 121 794 tonnes. Assuming that woodfuel demand is only met with biomass from the Bidibidi settlement, there would be an annual loss of 25 077 tonnes, equivalent to 3.4 percent of the AGB stock. When based on the results of the biomass stock change analysis between 2018 and 2021 (see Table 4), the biomass loss within the settlement area was approximately 9 800 tonnes per year.

Table 6. Estimated woodfuel demand and potential supply within the Bidibidi settlement area under current conditions

Refugee population (July 2022)	Host community (2020)	Total woodfuel demand (t/year)	Above-ground biomass stock (t)	Annual above-ground biomass growth (t/year)	Annual biomass loss (t/year)	Overall annual loss
224 048	13 909	146 871	735 948	121 794	25 077	3.4%

Sources: SEPAL. N.d. Bfast Explorer. In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary and towns.* Kampala (unpublished).
Uganda, National Forestry Authority. 2019. *Land cover map.* Kampala (unpublished).
Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
UNHCR (Office of the United Nations High Commissioner for Refugees). N.d. *Bidibidi boundary.* Geneva (unpublished).

It is important to note that the difference between the estimated AGB loss based on woodfuel demand (Table 6) and the estimated biomass stock change based on geospatial analysis (Table 4) can be explained by the partial supply of woodfuel from the 5 km buffer zone or further away (especially for charcoal). It is also possible that neither the refugee headcount nor the population census data are accurate reflections of the number of people actually present within the settlement area and buffer zone. In addition, inaccuracies in the national LULC maps, the biomass factors applied for each LULC class and the degradation/loss maps obtained from BFAST may have contributed to some discrepancies between the results of woodfuel demand and biomass stock changes. Considering the estimated figures on woodfuel demand for cooking, the main goal of establishing woodlots for energy is to close this gap by supplying sustainable woodfuel, while at the same time promoting the adoption of more efficient cooking systems and practices at household, commercial and institutional levels.

It is also important to note that field observations have revealed numerous other demands for forest products: for construction, energy for economic activities (including commercial and agricultural activities), as well as losses to fire. These types of demand further contribute to the overall demand for woody biomass but are not included in the calculations in this report.

5 PROPOSED MANAGEMENT STRATEGIES

Fuelwood and charcoal are the main sources of energy for cooking for both the refugee and the host communities in the Bidibidi refugee settlement area

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The following proposals, aimed at preserving a fragile ecosystem and supporting the basic needs of the refugee and host communities, considering their difficult life conditions, were analysed; they are based on the preliminary meeting conducted in 2018 with local authorities and the refugee and host communities.

The proposals discussed in the following sections focus on the establishment and management of woodlots for energy purposes, the restoration of degraded land, and the conservation of intact forest and other sensitive ecosystems.

5.1 Woodlots for energy

Fuelwood and charcoal are the main sources of energy for cooking for both the refugee and the host communities in the Bidibidi refugee settlement area. Demand is expected to increase with the growing population, as other energy options for cooking are often unaffordable or deliver an inferior performance. As natural resources are depleted, the imbalance between demand and the sustainable supply of woody biomass is expected to increase. This will place growing strains on the well-being of both hosts and refugees and may contribute to the environmental impact in the Bidibidi settlement area.

The objective of this intervention is to maximize biomass production in a short time and increase tree density to reach the optimum growth per unit area, thus reducing the use of wood sourced from the overharvested natural forests. Fast-growing tree species and short-rotation coppice management should be adopted to enable early harvesting for woodfuel. The use of multipurpose species can increase people's motivation to manage trees effectively as these species provide additional benefits, such as the supply of material for construction poles and fence posts. It is important to highlight that the labour needed to plant and tend trees is particularly intense for the initial three years, at least, before they produce an appreciable quantity of biomass.

This intervention targets areas owned by host communities and individuals, as well as areas assigned to the refugees and gazetted forest reserves. It is important that landowners are made fully responsible for tree planting and management on their own land and for other aspects of this intervention (including maintaining dialogue and decision-making), as project partners with their own cash and in-kind commitments. Technical staff of the Yumbe District Local Government should provide on-site support for the selection of suitable species and for the development of tactical plans and annual plans of operation to guide site-specific interventions.

5.1.1 Establishing woodlots

Survey and land demarcation for zones of intervention

Land for the establishment of potential woodlots was identified and demarcated in 2018 only within the settlement boundary, with the main purpose of balancing the estimated woodfuel supply and demand for cooking from refugee households and contributing to more sustainable livelihood opportunities.

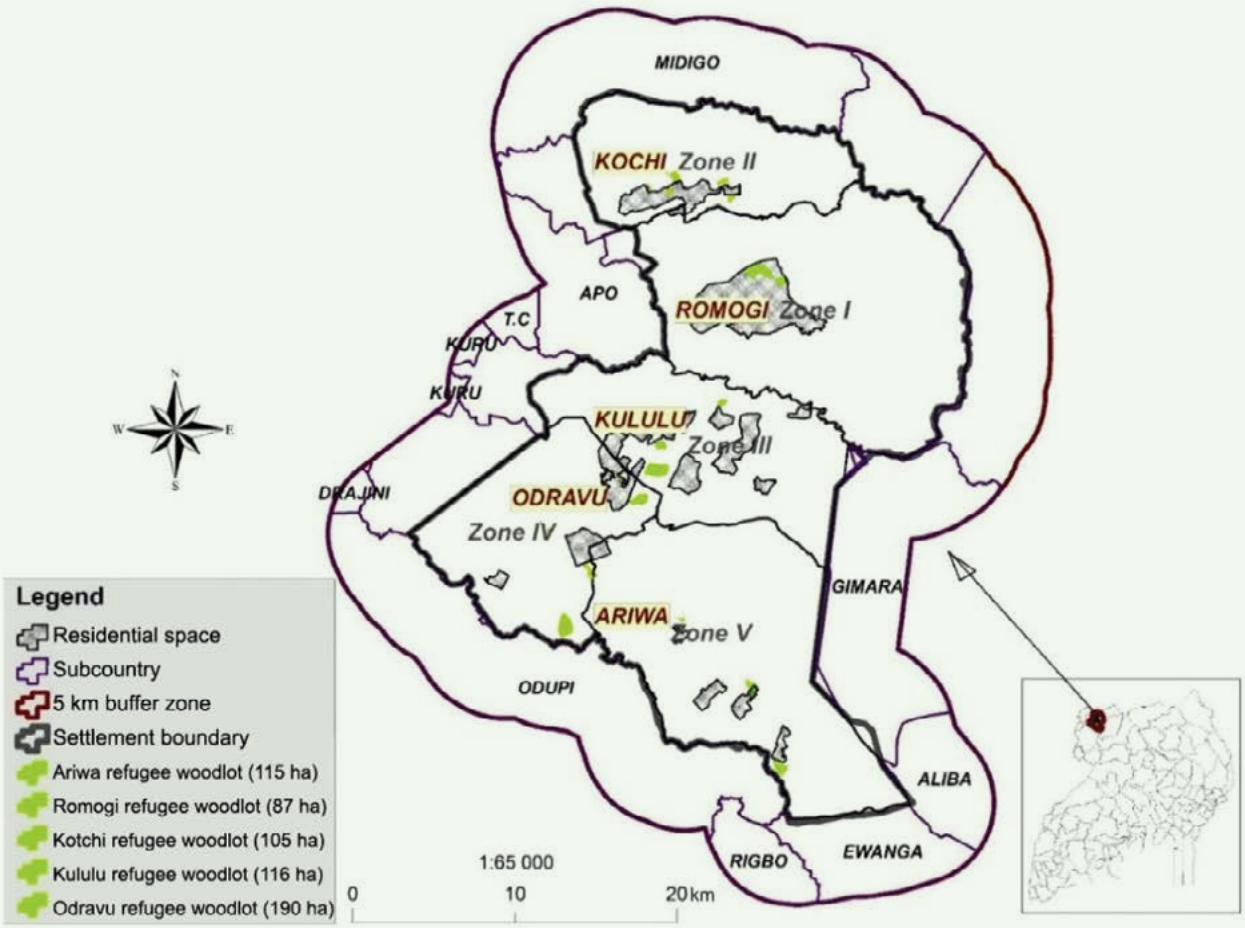
OPM and UNHCR took the lead in the land identification within the refugee settlement area in order to avoid the allocation of prime agricultural land for woodlot establishment. This land selection for forestry intervention should inform the next revision of the Bidibidi site plan by UNHCR.

FAO and UNHCR, together with the landlords, OPM settlement commandants and Yumbe District Local Government officials, conducted boundary mapping of potential blocks for woodlot establishment within the refugee settlement area. On average, the blocks are large and will require compartmentalization at the time of woodlot development. In addition, some of the blocks have physical barriers such as native vegetation belts and streams, which must be protected. Standard compartments ranging from 5 to 20 ha will be easy to manage. Each compartment should be surrounded by an internal firebreak of at least 5 m wide, which would double as a compartment boundary road, and a 10 m wide external firebreak.

The majority of the host community lands are highly fragmented and located in areas with poor road access. The land identification process outside the refugee settlement area was led by the designated land committee, which identified landlords with vacant land who were interested in forestry engagements. FAO, together with UNHCR, OPM and the Yumbe District Local Government, assessed the identified land and sites, and those with potential for woodlot establishment were demarcated and mapped.

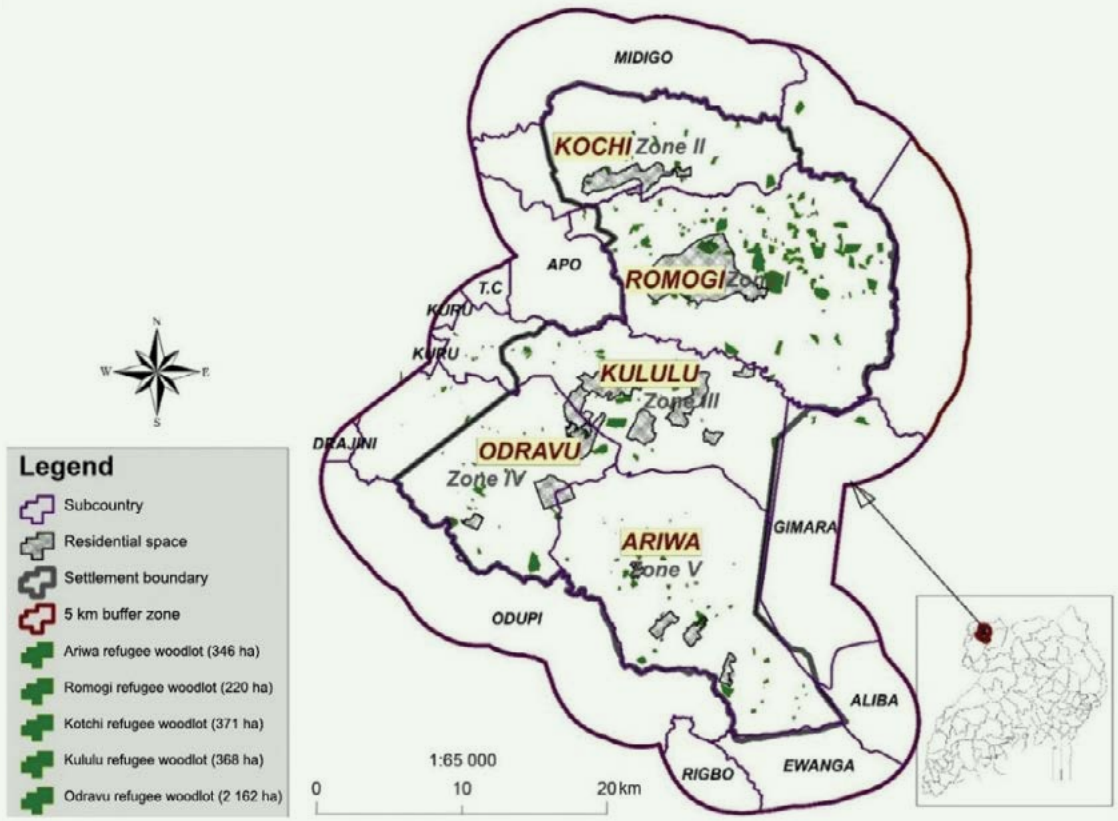
A total 614 ha of land were identified and demarcated for potential woodlot establishment within the settlement area to support the energy needs of the refugees (see Figure 6), and 3 467 ha to support the host community's needs (see Figure 7), for a total of 4 081 ha.

Figure 6. Potential areas identified for woodlots targeting refugees within the settlement boundary



Sources: SEPAL. N.d. *Bfast Explorer.* In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary and towns.* Kampala (unpublished).
Uganda, National Forestry Authority. 2019. *Land cover map.* Kampala (unpublished).
Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
UNHCR. N.d. *Bidibidi boundary.* Geneva (unpublished).

Figure 7. Potential areas identified for host community woodlots within the settlement boundary



Note: The administrative boundaries of the subcounties in these maps were last updated in 2019 and might not reflect the most recent changes.

Sources: SEPAL N.d. *Bfast Explorer.* In: SEPAL Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary and towns*. Kampala (unpublished).
Uganda, National Forestry Authority. 2019. *Land cover map.* Kampala (unpublished).
Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
UNHCR N.d. *Bidibidi boundary.* Geneva (unpublished).

Table 7. Potential areas identified for woodlot establishment

Zone	Subcounty	Settlement area (ha)	Host community area (ha)	Total area (ha)
1	Romogi	87.2	2 161.5	2 248.7
2	Kochi	105.1	220.4	325.5
3	Kululu	116.2	368.5	484.7
4	Odravu	190.1	370.7	560.8
5	Ariwa	115.4	346.1	461.5
Total		**614**	**3 467.2**	**4 081.2**

Land suitability for energy woodlot establishment

Land suitability for the establishment of woodlots was determined before site-species matching. A soil survey was conducted for this purpose.

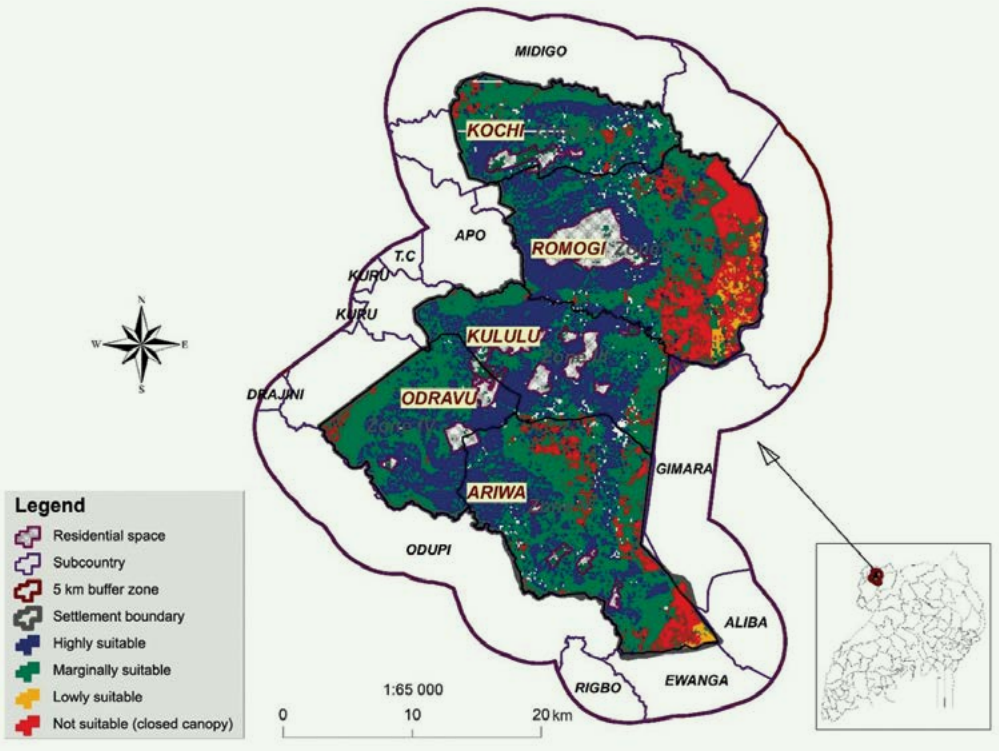
Sampling was based on a 100 m grid (equating to a sampling intensity of one sampling point per hectare for sites with great variation), resulting in a total of 4 081 sampling points. This analysis was limited to the area within the settlement boundary.

Soil samples were collected at 25 cm intervals to a depth of 100 cm at each sampling point, and the following were analyzed: soil drainage, consistency, structure, texture, soil depth and soil fertility (see Annex 3). For sites with uniform soils, sampling intensity was reduced to one sampling point per 10 ha.

Climatic requirements, including mean annual precipitation, mean annual temperature and the absence of frost were also taken into consideration. The terrain in Bidibidi is generally flat. In addition to these factors, management limitations (e.g. boulders and rock outcrops that restrict accessibility), land degradation risk (e.g. erosion and landslides) and the status of natural vegetation were taken into consideration (see Annex 3). The general requirements for tree growth were used to divide the area into blocks.

With the use of degradation data, biomass stock data, access to roads and the distance from the refugee residential area, a land suitability map was modelled. This map shows the three categories of area suitability (low, medium and high) to inform site selection for the establishment of woodlots (see Figure 8). Areas with a biomass stock of 25 tonnes/ha and above were considered to be unsuitable for woodlot establishment, as they are intact enough to be considered for restoration and/or protection interventions.

Figure 8. Land suitability for woodlot establishment within the settlement



Note: The administrative boundaries of the subcounties in this map were last updated in 2019 and might not reflect the most recent changes.

Sources: SEPAL N.d. *Bfast Explorer.* In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
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UNHCR N.d. *Bidibidi boundary.* Geneva (unpublished).

The site suitability classes for the Bidibidi settlement area range from site class III to site class V (see Annex 3). It is recommended that woodlot establishment be undertaken on site class III areas. Areas with site classes IV and V can be considered for restoration and protection interventions. The suitability for woodlot establishment was affected mainly by low effective rooting depth (shallow soils), low soil moisture content and high mean annual temperatures.

Selection of tree species for energy and other uses

For the fast production of wood for energy with minimal investment and equipment, selected species should have the following attributes: (a) be pioneer species; (b) be competitive and able to grow in dense stands; (c) be fast-growing; (d) have the ability to coppice; e) produce good-quality fuel; and (f) strong branching ability may be considered as well (FAO and UNHCR, 2018).

Table 8 shows a number of tree species for fuelwood production (with their site requirements) that are recommended for the area in and around the Bidibidi settlement.

Table 8. Site requirements and growth characteristics for tree species recommended for fuelwood production in the Bidibidi settlement area

<table>
<tr><th>Tree species</th><th>Products</th><th>Growth requirements</th></tr>
<tr><td>Eucalyptus camaldulensis

Common names: red river gum or Murray red gum</td><td>Fuelwood</td><td>Climatic requirements: can withstand arid or semi-arid conditions provided there is sufficient moisture in the soil.
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 600</td><td>> 225</td><td>> 15</td><td>> 700</td></tr>
</table>
Resistance to the following:
<table>
<tr><th>Drought</th><th>Wind</th><th>Hail</th><th>Insects and diseases</th><th>Fire</th></tr>
<tr><td>Good</td><td>Fair</td><td>Fair</td><td>Good</td><td>Moderate</td></tr>
</table>
Soil requirements: suitable for light (sandy), medium (loamy) and heavy (clay) soils. Prefers well-drained soil and can grow in nutritionally poor soil. Prefers dry, moist or wet soil and can tolerate drought. Reaction to waterlogging is generally poor, although fair in seasonally waterlogged soils.</td></tr>
<tr><td>Eucalyptus (GC) hybrid clones
Eucalyptus grandis x Eucalyptus camaldulensis</td><td>Fuelwood, construction poles</td><td>Eucalyptus grandis x Eucalyptus camaldulensis. These hybrids, commonly referred to as GC hybrids, combine good growth from E. grandis with drought tolerance from E. camaldulensis. GCs are best suited for hotter and humid sites. In Uganda, GCs have been found to perform best in the northern and eastern parts of the country.
Climatic requirements:
<table>
<tr><th>Rainfall (mm)</th><th>Mean annual temperature (º C) range</th><th>Effective rooting depth (mm)</th><th>Soil drainage</th><th>Drought resistance</th><th>Hail resistance</th><th>Insects</th><th>Diseases</th></tr>
<tr><td>> 600</td><td>> 18–22</td><td>> 700</td><td>Good</td><td>High</td><td>Low</td><td>High</td><td>Moderate</td></tr>
</table></td></tr>
<tr><td>Gmelina arborea
Common names: white teak or gmelina</td><td>Fuelwood</td><td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 1200</td><td>> 700</td><td>> 20</td><td>> 700</td></tr>
</table>
Resistance to:
<table>
<tr><th>Drought</th><th>Wind</th><th>Hail</th><th>Insects and diseases</th><th>Fire</th></tr>
<tr><td>High</td><td>Moderate</td><td>High</td><td>High</td><td>High</td></tr>
</table>
Soil requirements: the site range is wide, but the species shows a preference for moist fertile valleys with sandy loam soil; it does not thrive where drainage is poor, and remains stunted in dry sand or poor soils.</td></tr>
</table>

<table>
<tr>
<td>Grevillea robusta

Common names: grevillea or silky oak</td>
<td>Fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 2500</td><td>> 800</td><td>> 13</td><td>> 700</td></tr>
</table>
Resistance to:
<table>
<tr><th>Drought</th><th>Wind</th><th>Hail</th><th>Insects and diseases</th><th>Fire</th></tr>
<tr><td>Fair</td><td>Poor</td><td>Poor</td><td>Fair</td><td>Moderate</td></tr>
</table>
Soil requirements: the species performs best in well-drained fertile soils, but also grows moderately well in medium-textured soils (loam, clay loam to light, sandy soils). However, it does not tolerate waterlogged soils.</td>
</tr>
<tr>
<td>Corymbia citriodora

Common names; Lemon-Scented Gum, blue spotted gum, lemon eucalyptus</td>
<td>Construction poles and fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 2000</td><td>> 600</td><td>> 10</td><td>> 900</td></tr>
</table>
Suitable for a wide range of sites in terms of altitude and temperature and frost tolerant. Does not favour close spacing.</td>
</tr>
<tr>
<td>Corymbia maculata

Common names: spotted gum</td>
<td>Construction poles and fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 2000</td><td>> 500</td><td>> 10</td><td>> 900</td></tr>
</table>
Suitable for a wide range of sites in terms of altitude and temperature, and frost tolerant. Does not favour close spacing.</td>
</tr>
<tr>
<td>Melia volkensii and Melia azedarach

Common names for Melia azedarach: Persian lilac, giant lira or Lira</td>
<td>Construction poles and fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 1600</td><td>> 300</td><td>> 13</td><td>> 500</td></tr>
</table>
Both species grow in a wide range of soils, i.e. sandy, loamy, clay and shallow stony soils, but with exceptional performance in sandy loamy soils with good drainage.

Melia volkensii is a fast-growing species compared to other dryland species, reaching 3 m in height after 1.5 years.</td>
</tr>
<tr>
<td>Moringa oleifera

Common names (english): Horse-radish tree</td>
<td>Fuelwood and medicinal uses</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>400–2100</td><td>500–1400</td><td>24–30</td><td>> 500</td></tr>
</table>
The species does not have any specific soil requirements, except that it does not grow in waterlogged or swampy soils.</td>
</tr>
<tr>
<td>Senna siamea

Common names (english): Black-wood cassia, ironwood</td>
<td>Fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 1300</td><td>500–2800</td><td>> 20</td><td>> 500</td></tr>
</table>
Maximum length of dry period should not exceed four to eight months. Prefers a pH range of 5.5 to 7.5. Grows best in deep, well-drained fertile soils; can tolerate degraded lateritic soils provided drainage is not impeded.</td>
</tr>
</table>

<table>
<tr>
<td>Azadirachta indica

Common names : Neem</td>
<td>Fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 1500</td><td>400–1200</td><td>< 40</td><td>> 500</td></tr>
</table>
Grows well in neutral to alkaline soils (pH 6.2–7) and performs better than most species in shallow sandy soils, stony soils, calcareous soils or in soils with a hard clay pan.</td>
</tr>
<tr>
<td>Pseudocedrela kotschyi

Common names: (Lugbara) Mala, (Madi) Ala.</td>
<td>Construction poles and fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 1200</td><td>< 1200</td><td>< 35</td><td>> 500</td></tr>
</table>
Species can grow in heavy and poorly drained soils. It has profuse regeneration in the rainy season, and fires improve germination of seeds.</td>
</tr>
<tr>
<td>Gliricidia sepium

Common names (english): Mother of cocoa, tree of iron, Mexican lilac, quick stick</td>
<td>Fuelwood</td>
<td>Climatic requirements:
<table>
<tr><th>Altitude (m)</th><th>Rainfall (mm)</th><th>Mean temperature (ºC)</th><th>Effective rooting depth (mm)</th></tr>
<tr><td>< 1200</td><td>600–3500</td><td>15–30</td><td>> 500</td></tr>
</table>
Adapted to a wide range of well-drained soils. Can perform in acidic soils (pH 4.5–6.2) but will not tolerate very acidic soils. Does not grow well in wet or waterlogged soils.</td>
</tr>
</table>

Sources: Uganda, Ministry of Water and Environment. 2009. Tree planting guidelines for Uganda. Kampala. https://spgs.mwe.go.ug/sites/files/SPGS%20Tree%20Planting%20Guidelines%20for%20Uganda_compressed_0.pdf

FAO. 2011. Geographic information - Introduction. In: FAO Fisheries and Aquaculture Department. Rome. Cited 15 February 2017. www.fao.org/fishery/geoinfo/en

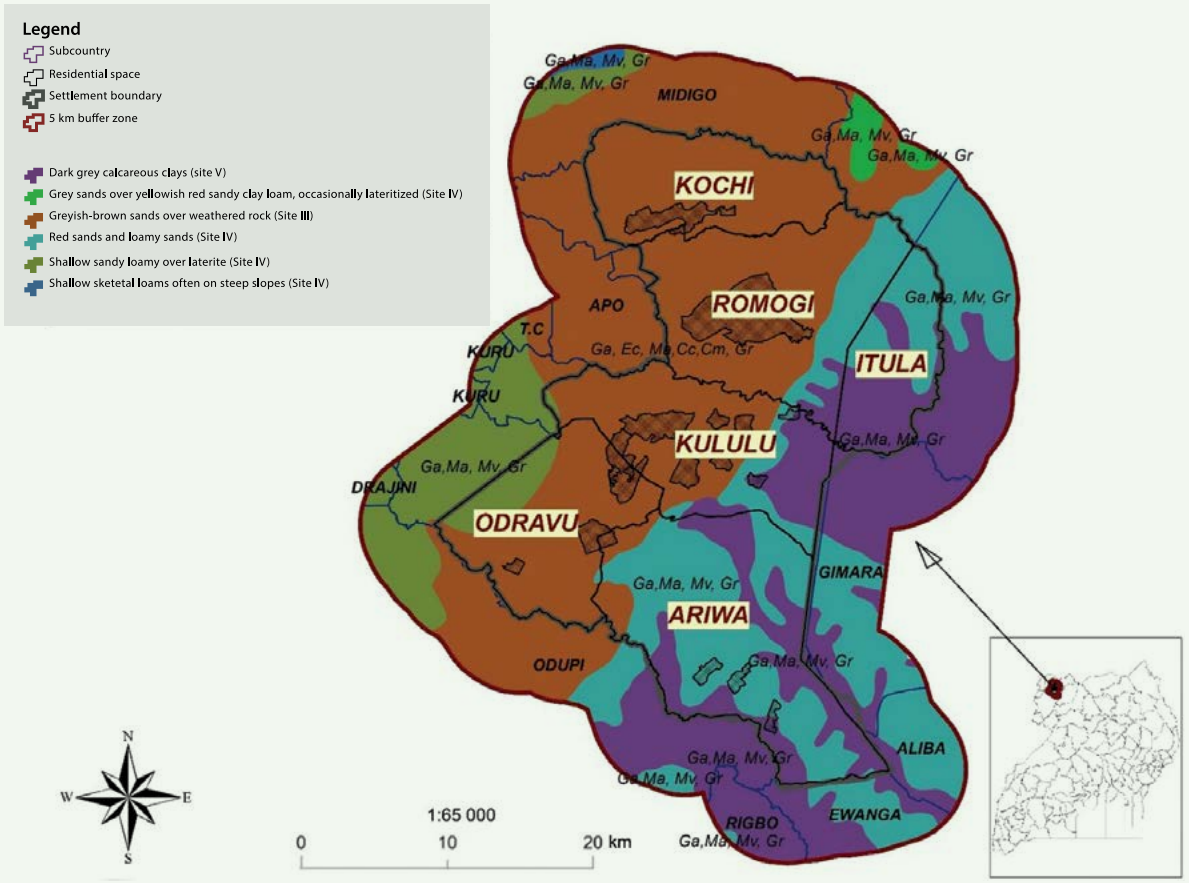
Uganda, Ministry of Water and Environment. 2016. *Guidelines for establishing and maintaining fuel wood plantations in Uganda.* Kampala. http://spgs.mwe.go.ug/sites/files/Establishing%20and%20maintaining%20fuelwood%20plantations%20in%20Uganda.pdf

Some of the tree species suggested for woodlot establishment are multipurpose trees that can produce various products, including fuelwood and construction poles (on short rotations) and timber (on longer rotations). By selecting fast-growing tree species planted at a close spacing of 2 × 2 m (2 500 seedlings per ha), trees will have accumulated substantial volume for the first harvest of woody biomass for woodfuel production on a three-year rotation (see Annex 4).

Site–species matching

Site–species matching involves partitioning a block that is suitable for forestry into silviculturally homogeneous units. These units of land require the same silviculture treatments. The aim of site–species matching is to assign the most suitable tree species to a land unit for planting. Site–species matching also considers soil, climatic and terrain factors. Pests and diseases and existing vegetation must also be considered during site–species matching. Where these site factors are not optimal for a particular species, acute problems will arise including tree stress, die-back and mortality, reduced growth, poor yields, disease and deforestation. Most land units in Bidibidi are best for shallow-rooted fuelwood trees species such as *Gmelina arborea, Corymbia citriodora, Corymbia maculate, Grevillea robusta, Melia volkensii, Pseudocedrela kotschyi* and *Melia volkensii.* The preferred fuelwood species considered for this region can tolerate a low effective rooting depth of 500–700 mm, which is common across the Bidibidi area.

Figure 9. Species suitability for the Bidibidi settlement area



Notes: Ga: *Gmelina arborea;* Ma: *Melia azedarach;* Mv: *Melia volkensii;* Gr: *Grevillea robusta;* Ec: *Eucalyptus* spp; Cc: *Corymbia citriodora;* Cm: *Corymbia maculate*. The administrative boundaries of the subcounties in this map were last updated in 2019 and might not reflect the most recent changes.
Source: Based on FAO. 2022. Harmonized World Soil Database data v.1.2 In: Soils portal. Rome. Cited 20 November 2022. www.fao.org/soils-portal/data-hub/soil-maps-and-databases/harmonized-world-soil-database-v12/en/

Table 9. Soil suitability classes and site–species matching for tree growth in the Bidibidi settlement area

Soil types	Soil class	Zones	Species	Subcounties	Coverage area (ha)
Greyish-brown sands over weathered rock, dark grey calcareous clays	III	1, 2, 3, 4	*Gmelina arborea, Eucalyptus hybrid, Melia azedarach, Grevillea robusta, Corymbia citriodora, Corymbia maculata, Senna siamea, Pseudocedrela kotschyi, Azadirachta indica, Moringa oleifera, Gliricidia sepium*	Romogi, Kochi, Kululu, Odravu	42 935
Shallow sandy loams over laterite, red sands and loamy sands	IV	4	*Gmelina arborea, Melia azedarach, Melia volkensii, Grevillea robusta, Senna siamea, Pseudocedrela kotschyi, Azadirachta indica, Moringa oleifera, Gliricidia sepium*	Odravu	22 574
Dark grey calcareous clays	V	1, 3, 4, 5	*Gmelina arborea, Melia azedarach, Melia volkensii, Grevillea robusta. Pseudocedrela kotschyi, Azadirachta indica, Moringa oleifera, Gliricidia sepium*	Kochi, Ariwa, Odravu, Kululu	14 389

Woodlot plantation schemes

Woodlots for energy will be planted for biomass generation to support the energy needs of refugee and host communities. For this purpose, these guidelines consider a rotation of three years. Agroforestry systems can be integrated to reduce weeding costs, in which case low-lying agricultural crops are intercropped with trees for up to two years.

The seedling projection will take into consideration a seedling requirement of 2 875 seedlings per ha (at a spacing of 2 × 2 m) and factor in 15 percent loss of seedlings for the blanking operation. The production of seedlings should be encouraged locally, bearing in mind that long transportation often results in a loss of seedling quality.

Table 10. Espacement and estimated harvestable volume for woodlot schemes

Recommended spacing (m)	Main product	Rotation length (years)	Harvestable volume (m3/ha)
2 × 2	Fuelwood	3	30

Site preparation

Initial site clearing and preparation will involve the removal of shrubs, grass, crop residues, etc., which must be burnt to reduce the risk of fire and facilitate movement in the compartment. The major activities for site preparation are:

- Felling and cross-cutting: existing shrubs and grasses will be cleared. Land clearing will be done early enough (in the dry months from December to February) to allow for complete drying or combustion. There will be no cutting of existing trees in order to establish woodlots.
- Collecting and heaping: collecting and heaping of the slash will be done manually. Heaping will take due consideration of any fire-prone ecological concern. Cleared slash will be heaped in sizable quantities to facilitate cool burning.
- Burning: burning reduces the amount of slash on a site and improves access. Burning will be done in the early morning and late evening so as to have a cool burn that does not cause adverse effects for the soils and environment. To prevent the risk of wildfires, burning will be limited to small controllable quantities of dry material. It will be done when the cleared matter is relatively dry and at least three weeks before the onset of rains to avoid leaving unburnt debris on the planting site.

Tilling the land one to two planting seasons ahead of tree planting operations helps to clear the land and loosen the soils, resulting in better performance and survival of the woodlots.

Pre-plant weed control

Cultural practices integrated with the distribution of bioherbicides will be adopted for weed control, while chemical herbicides should be adopted only as a last resort and only herbicides approved by the Forest Stewardship Council (FSC) should be used. Herbicides should be applied during dry and windless weather. Herbicides will be mixed according to the instructions on the brand package. Spraying will be carried out prior to planting to give seedlings a wider window without weed competition at the beginning of the rainy season and at other times when weeds are actively growing.

Espacement, marking and pitting

Lining out will be done before the onset of rains, ensuring that pits are dug at a spacing interval of 2 m × 2 m. This spacing interval minimizes the costs of weeding by reducing the time required to carry out the work. Furthermore, a high initial stocking rate (2 500 seedlings per ha) provides an opportunity for substantial biomass accumulation at the end of the tree growth rotation length. The pit size will be 30 cm × 30 cm, with ring hoeing (1 m diameter) to reduce establishment costs and give young trees an opportunity to start growing in a competition-free environment. Pitting will be carried out prior to the rains so that the soils placed back into the pits can trap the first rains before they are lost to the deeper horizons. Only soils free of stones and gravel will be placed back in the pits. Considering the nature of the soils in the Bidibidi settlement area, the use of pitting tools such as the pick mattock or axe is highly recommended.

When lining out seedlings on steep slopes (more than 20o), the spacing should be increased to 2.5 m × 2.5 m to maintain a similar stocking per area unit. The cross-head method is recommended for lining out seedlings.

Transporting seedlings

Seedling trays will be used to carry seedlings to the planting spots. Loading and offloading will be done with the utmost care to keep the soil and roots intact. The seedlings will be kept in a holding nursery for about five days and watered regularly before planting.

Planting

Planting should be carried out at the beginning of the rainy season to allow for maximum growth of the young trees before the first dry season. Seedlings will be planted as quickly as possible when moisture levels have built up to sufficient levels; this is often after 100 mm of steady rain. The steps below are to be followed for seedlings:

- Gently tear the polyethylene tube, taking great care to keep the soil and roots intact.
- Adjust the planting pit with a garden trowel or shovel and then place the seedling vertically, avoiding damaging roots by breaking, bending or crushing.

- Place the soil back to the root collar and as deep as four fingers above the root plug, and tamp the soil around the roots.
- Return the polyethylene tube for proper disposal.
- To boost survival and extend the planting window (where large areas are involved), the use of hydrogels can be explored. However, this will increase the cost of establishment by close to 20 percent.

Because the soils in the planting area are quite fertile, there will be no need to apply fertilizer. However, management may review this after the first planting season.

Gap filling and blanking

Within four to eight weeks of planting, a stock count will be conducted to determine whether there is a need for a gap filling operation. Gap filling will be carried out only if the survival rate is below 85 percent.

To determine the survival percentage, the plantation should be inspected and counts should be made as follows:

- Randomly walk along every third row and count the first ten planting pits encountered.
- Record the number of dead and surviving plants in these ten planting pits.
- Repeat the same procedure on the next third row for at least five rows to cover a total of 50 planting pits.
- Add up the total number of seedlings that survived in the 50 planting pits and divide by the total number of planting pits surveyed (i.e. 50).
- Multiply that number by 100 to obtain the survival percentage.

The calculation is as follows:
survival percentage/stocking = (number of surviving seedlings × 100) ÷50

A mortality rate of less than 15 percent in compartments planted at 2 × 2 m or less should not warrant a blanking operation. If the mortality rate is between 15 percent and 40 percent, the compartment should be blanked. In cases where the mortality rate is higher than 40 percent, a replanting operation is recommended. High blanking percentages result from poor pitting and planting and from inadequate pest and weed control within the 50 cm radius from the plant.

Gap filling is to be carried out during the same season and at least four to eight weeks after planting to maintain uniformity in the tree planting scheme. Seedlings or clones used to blank must be of the same species and contain the same stock or clone number as the original crop. They must be approximately the same size as the original crop already growing in the field. A compartment must have at least 85 percent stocking six to eight weeks after planting.

Post-plant weed control

A clear weed control strategy is to be developed before planting. Weeding will be done to reduce the density of undergrowth and thus ensure the proper development of the crop. The main activities will be slashing, climber cutting, hoeing and herbicide spraying.

Table 11. Post-plant weeding cycle

Weeding method	Year 0	Year 1	Year 2	Year 3
Slashing	-	2	2	-
Hoeing	1	1	1	1
Herbicide spraying	-	4	2	2

Note: The frequency of weeding will vary according to site conditions.

Some recommended weeding methods are:

- **Slash weeding:** this will be done immediately after spot weeding, mainly to reduce competition and attacks from rodents, pests, fire and disease.
- **Spot hoeing:** weeds will be removed in a ring with a diameter of 1 m around the centre of the seedling, using a hoe and by hand pulling. Hand pulling will be done in the no-hoe zone (20 cm from the base of the seedling), while the rest of the weeding spot will be cleared by scrapping with a hoe. Spot hoeing will be applied to all trees with less than two years of growth, after which the trees will have developed deep roots and will no longer be affected by shallow-rooted grasses.
- **Herbicide spraying and use:** the application rate will be based on the manufacturer's recommendations for a specific type of weeds, and the amount of water required will be determined through a calibration process prior to the application of the herbicide. All spraying operations will be carried out by trained teams using personal protective equipment.

Table 12. Timing of spraying

Weed type	Correct stage to spray
Perennial broadleaves	Below 30 cm in height, not during regrowth.
Annual broadleaves	Before weeds develop a woody stem.
Grasses	When actively growing and before weeds set seed, and below 15 cm in height.

Note: When applied correctly, chemical weeding reduces the frequency and costs of weeding.

Source: Sawlog Production Grant Scheme III *guidelines*. Kampala. Cited 29 October 2022. https://spgs.mwe.go.ug/guidelines-0

Labour needs and costs for establishing woodlots

Matching labour needs to work volumes ensures the maximum use of workdays available, limiting underperformance due to labour shortages or work overload. The average daily wage is estimated at USD 4.30.

The following productivity values will guide the allocation of labour to the various operations. However, it is recommended that, in time, a study be carried out for Yumbe District to determine the correct productivity levels for the different forest operations.

Table 13. Indicative labour requirements (person-days/ha) for the establishment of woodlots

Woodlot operation	Person-days/ha		
	Light task	Medium task	Heavy task
Land clearing	10	12	15
Pre-plant spraying	1.5	2	2.5
Marking and pitting	5	6.5	8
Planting (2 500 seedlings per ha)	3	4	5
Blanking	1.2	2	2.5
Post-plant chemical spraying (coning/shielding)	2.6	3	3.2
Post-plant manual labour (lean hoeing)	2.5	3.5	4.5
Post-plant manual slashing (full cover)	3.8	5.6	7.8

Note: The average daily wage (USD 4.30) is the current daily rate in the country for forestry work. This rate includes other costs such as workers' insurance, protective clothing and transportation.

Sources: Uganda Timber Growers Association. 2014a. UTGA News. No. 25. In: Newsletters. Kampala. Cited 30 November 2022. www.utga.ug/newsletters

Uganda Timber Growers Association. 2014b. UTGA News. No. 31. In: Newsletters. Kampala. Cited 30 November 2022. www.utga.ug/newsletters

Weed control maintenance

Weed control maintenance operations will serve to reduce the fuel load in the woodlot as a fire prevention measure and to create access for subsequent maintenance operations, such as pruning and fire suppression.

Major operations will include inter-row weed slashing and climber control by cutting and treating stumps with an herbicide, as follows:

- **Weed slashing:** two years after woodlot establishment, weeds will be controlled by slashing. This operation involves the slashing and removal of noxious and invasive weeds. All weeds should be slashed to a maximum height of 25 cm for the operation to be effective. Inter-row slashing can be carried out effectively by using tools such as slashers, pangas and billhooks. Depending on the rate of weed growth, maintenance slashing operations can be conducted at least once every rainy season (towards the end of the rains) to ensure a reduced fuel load within the woodlot during the dry season.
- **Climber cutting and treating stumps with herbicides:** forest climbers may retard the growth of trees or even cause tree death. Climbers are removed by uprooting or cutting off their vines. Through regular monitoring, woodlot owners can detect the dangers associated with climbers and schedule an operation to remove them in time. Treating stumps with a systemic herbicide will be required to contain the spread of weeds.

Access pruning

For woodlots planted with tree species other than Eucalyptus, only one stage or lift of pruning is recommended. The main purpose of this first pruning is to improve accessibility for tending or maintenance operations. The first pruning also prevents ground forest fires from developing into crown forest fires, which are destructive and intense. Pruning must be done at the correct stage, i.e. before the lower branches start yellowing and drying out.

Brushing (for self-pruning species)

The lower branches of some tree species, especially Eucalyptus spp., usually die off slowly on their own because of physical and environmental conditions or stress when sunlight is reduced by the upper branches. To enable access to the compartment and reduce fire hazards, dead branches may be knocked off the tree stems using a large wooden stick. This process is referred to as brushing

Table 14. Pruning regime for recommended species

Timing	Species	Stage of pruning	Pruned height	Purpose
First pruning	*Eucalyptus spp.*	Year 1 or Year 2	2 m	Create access, improve forest health and reduce the risk of crown forest fires.
	Grevillea robusta	Year 2		
	Gmelina arborea	Year 2		
	Melia volkensii and Melia azedarach	Year 2		
	Pseudocedrela kotschyi	Year 2		
	Azadirachta indica	Year 2		
	Gliricidia sepium	Year 2		
	Senna siamea	Year 2		

Source: Uganda, Ministry of Water and Environment. 2016. Guidelines for establishing and maintaining fuel wood plantations in Uganda. Kampala. http://spgs.mwe.go.ug/sites/files/Establishing%20and%20maintaining%20fuelwood%20plantations%20in%20Uganda.pdf

Woodlot/plantation protection

Protection against forest fires

Forest fires are a serious threat to woodlots. Extra efforts will be put into fire prevention measures before and at the time of planting and into fire suppression during the fire season. This will involve extra vigilance and a larger workforce.
The kind of fuel in and around the plantation, the amount of rainfall, the direction of the wind, the daily temperature and the relative humidity are factors that help fire professionals determine the kind of fire danger that exists in and around the plantation during each dry season.

Woodlot management must put in place resources and plans to overcome any eventuality in the fire season. Integrated forest fire management approaches (e.g. weeding, pruning, understory burning, firebreaks and fire guard preparation) will be adopted and implemented in cooperation with local communities. The Yumbe District Local Government should develop and enforce local ordinances and by-laws on fire management. FAO, UNHCR and OPM should design fire management activities in close cooperation with the Yumbe District Local Government to mobilize communities to adopt firefighting measures. It is also important to work with other relevant stakeholders to build capacity for fighting wildfires, including by providing training and equipment. The strategies listed below will form the main fire control strategy for the woodlots.

Fire prevention

In order to prevent fires, the following actions are recommended:

- sensitization of the workforce and neighbouring communities about the importance and relevance of preventing any fire outbreak within the woodlot;
- formulating and implementing local government by-laws on fire management with clear penalties; and
- further awareness raising on forest fire prevention through regular meetings and information signs and posters.

Protection from fires

This involves:

- ensuring that firebreaks, forest roads and tracks are created and kept clean of any fuels;
- recruiting a fire patrol team and equipping them with transport and communication tools;
- ensuring that controlled (understory) burning is carried out with clear and precise instructions;
- carrying out rotational burning to reduce fuel in the neighbouring blocks;
- having a concise post-plant weeding regime for established woodlots;
- acquiring the correct firefighting tools (see Annex 5); and
- recruiting and training a fire monitoring and firefighting crew.

Detection of fires

This involves:

- putting in place detection and communication facilities, such as fire lookout points and mobile telephones;
- promoting friendly relationships with local communities and the police; and
- guarding and patrolling the woodlots.

Suppression of fires

In case of a fire outbreak, the following interventions can help to suppress a forest fire quickly:

- applying water through pressure pumps, using light soil to cover fuel, using fire beaters and fire pumps and creating safety belts using rake hoes;
- back burning/counterfire: setting fire from the front to the back so as to cut off the main fire;
- mopping up: completely extinguishing any smoldering debris left after the main fire has been put out in order to prevent a new fire; and
- guarding: watching or guarding the fire-affected area to ensure that no fire reignites in the absence of a firefighting team.

The estimated annual cost of fighting forest fires is about USD 50/ha (based on experiences from the Sawlog Production Grant Scheme project, phase III, 2015-2021), so prevention is critical for reducing firefighting costs.

Protection against grazing animals

The area of interest borders on residential areas occupied by host communities and refugees, which could pose problems in terms of domestic animals (cows and goats). Woodlot owners and management teams will hold regular discussions with livestock owners and set up a strategy to protect woodlots from grazing animals.

Domestic animals will be allowed to graze in mature woodlots (of at least three years old) only.

Preventive measures will be put in place to control threats from wild animals (e.g. clearing the site of all weeds and setting up dedicated feeding areas).

Protection from tree pests and diseases

Woodlot owners and the management team may not be in a direct position to detect and prevent diseases and pests. However, they should ensure that any form of disease or pest outbreak detected on trees is reported to the district forest department, which should liaise with forest researchers (such as those at the National Forestry Resources Research Institute) to ensure that preventive measures are carried out in time.

Overall, Uganda has been fortunate to have grown exotic tree species without experiencing major pests, apart from cases of termite pests attacking most *Eucalyptus* species and *Grevillea robusta*, particularly in dry areas. *Leptocybe invasa* (blue gum chalcid) is another pest that has been attacking *Eucalyptus* in the country since 2002. It is therefore important to select appropriate, resistent *Eucalyptus* species for planting.

Seeds should be imported through bodies such as the Uganda Timber Growers Association and the National Tree Seed Centre. A phytosanitary certificate should be provided by the seed exporter and verified by the plant protection unit of Uganda to avoid the introduction of new pests and diseases through imported seed, especially for exotic species. Pest management in nurseries needs to be enhanced.

Precautionary measures will be taken to prevent the occurrence and spread of diseases and pests by ensuring proper woodlot hygiene and health. Such measures include correct site-species matching and regular weeding, as well as preventing forest fires. No particular diseases or pests were observed in Yumbe District; however, it is necessary to monitor all planted exotics.

Protection from trespassers

Access to the woodlots within the refugee settlement area will need to be regulated. For example, precautions will be taken to restrict movement through the woodlots during the fire season. Through proper site planning, woodlot establishment should not impair the local area road network, which is often the cause of trespassing. Mass sensitization, staging notices, the enforcement of by-laws by local leaders and fencing in high-risk areas will be explored.

Labour needs and costs of woodlot maintenance operations

Labour needs and costs of maintenance operations can be ascertained based on the figures provided in Table 15. However, it is recommended that, in time, a work study be carried out in Yumbe District to update these figures. As stated above, the daily wage is estimated at about USD 4.30.

Table 15. Indicative labour requirements (person-days/ha) for plantation and woodlot maintenance operations

A phytosanitary certificate should be provided by the seed exporter and verified by the plant protection unit of Uganda to avoid the introduction of new pests and diseases through imported seed, especially for exotic species.

Table 15. Indicative labour requirements (person-days/ha) for plantation and woodlot maintenance operations

Activity	Person-days/ha		
	Light task	Medium task	Heavy task
Maintenance – manual slashing (full cover)	4.2	4.8	7.9
Access pruning/first pruning (2 m)	4.8	5.0	5.3
First pruning and brushing for Eucalyptus (2 m)	1.9	2.0	2.5
Forest fire protection (patrollers)	0.2	0.5	1.0
Manual firebreak preparation (scoffling)	17.1	18.0	18.9

Sources: Uganda Timber Growers Association, n.d., 2014a, 2014b.

Harvesting systems and techniques will be refined continuously so that they become fully compatible with the objectives of sustainable forest management, allowing them to contribute in an important way to the economic and social aims of sustainable development. The primary objective is to promote forest harvesting practices that improve standards of utilization and reduce environmental impacts, thereby contributing to the conservation of forests.

Annual harvestable volume

For the total plantable area of 4 081 ha (see Table 7), with a close spacing interval of 2 m × 2 m and a rotation of three years, a mean annual increment of 10 m^3/ha is assumed. In year 3, the harvestable volume is expected to be 30 m^3/ha. Assuming an average wood density of 600 kg/m^3 and a biomass expansion factor of 1.5 (to include bark and branches), the total annual AGB increment achievable with tree plantations would be 9 tonnes/ha.

To compensate fully for the estimated annual loss of biomass (based on the analysis' results for woodfuel demand) and balance the estimated woodfuel supply and demand for cooking by refugees and host communities within the settlement boundary (25 077 tonnes/year), it would be necessary to harvest 929 ha of dedicated tree plantations every year, which means a total of about 2 786 ha of woodlots with a rotation length of three years (see Table 16). The gap could be filled through the sustainable supply of woodfuel in combination with the promotion of energy-efficient technologies and practices for cooking at household, commercial and institutional levels.

Table 16. Woodlot parameter predictions

Parameter	Values
Mean annual increment (m^3/ha per year)	10
Rotation age (years)	3
Sum of mean annual increment for rotation (m^3/ha)	30
Area required to balance woodfuel supply and demand (ha)	2 786
Annual harvestable biomass for energy woodlots (tonnes)	25 077
Plantable area allocated for woodlots (ha)	4 081

Note: 10 m^3 ha/year is the average growth rate for Eucalyptus clones at marginal sites (site class III) in Uganda.

5.1.2 Stakeholder roles and responsibilities

The roles and responsibilities of the different key stakeholders will be further defined during the implementation stage. Key aspects to be considered in this process are described below.

Woodlot establishment and maintenance in the refugee settlement area

Consultations: OPM, in consultation with local leaders, should consult with and clarify to host landlords the proposed land use changes to establish woodlots. These consultations should emphasize aspects relating to:

- formalization of a special land agreement between OPM and landlords to ensure that benefits accrue to both the refugee population and the host community in a conflict-free arrangement;
- land use, to be clearly defined in agreements between the district local government, OPM and landlords;
- proposed acreage for woodlot establishment and duration of the project; and
- benefit-sharing, to be specified in the lease agreements with landlords.

A land consent template is annexed to this plan (Annex 7); this template can be tweaked to suit specific project requirements. A more general memorandum of understanding should be prepared by UNHCR, OPM, the district local government and relevant technical bodies. Local nursery operators will be identified, trained and certified to guarantee the quality of the seedlings supply.

Incentives: UNHCR and other key stakeholders should inform both refugee and host communities about the different incentives for woodlot development.

Incentives for woodlot establishment and maintenance

The following incentive schemes, aimed at both refugee and host communities, may be explored to ensure the successful establishment and maintenance of woodlots for energy:

- **Income from seedlings:** training refugees, members of institutions and host community groups in tree nursery business management to raise quality seedlings for establishment and rehabilitation interventions, in addition to providing the inputs required to establish standard tree nurseries (a nursery calendar for seedling production in Bidibidi is provided in Annex 1).
- **Performance-based payment for trees:** providing incentives, in the form of money or inputs, to the refugee community to ensure that the planted trees are maintained and protected. Incentives should be given based on an annual woodlot assessment looking into the level of stocking, the quality of weed control and forest protection, and adherence to environmental and social standards. Depending on the agreed minimum standards of woodlot maintenance, payments (incentives) can be made.
- **Cash for work:** training refugee and host communities in tree planting skills, so they can implement forestry operations and gain employment through a cash-for-work scheme. Such schemes have been found to yield positive results if the interest in planting the trees originates with the beneficiaries. The implementing agencies, in addition to providing cash for the labour offered, ensure that appropriate tools are provided, coupled with training and technical guidance for tree planting.
- **Partnerships with local NGOs:** NGOs working with small and medium-sized enterprises can provide training to communities to help them start and manage additional, quickly set up projects (e.g. beekeeping) in the woodlot areas.

Woodlot harvesting

Procedures to operationalize the harvest of fuelwood on an annual basis

OPM, the refugee welfare councils of the particular zone will register each refugee household in the settlement. The environment protection committee of each zone of the settlement will supervise woodlot felling and cross-cutting. In each zone, members of the environment protection committee and refugee households will be involved in the cutting of the woodlot at maturity. The implementing partners may also contract out woodlot harvesting, processing, seasoning and supply to private operators. Fuelwood or poles will then be apportioned to the households according to their size and needs (further supplies can be provided at a subsidized price). OPM and UNHCR will identify a partner that can provide e-voucher credits to refugees, host communities and institutions for energy to offset the cost of wood energy harvesting and processing. OPM and UNHCR will regulate the price charged based on the market price, and ensure an equitable supply of biomass to the refugee communities.

The environment protection committees will keep records of the harvested and distributed volumes. Strict rules and by-laws on how to communally manage the woodlots will be formulated by the settlement leaders.

Procedure for monitoring and reporting

- **Monitoring and reporting in the settlement area:** OPM settlement commandants will be responsible for ensuring the smooth and sustainable harvest and use of the fuelwood in each settlement. Any silvicultural needs or damages by fire, animals or humans will be reported by the environment protection committee to the settlement commandants, who will inform the district forest officer. Where necessary, the district natural resources department will take action and conduct routine environmental management checks.
- **Monitoring and reporting in the host community:** the plantation manager will monitor performance against the annual plan of operations. The outcome of this annual monitoring will be used to update the three-year tactical plan (the medium-term plan), which is overseen by district officials, FSSD and OPM.

After six years, FSSD and district officials should evaluate the extent to which the Forest Landscape Management Plan has been carried out. The results of this evaluation are to be used to streamline plantation management.

Routine monitoring of woodlots to protect them against wildfires, theft of forest resources and damage by animals, diseases and pests will be the responsibility of the landlords and their woodlot managers.

Labour needs for various operations

The woodlots owned by the host community and the refugees will depend on labour from communities in immediate and neighbouring areas. For operations relating to the woodlots owned by the refugees, labour will largely be paid for in cash until the first harvest. No labour shortages are expected in the foreseeable future.

Maintenance and harvesting

The stakeholders responsible for maintenance and harvesting are the refugee leaders, local community leaders, Yumbe District Local Government, OPM, FAO and UNHCR. The harvesting of the woodlots owned by the refugees will be contracted out to contractors from the refugee settlement to create employment for refugees. FAO will provide technical information, skills training and capacity building.

5.2 Restoration of degraded land

The purpose of land restoration is to restore the capacity of degraded land to deliver products and services. Land restoration re-establishes the original productivity of the target land, while also contributing to reducing risks in the face of natural hazard-related shocks.

Land restoration proposals will target tropical high forest, woodland and farmland. Potential beneficiaries of this intervention are both private landholdings and institutions.

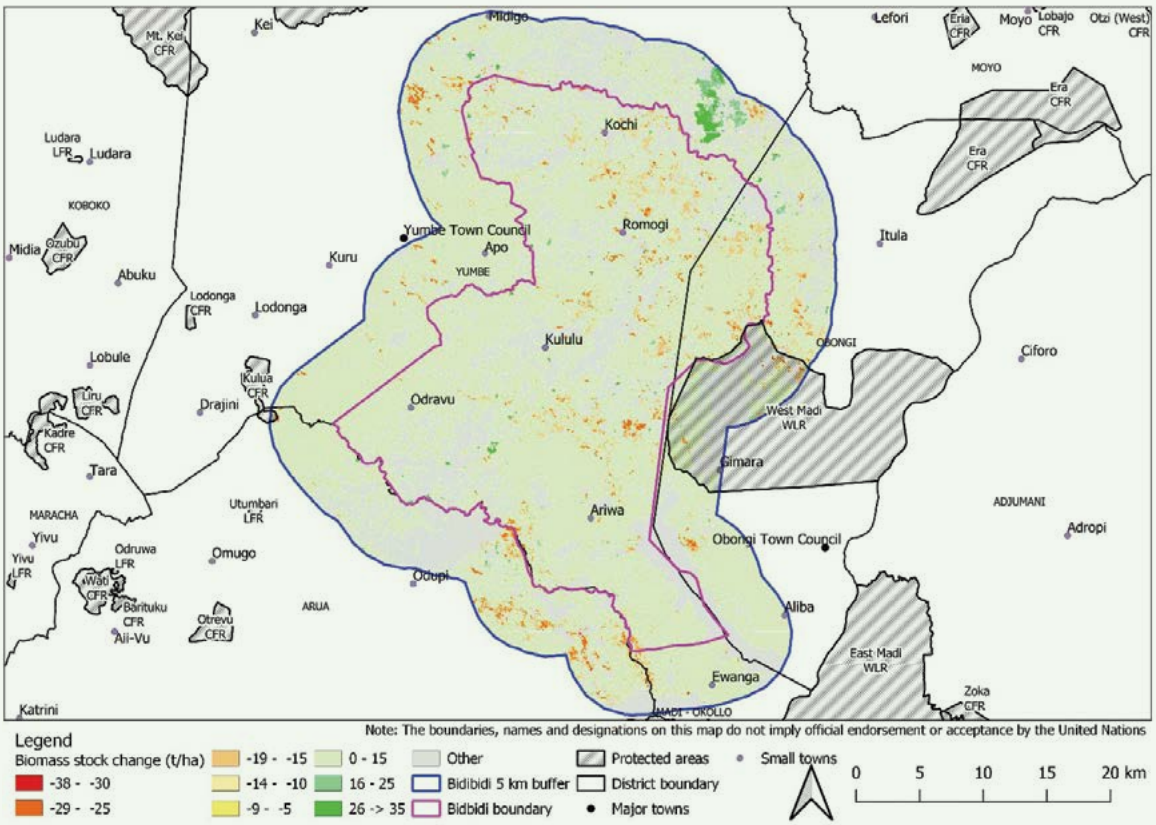
According to the type of LULC, specific strategies will be developed to rehabilitate land through natural or assisted regeneration using indigenous tree species. The harvesting of forest products will be controlled and regulated. Efforts to rehabilitate degraded land are aimed inter alia at stabilizing land, conserving biodiversity, reducing disaster risks and conserving soil and water.

For the restoration of degraded communal land to be successful, the right to access the land and harvest wood and NWFPs should be clarified and agreed upon with all members of the communities, including the refugees. A lack of collective rights and benefits could encourage the unsustainable harvesting of woody biomass.

The land proposed for restoration interventions within the refugee settlement area and the 5 km buffer zone was selected based on the biomass stock change map of the area for the period 2019–2021 (see Figure 10).

According to the type of LULC, specific strategies will be developed to rehabilitate land through natural or assisted regeneration using indigenous tree species. The harvesting of forest products will be controlled and regulated. Efforts to rehabilitate degraded land are aimed inter alia at stabilizing land, conserving biodiversity, reducing disaster risks and conserving soil and water.

Figure 10. Potentially suitable areas for the restoration of degraded land, based on the biomass stock change map for 2019–2021



Sources: SEPAL N.d. *Bfast Explorer.* In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns*. Kampala (unpublished).
Uganda Bureau of Statistics. 2018. *District boundary and towns*. Kampala (unpublished).
Uganda, National Forestry Authority. 2019. *Land cover map.* Kampala (unpublished).
Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
UNHCR N.d. *Bidibidi boundary.* Geneva (unpublished).

The recommended restoration interventions would mainly target the tree cover loss occurred on farmland, which is the main class of degraded LULC with woody biomass loss driven by agricultural expansion, the overharvesting of fuelwood, and wildfires and other destructive agents. Degraded forest, woodland and bushland are also targeted for restoration interventions.

A total 6 846 ha of land where woody biomass loss has recently occurred (between 2018 and 2021) have been identified for potential restoration efforts. Most of these lands are classified as farmland, with a total of 6 771 ha within the refugee settlement area and the 5 km buffer zone, while degraded tropical high forest and other woodland and bushland cover a total of about 88 ha, as shown in Table 17.

Table 17. Potential areas for the restoration of degraded land, by land use and land cover class

LULC class	Degraded land within the refugee settlement (ha)	Degraded land within the 5 km buffer zone (ha)
Tropical high forest – well stocked	4	0
Tropical high forest – low stocked	5	53
Woodland	7	6
Bushland	12	1
Subsistence farmland	3 691	3 080
Total	3 719	3 127

Notes: Due to rounding, some totals may not correspond with the sum of the separate figures.
LULC = land use and land cover.

5.2.1 Approaches to restoration

The main strategies for the proposed restoration interventions are promoting natural regeneration, enriching planting using indigenous species present in the area, adopting agroforestry techniques and strengthening value chains for NWFPs.

The rehabilitation of all categories of degraded land can follow different approaches. The Forest Landscape Management Plan suggests the following approaches:

- **Farmer-managed natural regeneration:** this approach will target degraded woodlands and bushlands. One of the activities under this approach is enrichment planting, which aims to increase the density of the trees in the degraded area. Enrichment planting involves preparing land and planting tree species that were logged excessively. Other activities include the management of saplings, pruning, coppice reduction, weeding and forest fire protection. Coppice shoots that are removed during coppice reduction will be used for fuelwood.
- **Natural regeneration and protection:** this approach will target degraded woodlands and bushlands by protecting remnant trees from fuelwood harvesting, livestock grazing and other destructive agents, such as wildfires. Under this approach, tree density is determined through natural competition.
- **Agroforestry systems:** the implementation of agroforestry activities to rehabilitate degraded land (by e.g. enhancing soil conservation and improving soil fertility) can strengthen livelihood opportunities and support the provision of ecosystem services. At the same time, agroforestry activities can help meet food needs and define boundaries, among other things. Multipurpose and fast-growing woody species should be considered in order to increase the motivation of people to manage trees effectively.

For each approach, both refugee and host communities will be engaged in the implementation of restoration operations and routine maintenance activities. However, considering the technical aspects involved in the execution of some of the operations, skilled workers trained by certified forest contractors should be recruited by the district or implementing agencies to train, guide and eventually engage the communities in the area of interest in carrying out specific activities.

5.2.2 Tree species selection

Efforts to rehabilitate degraded land in the area of interest will be aimed at addressing land stabilization, biodiversity conservation, and soil and water protection, among other objectives. For this reason, a number of (mostly indigenous) tree species were selected for different restoration strategies. The list of tree species identified in a 2017 report by FAO and UNHCR was adopted for the present Forest Landscape Management Plan (FAO and UNHCR, 2017) (see Annex 2). Table 18 shows the priority list, comprising only high-value timber and fuelwood species. Although these species are slow-growing, they would improve species diversity in the area. It has been reported that some of these species, including *Afzelia* spp., are currently heavily exploited for timber. To confirm the priority list and ensure the success of the intervention, consultations were held with the local population and the District Forestry Department regarding the potential of the species and the preferences of the locals.

Table 18. High-value timber and fuelwood species for land restoration interventions

Agroforestry species	Site conditions/management system
Acacia sieberiana, Ficus natalensis	Poorly drained soils, sites with a high water table, riverine sites.
Combretum spp., Piliostigma thonningii	Water-stressed sites, soils with rapid drainage.
Combretum spp., Pilostigma thonningii	Shallow soils with underlying rock, effective rooting depth of less than 50cm.
Antiaris toxicaria, Afzelia spp., Celtis africana, Khaya senegalensis, Pseudocedrela kotschyi, Albizia coriaria, Milicia excelsa	Deep, fertile, well-drained soils.
Calliandra calathyrsus, Sesbania spp., Tephrosia spp., Cajanus cajan, Gliricidia sepium, Moringa oleifera	Tree species for agroforestry systems.

5.2.3 Planting material for restoration

Both seedlings and wildings (naturally regenerated seedlings) can be good planting materials. Seedlings will be raised in the local tree nurseries, while wildlings will be collected from the woodlands or existing forests. For most of the tree species recommended, seeds are also readily available at the National Seed Centre in Namanve or from the Uganda Timber Growers Association and can be procured for raising by the nurseries (see Annex 1 for a nursery calendar for seedling production in Bidibidi).

Seedlings for planting must possess the following characteristics:

- optimum height of 20 cm (from root collar to the tip)
- healthy and vigorously growing
- pest- and disease-free
- root-to-shoot ratio of 1:2
- sturdy and straight stem
- accustomed to short periods without water and to full sunlight

5.2.4 Stakeholder roles and responsibilities for the restoration of degraded land

The roles and responsibilities of the different key stakeholders will be further defined during the implementation stage. Key aspects to be considered for this intervention will include, but are not limited to:

- consulting with the landlords of the areas proposed for restoration in the host community and settlement areas, to create awareness and understanding of the proposed interventions;
- communicating the different opportunities and incentives that arise from restoring degraded land for both refugee and host communities;
- considering a cash for work approach to encourage refugees to implement assisted natural regeneration practices; and
- identifying a partner that can promote a payments for ecosystem services scheme to guarantee the protection of the restored areas by the landlords.

The district local government, implementing partners and a technical agency will promote incentive schemes to sustain restoration interventions, focusing inter alia on income generating activities, carbon finance and the strengthening of value chains for NWFPs.

5.2.5 Incentive mechanism for the restoration of degraded land

The following incentive schemes can be explored to encourage the restoration of degraded land within the area of interest:

- partnerships with local NGOs working with small- and medium-sized enterprises, which can train community members to help them start up and manage short-term projects, such as beekeeping, in the restored areas;
- training in sustainable NWFP harvesting techniques and methods to replace and expand indigenous species;
- integrating restoration initiatives with national carbon funding initiatives such as REDD+; the financial incentives through payments for ecosystem services will motivate the host community to rehabilitate and protect the restored forests from potential threats such as wildfires;
- co-investment programmes in which farmers provide farm labour in exchange for seedlings, farm inputs and training for land restoration interventions on their own pieces of land (both community and private landholdings); and
- cash for work to the refugee and host communities, for labour to implement forestry operations and protect the rehabilitated areas from further degradation.

5.3 Conservation of intact natural forests and other sensitive areas

5.3.1 Intact natural forests

Natural forests (or closed forests) are any group of indigenous trees whose crowns are contiguous and where a closed canopy exists. These forests usually consist of large trees, shrubs and climbers. The primary management objective for these indigenous forests is to protect them from unregulated harvesting of forest products. Closed natural forest belts in Bidibidi are largely on host community land, with some pockets of forests along the riverbanks. These native forests are sources of NWFPs and timber products. Intact natural forests must not be cleared and replaced by woodlots; they serve as natural barriers, wildlife corridors and parts of special management zones for biodiversity conservation. Such forest areas should be protected with firebreaks with a minimum 5 m buffer strip.

For the present Forest Landscape Management Plan, forest areas with a high biomass stock (higher than 25 tonnes/ha) and presenting the parameters presented in Table 19 were considered for protection interventions.

Table 19. Criteria used to identify potential areas for forest conservation interventions

Specific requirements	
Protected area	Yes
Soil site class	All classes on the site (III, IV, V)
Biomass stock (t/ha)	>25
Biomass stock change (t/ha)	< 15
LULC (2019)	Tropical high forest – well stocked;
tropical high forest – low stocked;	
woodland	
Average distance to road	Any
Residential areas (for refugees and for hosts)	No

Note: LULC = land use and land cover.

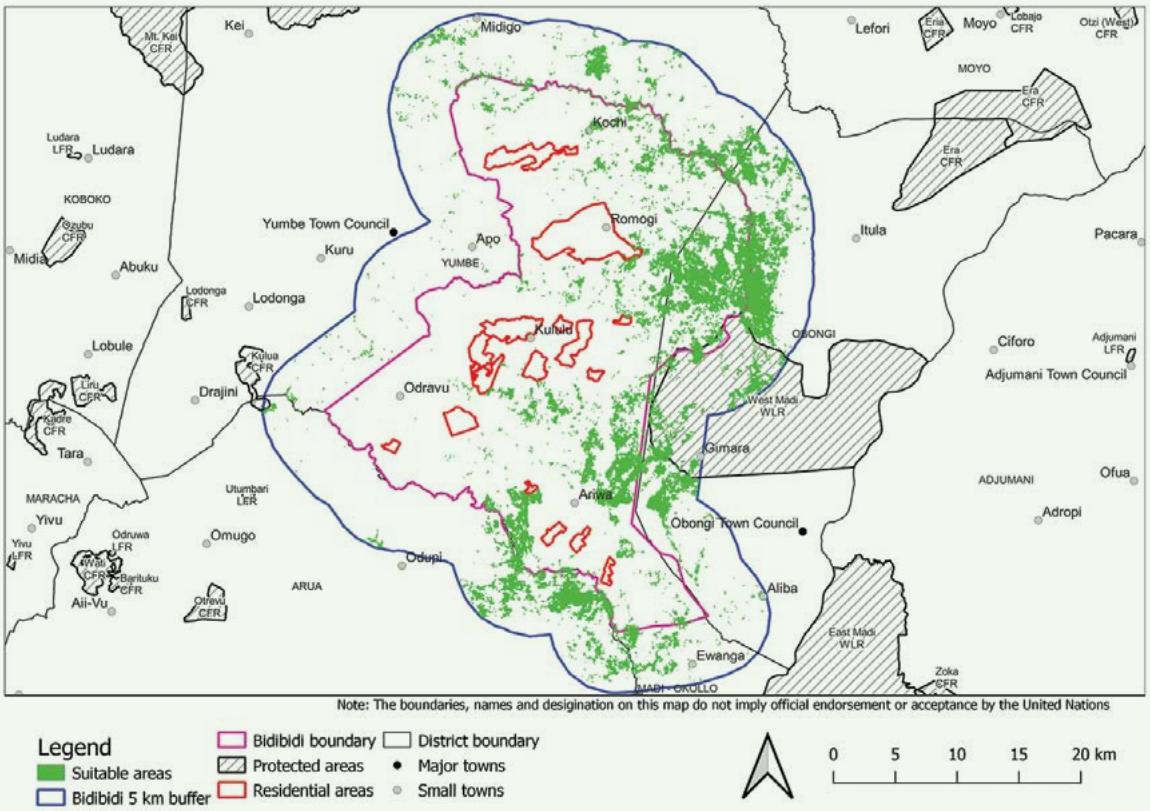
The areas selected were forest areas that had remained intact over the monitoring period 2018–2021. The total potential area identified is 20 054 ha, with 9 767 ha falling within the Bidibidi settlement area and 10 287 ha falling within the 5 km buffer zone. Table 20 shows the extent of forest area suitable for protection in the area of interest, by subcounty. Figure 11 shows the spatial distribution of suitable areas within the area of interest.

Table 20. Areas suitable for the conservation of intact natural forests

Subcounty	Within the Bidibidi settlement area (ha	Within the 5 km buffer zone (ha)
Rigbo	0	336.1
Odupi	52.5	2 046.1
Ariwa	3 130.5	54.6
Drajini	0	5.4
Kochi	763.8	684.1
Kululu	599.3	58.5
Kuru	0	8.9
Lodonga	0	0.5
Midigo	15.8	1 098.4

Subcounty	Within the Bidibidi settlement area (ha	Within the 5 km buffer zone (ha)
Odravu	128.2	100.6
Romogi	1 694.6	6.4
Aliba	0	71.5
Gimara	44.4	2 116.7
Itula	3 288.4	3 077.7
Ewanga	42.6	574.6
Apo	7.5	46.3
Yumbe Town Council	0	0.6
Total	**9 767.5**	**10 286.8**

Figure 11. Areas suitable for the conservation of intact natural forests



Sources: SEPAL N.d. *Bfast Explorer.* In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
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Uganda, National Forestry Authority & Uganda Wildlife Authority. N.d. *Protected areas boundary.* Kampala (unpublished).
UNHCR N.d. *Bidibidi boundary.* Geneva (unpublished).

5.3.2 Other special management zones

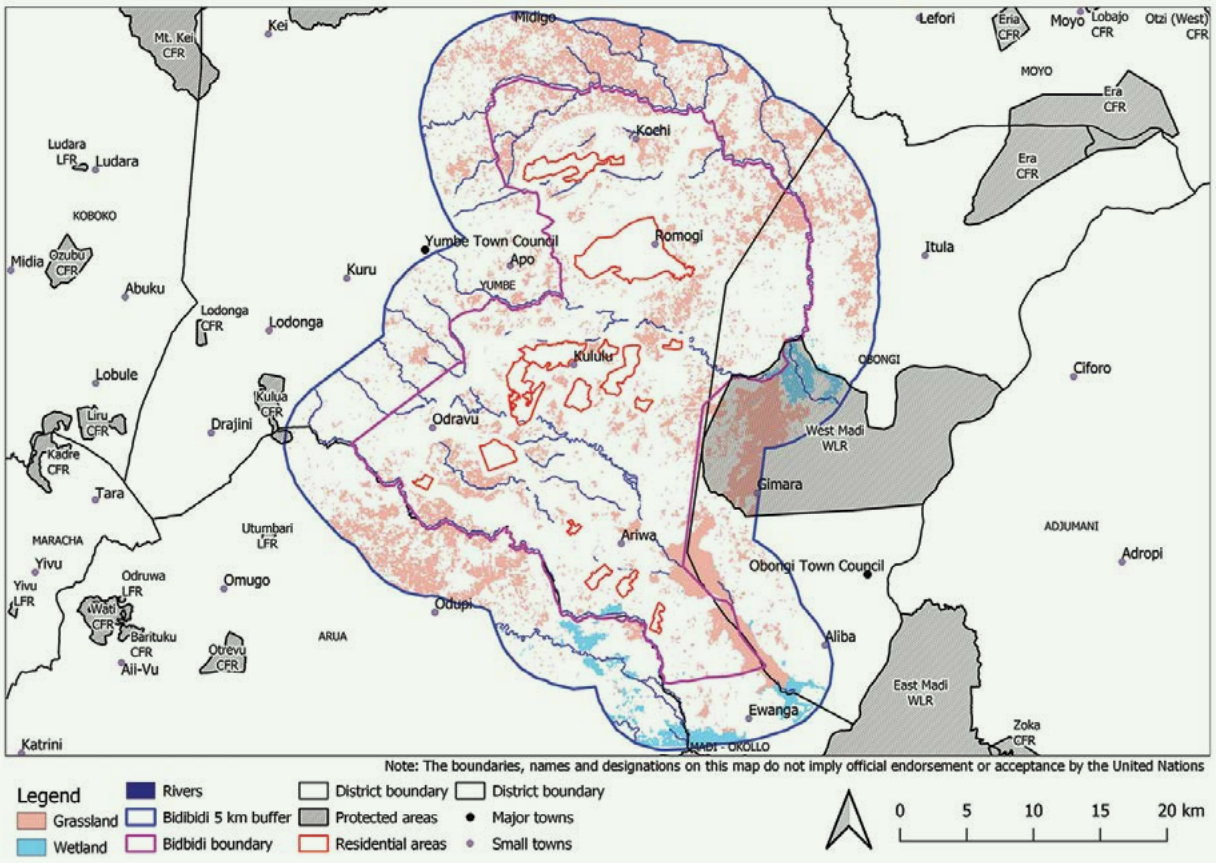
In addition to interventions to protect natural forests, interventions should be conducted to protect and safeguard riverine areas, wetlands and grasslands. These special management zones within the area of interest include sensitive ecosystems that cannot be replaced by plantations. These zones may require particular attention when planning fire management interventions.

The data for the intervention have been calculated without taking residential areas into consideration (see Table 21). The riverine area was estimated taking into account a distance of 50 m from each side of rivers and streams. Figure 12 shows the spatial distribution of suitable areas within the area of interest.

Table 21. Suitable areas for special management zones: breakdown by type of area for intervention

Special management zone (ha)	Within the Bidibidi settlement area (ha)	Within the 5 km buffer zone
Wetland	91	1 352
Riverine	1 876	2 050
Grassland	4 828	8 570

Figure 12. Suitable areas for special management zones



Sources: SEPAL N.d. *Bfast Explorer.* In: SEPAL. Rome. Cited 20 November 2022. https://docs.sepal.io/en/latest/modules/dwn/bfast_explorer.html
Uganda Bureau of Statistics. 2016. *District boundary and towns.* Kampala (unpublished).
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UNHCR N.d. *Bidibidi boundary.* Geneva (unpublished).

Specific management interventions aimed at maintaining these areas in a pristine natural state are presented in Table 22.

Table 22. Protection interventions in special management zones

Special management zone	Management actions	Protection measure
Wetlands and riverine areas	• prescribed burning; • removal of invasive vegetation; • inventory of flora and fauna; • increasing monitoring activities; • involving refugee and host communities in wetland management; • training resource user groups on the sustainable harvesting of various wetland resources; and • operationalizing wetlands user committees.	Patrolling for illegal fishing, grazing, pollution.
Grasslands	• rotational burning; • removal of invasive vegetation; and • fire protection from prescribed fires.	Patrolling for illegal burning, hunting.
Wildlife corridors	• inventory of fauna and flora; • fire protection; and • removal of invasive plants.	Patrolling for illegal hunting, burning.

5.3.3 Stakeholder roles and responsibilities

The roles and responsibilities of the stakeholders will include:

- consulting with the landlords in the areas proposed for protection, to create awareness and understanding of the proposed intervention;
- communicating to the communities the different opportunities (incentives) from which they can benefit by conserving intact natural forests and other special management zones; and
- supporting forest landowners in protection activities, such as wildfire prevention, grazing prevention and the sustainable harvesting of wood and NWFPs.
- partnerships with local NGOs working with small- and medium-sized enterprises, to train the communities in the starting up and managing of short-term projects (such as beekeeping) within the protected area, for short-term returns;
- training in sustainable NWFP harvesting techniques, strengthening value chains and implementing methods to replace and expand indigenous species; and
- payments for ecosystem services to motivate the host community to rehabilitate and protect protected native forests from threats.

5.3.4 Incentive schemes for protection

The following incentive schemes can be explored to enhance the conservation of intact natural forests within both the refugee settlement and the host community areas:

6 MONITORING AND EVALUATION

Monitoring the forest landscape management includes screening its environmental and social impacts, both positive and negative.

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6.1 Why monitor and evaluate

Monitoring implies keeping watch over the progress, quality and success of the proposed interventions; it involves the ongoing assessment of the technical, environmental and social performance and effects of management. The evaluation of the progress and quality of the work involves comparing results with the prescribed standards, milestones, aims and objectives (FAO and UNHCR, 2018). Changes in strategy, technology, management practices or any other component or subsystem of an intervention can be made in light of the outcomes of monitoring and evaluation (Siyag, 2014). A monitoring system will be set up to collect, analyse and make available the information needed for decision-making and for adapting the management plan, where necessary. This is crucial for the following (FAO and UNHCR, 2018):

- understanding success, failure, and change over time;
- supporting implementation and providing feedback for adaptive management;
- increasing transparency and providing evidence of progress, achievements and impacts in relation to specific goals and objectives;
- communicating results and outcomes to encourage positive momentum, inspire replication, encourage scaling up, and allow the transfer of results;
- supporting the sharing of evidence with investors and increasing trust as a way of fostering additional investments; and
- supporting reporting at various levels.

Monitoring and reporting on progress towards the achievement of forest management objectives, as set out in the forest management plan, also helps in:

- controlling forest operations, including those carried out by contractors and other actors working under contract or licence in the forest;
- identifying under- or overachievement, determining the causes of underachievement, and taking action to rectify the situation and to adjust annual operational plans as necessary;
- detecting inefficiencies or fraud;
- providing information for the future revision of the plan; and
- providing information for the evaluation of the management plan or its prescriptions.

6.2 Monitoring environmental and social impacts

Monitoring the forest landscape management includes screening its environmental and social impacts, both positive and negative. Any positive impacts should be enhanced, while measures should be developed to mitigate the negative impacts.

To assess progress achieved through project interventions, it is necessary to define indicators to establish the baseline situation and track changes in performance and impact over time. Possible impacts, and related indicators that can be used to monitor operational performance, include:

a) Possible positive environmental and social impacts

- increased forest cover
- improved sources of livelihood through employment (income)
- improved sustainability of wood harvesting
- reduced dependence on non-renewable biomass
- enhanced atmospheric carbon uptake/carbon sink
- improved biodiversity conservation

b) Possible negative environmental and social impacts

Impact	Possible mitigation measures
Loss of biodiversity (flora and fauna) because of site clearing for woodlot establishment	Reduce site clearing to spot/ring/strip clearing.
Increased risk of soil erosion because of site clearing and burning	Leave stubble and other vegetation residues on or near the surface as mulch to reduce soil exposure and thus limit erosion.
Surface water pollution resulting from soil erosion	Reduce site clearing.
Surface and underground water pollution resulting from the use of herbicides	Minimize the use of herbicides and use only certified/recommended herbicides by the Forest Stewardship Council (FSC).
Risk of fire spreading unintentionally to other properties	Limit burning and train workers responsible for burning.

Increased air pollution because of the smoke from burning	Use vegetation residues for mulching instead of burning them.
Reduced area for the cultivation of subsistence crops	Promote agroforestry, use the *taungya* system,[6] and promote the development of other sources of livelihoods that can be integrated with agroforestry (such as beekeeping).
Increased encroachment on protected areas (wetlands, forest reserves) for food crop farming	Create buffer zones along protected areas, increase patrols in protected areas and sensitize the population about the need to conserve and protect fragile ecosystems.
Land fragmentation	Promote and encourage integrated crop farming.
Increased waste generation from seedling pots, herbicide containers, etc.	Set up a mechanism to collect all waste for proper disposal.
Increased community conflicts	Develop a conflict management and redress mechanism, and conduct thorough stakeholder consultations.
Increased risk of food contamination resulting from the use of herbicides	Use herbicides only after harvesting food crops, and use only certified/recommended herbicides.

6.3 Adopting a monitoring system

Various methods and data sources can be used to establish baselines and track progress against project indicators, and all have trade-offs. Data collection methods include top-down (e.g. remote sensing) and bottom-up (i.e. ground-based) approaches, as well as a combination of the two. Which method is selected for collecting and analysing data depends on the scale of the intervention, the indicators chosen, costs and available resources. Remote sensing techniques using satellite imagery or other aerially collected data can help monitor certain biophysical and socioeconomic indicators over large areas with a high degree of accuracy. Tools such as Open Foris, the System for Earth Observations, Data Access, Processing and Analysis for Land Monitoring, and Google Engine can help in monitoring biomass stock changes using a combination of high-resolution satellite imagery and field surveys. Field-based monitoring is usually more expensive but can generate more accurate data and capture local socioeconomic conditions. Possible approaches include:

- regular inspections
- spot checks on operations
- plot-based sampling for forest inventory
- research plots
- process studies in field and laboratory
- environmental audits
- destructive sampling
- field experimentation, including testing responses to treatments and productivity trials
- visual checking of key habitats
- biological sampling
- use of comparative photographs
- rapid or participatory rural appraisal methods
- questionnaires

To obtain the best results possible, satellite and airborne methods should be combined with field assessments and participatory approaches.

6. The taungya system can be a useful practice to combine the establishment of plantations with the creation of labour opportunities for refugees and the promotion of food self-sufficiency. Taungya is an agroforestry system in which land is cleared and planted initially to food crops. Seedlings of desirable tree species are then planted on the same plot, leading in time to a harvestable stand of timber. Under the local taungya system, refugees are granted access to agricultural land and given the responsibility of protecting and caring for the trees. The tree root systems and the shade cast by tree canopies restrict the productivity of the crops growing underneath for two to four years; at that point, new plots are opened up nearby while the trees continue to grow on the original plot, providing a range of goods and ecosystem services.

6.4 Reviewing the Forest Landscape Management Plan

It is recommended to periodically review and update the management plan at least every three years. Annual and mid-term appraisals and reviews should be undertaken to assess the impacts of ongoing interventions and determine whether they are on track to achieve the objectives of the plan. For example, remote sensing imagery may be used in conjunction with a geographic information system to quickly assess progress in plantation establishment as part of such mid-term appraisals.

An annual plan of operations related to the implementation of the forestry interventions will be prepared and validated by MWE and OPM. A mid-term review of the performance of the management plan will be carried out every three years by the district local government, in close collaboration with OPM, MWE, the National Forestry Authority, UNHCR and the required technical partners. This mid-term review will assess the extent to which the plan has been implemented, and its aims and objectives have been achieved. Tangible outcomes will be measured quantitatively, while the assessment of intangible benefits should be as objective as possible. The landlords will be responsible for preparing the annual plan of operations, as well as for managing budgets and operations related to the implementation of multipurpose forest plantations.

After six years, the FSSD and district officials should evaluate the extent to which the Forest Landscape Management Plan has been carried out. The results of this evaluation are to be used to streamline plantation management.

Any positive impacts should be enhanced, while measures should be developed to mitigate the negative impacts.

7 COST ANALYSIS

Woodlots will be established and maintained using best practices and standard operating procedures agreed upon through the FAO Sawlog Production Grant Scheme.

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7.1 Establishment and maintenance of woodlots for energy

The establishment and maintenance of a woodlot with a rotation of three years would cost approximately USD 1 407/ha. Woodlots will be established and maintained using best practices and standard operating procedures agreed upon through the FAO Sawlog Production Grant Scheme. Table 23 shows the indicative operational costs for the working cycle of the woodlots for energy (see Section 5.1).

Table 23. Indicative operational costs for the working cycle of woodlots for energy

Operation	Unit cost (USD/ha)	Number of operations per year				Total (USD/ha)
		0	1	2	3	
Surveying and planning	25	1	-	-	-	25
Land clearing	90	1	-	-	-	90
Land preparation (slash and burn)	33	-	1	-	-	33
Pre-plant weed spraying	43	-	1	-	-	43
Marking and pitting	43	-	1	-	-	43
Pre-plant termite control	133	-	1	-	-	133
Planting (including seedlings)	260	-	1	-	-	260
Blanking	52	-	1	-	-	52
Post-plant termite control	133	-	1	-	-	133
Post-plant manual weeding (ring hoeing)	23	-	2	2	-	92
Post-plant manual weeding (slashing)	30	-	1	1	-	60
Post-plant chemical weeding	42	-	2	1	1	168
Fire protection	50	-	1	1	1	150
Harvesting (coppicing and pollarding)	110	-	-	-	1	110
Technical management	5	-	1	1	1	15
Total						**1 407**

Source: Authors' elaboration based on Uganda, Ministry of Water and Environment, 2016b.

The tools and equipment required for the training of the refugee and host communities are shown in Annex 6.

7.2 Restoration of degraded land

Degraded land can be restored using different strategies, depending on the practical needs and the socioeconomic and ecological characteristics of the specific site. The overall objective of the recommended restoration intervention is to restore land productivity in order to provide ecosystem services. Table 24 presents the indicative costs for restoring degraded woodland and bushland through natural regeneration and protection measures (see Section 5.2).

Table 24. Indicative costs for the natural regeneration and protection of degraded areas, per hectare, over five years

Operation	Unit cost (USD/ha)	Number of operations per year					Total (USD/ha)
		1	2	3	4	5	
Fire protection	14.2	1	1	1	1	1	71.0
Watching	24.0	1	1	1	1	1	120.0
Tree marking	3.5	1	-	-	1	-	7.0
Surveying	26.6	1	-	-	-	1	53.2
Technical management	3.0	1	1	1	1	1	15.0
Administration	1.5	1	1	1	1	1	7.5
Total							**274.0**

Source: Authors' elaboration based on Uganda, Ministry of Water and Environment, 2016b.

Table 25 provides indicative costs for the restoration of degraded areas through assisted natural regeneration. The farmer-managed natural regeneration approach may be adopted for woodland and bushland. Under this approach, farmers conduct all the activities required to restore the target forest, including rehabilitating areas affected by erosion.

Table 25. Indicative costs for assisted natural regeneration, per hectare, over five years

Operation	Unit cost (USD/ha)	Number of operations per year					Total (USD/ha)
		1	2	3	4	5	
Land preparation	11.3	1	-	-	-	-	11.3
Marking and pitting	6.4	1	-	-	-	-	6.4
Other pre-plant operations	19.7	1	-	-	-	-	19.7
Planting	32.0	1	-	-	-	-	32.0
Survival count	1.8	1	1	-	-	-	3.6
Blanking	6.4	-	1	-	-	-	6.4
Post-planting slashing	4.4	1	1	-	-	-	8.8
Post-planting weeding	6.2	3	2	-	-	-	31.0
Fire protection	14.2	1	1	1	1	1	71.0
Watching	24.0	1	1	1	1	1	120.0
Surveying	26.6	1	-	-	-	1	53.2
Technical management	3.0	1	1	1	1	1	15.0
Administration	1.5	1	1	1	1	1	7.5
Total							**386.0**

Source: Authors' elaboration based on Uganda, Ministry of Water and Environment, 2016b.

Table 26 summarizes the estimated costs for agroforestry interventions at the community level. Agroforestry measures are designed to address the tree cover loss occurred on farmland while also providing ecosystem services. It is important to raise awareness about the benefits of agroforestry.

Table 26. Indicative costs of agroforestry interventions through community centres

Operation	Unit cost (USD)	Number of operations per year		Total (USD)
		1	2	
Establishment	312	1	-	312
Management	26.5	1	1	53
Tree seedlings	80	1	1	160
Providing training (agroforestry experts and outreach)	20	1	1	40
Total cost per community centre (one centre per 30–50 ha under agroforestry)				**565**

Source: Authors' elaboration based on Uganda, Ministry of Water and Environment, 2016b.

7.3 Conservation of intact natural forests

Intact natural forests may be protected from degradation by host and refugee communities through awareness raising and fire protection. Field operations for the protection of natural forests should focus on surveying, monitoring, boundary maintenance (particularly for tropical high forests), fire protection and awareness raising about the need to manage existing natural resources (see Section 5.3).

Table 27. Indicative costs for the conservation of intact natural forests

Operation	Unit cost (USD)	Number of operations per year					Total (USD/ha)
		1	2	3	4	5	
Surveying	25	1	-	-	-	-	25
Boundary maintenance	15	1	-	-	-	1	30
Fire protection	50	1	1	1	1	1	250
Watching	2	1	1	1	1	1	10
Awareness raising	2	1	1	-	-	-	4
Technical management/ administration	5	1	1	1	1	1	25
Total							**344**

Source: Authors' elaboration based on Uganda, Ministry of Water and Environment, 2016b.

7.4 Funding requirements

A summary budget for the implementation of the Forest Landscape Management Plan for the Bidibidi refugee settlement is presented below. The Forest Landscape Management Plan provides a sequenced implementation plan for two time periods, i.e. 2022–2024 and 2023-2028.

Table 28. Funding requirements of the Forest Landscape Management Plan

Intervention	Unit cost (USD)	Planned area (ha)	Year 1	Year 2	Year 3	Year 4	Year 5	Total cost (USD)
Woodlots for energy	1 407	2 786	2 861 222	481 978	576 702			3 919 902
Restoration of degraded forests[a]	330	88	10 397	4 858	3 758	3 912	6 098	29 022
Agroforestry[b]	565	6 771	74 227	21 413				95 640
Conservation of natural forests	344	20 054	1 985 346	1 183 186	1 143 078	1 143 078	1 443 888	6 898 576
Total (USD)			**4 931 192**	**1 691 435**	**1 723 538**	**1 146 990**	**1 449 986**	**10 943 141**

a) Average costs for natural regeneration and for assisted natural regeneration.

b) Total cost per community centre (one centre every 40 ha under agroforestry).

Source: Authors' elaboration based on Uganda, Ministry of Water and Environment, 2016b.

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9. ANNEXES

Annex 1: Nursery plan

The suggested nursery plan for the Bidibidi settlement area considers that it will take at least three months for most of the recommended seedlings to be ready for planting in the field. The nursery plan is based on a planting season in March and April.

Table 1. Nursery calendar for the production of seedlings in Bidibidi

Nursery operation	Months								
	August	September	October	November	December	January	February	March	April
Nursery site preparation	■								
Sourcing of seeds	■								
Construction of beds		■							
Soil collection		■							
Soil mixing			■	■					
Potting			■	■					
Sowing of seeds					■	■			
Shade manipulation				■	■	■			
Watering			■	■	■	■	■	■	■
Weeding			■	■	■	■	■	■	■
Pesticide and fertilizer application			■	■	■	■	■	■	■
Sorting and grading						■	■		
Root pruning						■	■		
Hardening off							■		
Dispatching/planting								■	■

Planting should target the first rainy season of March and April to ensure that seedlings are fully established by the second rainy season of August and September, and thus increase the survival rate during the harsh and long dry spell from November to March.

Annex 2: Tree species and number of recordings from the field inventory, according to land use and land cover class

Tree species	Closed woodland	Open woodland	Bushland and grassland	Cultivated land	Total	Common uses	Remarks
Acacia hockii (common name [Lugbara]: ali)	40	51	11	0	102	Fuelwood, charcoal, medicine (roots), ropes (bark), fencing (dry branches)	The root is used to treat a cough.
Acacia polyacantha	1	2	0	0	3	Fuelwood, timber (roofing, tables, matches, boxes, carvings, musical instruments), live fencing	N/a.
Acacia sieberiana (common name [Madi]: lasa)	1	5	0	0	6	Fuelwood, charcoal, timber, fodder (leaves), tool handles, nitrogen fixation, gum, fencing	The foliage and fruit are good fodder and particularly important in the dry areas of northern Uganda. Trees are often kept in fields for shade.
Antiaris toxicaria (common name [Madi]: ripi)	1	0	0	0	1	Timber (veneer, beer canoes), medicine (leaves, roots), barkcloth	The roots or leaves are used to treat mental illnesses. Individual trees are planted for shade, as avenue trees or as a pure stand.
Balanites aegyptiaca (common name: desert date, [Lugbara and Madi] loba, logba)	0	1	0	0	1	Fuelwood, charcoal, poles, timber (furniture), utensils, tool handles, food (fruit, leaves), medicine (roots, bark, fruit), mulch, shade, windbreak, gum, fencing (branches), oil (fruit), fish poison	An important species for dry areas, as it produces fruit in very dry seasons. Improved varieties exist in India. The wood is termite resistant. The edible fruits are rich in saturated fatty acids and used to produce cooking oil. The leaves are eaten by populations in Adjumani and parts of Teso.[a]
Borassus aethiopum (common name: [Lugbara and Madi]: itu)	0	0	0	1	1	Fuelwood, charcoal, poles, timber (roofing, door frames, etc.), tool handles, beehives, food (fruit, seeds, young seedlings), palm wine (sap of flower shoots), medicine (roots, flowers, oil), fodder (fruit, young leaves), thatch, fibre (leaves), baskets, mats (leaf stalks, leaves), oil (fruit, pulp), brooms, drums	Elephants eat the fruit, thus distributing the species. The wood is hard and resistant to termites and fungi. Populations in the Acholi area eat the first root shoot from the seed. The fruit, which tastes like peaches, can be eaten by humans.
Bridelia scleroneura	0	7	0	0	7	N/a	Medicinal. The wood makes excellent fuel and is termite resistant.

Butyrospermum paradoxum subsp. nilotica *(common name: shea butter tree, [Madi] awa, [Kakwa] komure, [Lugbara] kamiro, komere, komoro)*	0	1	0	0	1	Fuelwood, charcoal, timber, food (seeds), fodder, oil (cooking, soap, candles), shade, ornamental	The sheanut is a vital source of cooking and smearing oil (from the kernel) across northern Uganda, although more so in the Acholi and Langi areas than in West Nile. The fruit is also edible. The tree survives annual fires. The wood is hard and termite resistant, and much sought after for making charcoal.
Celtis oleana *(common name: camdeboo stinkwood, white stinkwood)*	2	0	0	0	2	Fuelwood, charcoal, timber (local construction, farm tools), tool handles, fodder (leaves), shade	The timber rots and splits easily, but it is very strong and with proper seasoning useful for tool handles and building. Leaves are grazed by animals, including cattle, and the leaves and fruits are important in the diet of black-and-white colobus monkeys. The trees not compete with crops, as they create only light shade. Suitable for parks and avenues.
Combretum collinum (common name: [Madi]: otubi)	20	29	9	9	67	Fuelwood, charcoal, medicine (leaves, roots), bee forage, fencing (cut branches), firebreaks	Roots are used to treat diarrhoea and vomiting. Makes very good charcoal. Flowers produce good nectar for honey. Suitable for savannah firebreaks. The hard, durable wood burns well but the living tree is resistant to grass fires.
Combretum fragrans	1	20	7	0	28	N/a	N/a
Combretum ole	3	10	3	0	16	Fuelwood, charcoal, poles, posts, timber (construction), tool handles, medicine (roots, leaves, bark), bee forage, mulch	There are three East African varieties. The hard yellow wood is useful for tools and burns well, producing intense heat. The wood is moderately termite resistant. Medicine from the roots is used for treating hookworm, snakebites, stomach pains, fever, dysentery and leprosy. The charcoal from this species is highly sought after in Uganda and its planting should be encouraged.
Combretum sp.	0	2	3	0	5	N/a	N/a

Dichrostachys sp.	1	2	0	0	3	Fuelwood, charcoal, poles, posts, tool handles, medicine (leaves, roots), fodder (leaves, pods), bee forage, nitrogen fixation, soil conservation, fibre (bark), live fencing, dry fencing	The tree is not planted near houses because it is very thorny. It can be an aggressive weed, has vigorous root suckers and can form a dense thicket. The timber is very heavy and hard but quite small in size. Pounded roots and leaves are used to treat epilepsy. Suitable for planting on degraded soils. The tree can be an indicator of overgrazing in low rainfall areas.
Ficus natalensis *(common name: barkcloth fig)*	1	0	0	0	1	Medicine (leaves), shade, live fencing, barkcloth	Barkcloth used to be made from this tree throughout Uganda. The leaves are used to treat dysentery and sore throats. The tree is also grown as a live fence around homes and at a wide spacing for shade in coffee, cocoa and banana plantations. It is increasingly being used as fodder for zero-grazed cows.
Flueggea virosa	1	0	0	0	1	N/a	In parts of Africa, the slender branches are used to make fish traps. The small fruit is sweet and eaten by people and animals, including birds, when ripe. The roots and fruits are believed to be an effective snakebite remedy. The roots are also used in some African communities as contraceptives and for the treatment of syphilis, gonorrhoea, rheumatism, sterility and rashes, and an infusion of the root is taken to relieve malaria. The bark is believed to provide treatment for diarrhoea and pneumonia.
Gardenia sp.	0	1	0	0	1	N/a	N/a

Grewia bicolor	5	0	0	0	5	Fuelwood, charcoal, timber, tool handles, carving (clubs, javelins, walking sticks), medicine (roots, bark), fodder (leaves, fruit)	Twigs from the tree are used by water diviners to locate underground water. The fruit is edible, sweet and high in iron. It is especially important for pregnant woman.
Grewia mollis *(common name: [Madi] enzu, [Lugbara] nzu, onju)*	1	33	0	8	42	Fuelwood, charcoal, timber, walking sticks, fodder (leaves, fruits), fibre (strings from bark)	Fibres under the bark are made into string for general use and in constructing granaries. The heartwood makes excellent walking sticks and the Acholi use the wood to make spears.
Harrisonia abyssinica	4	0	0	0	4	N/a	N/a
Hymenocardia acida	0	1	0	0	1	Fuelwood, charcoal, poles, medicine (bark, leaves), bee forage, ornamental, fibre (inner bark), oil (flowers, seeds), soap (roots), brooms (from saplings)	A beautiful flowering tree that can be used as an ornamental element in parks and gardens. The wood is pale yellow and is used for bows. The fibres are used for fishing nets, bead strings and thread to sew barkcloth. The roots contain ethyl salicylate and a saponin, making them highly poisonous. An antidote for snakebites and a mixture to treat coughs are prepared from the leaves and an abortifacient from powdered bark. A root infusion relieves toothaches. However, great care must be taken when using these medicinal substances.
Khaya senegalensis (mahogany) *(common name: [Kakwa] kirai, [Lugbara] mario, marigo, [Madi] erie)*	0	3	0	0	3	Fuelwood, charcoal, timber (heavy construction), soil conservation and improvement	Khaya senegalensis is a hardier species than other types of Khaya. It can grow in open savannahs and forests and is suitable for northern and northwestern regions. The timber, which is harder and heavier than that of the other Khaya, can be used for construction of, for example, bridges or railway sleepers. It is also more termite resistant.

Lannea barteri (common name: [Lugbara] odikodi, [Madi] adza)	0	6	1	0	7	Fuelwood, charcoal, utensils (durable mortars), live fencing	A species that should be encouraged in order to improve fuelwood supplies. All types of Lannea are very fire resistant and coppice easily.
Lannea schweinfurthii var. stuhlmannii	1	0	0	0	1	Fuelwood, charcoal, timber (stools, chairs, mortars), food (fruit), medicine (leaves, bark, roots), fodder (leaves)	The species is resistant to fire. The fibrous roots, which are a reddish brown and with a texture similar to that of wool, are used for stuffing pillows. Young branches are very flexible, and the white wood is soft and light.
Lannea sp.	0	1	0	0	1	Fuelwood, charcoal, utensils (durable mortars), live fencing	Planting of this species should be encouraged to improve fuelwood supplies. All types of Lannea are very fire resistant and coppice easily.
Lonchocarpus laxiflorus	0	2	0	0	2	N/a	N/a
Maytenus ovata	1	13	0	0	14	N/a	N/a
Maytenus sp.	0	0	0	0	0	Fuelwood, charcoal, timber (local construction), farm tools, medicine (roots), live fencing, ornamental	The wood is red and heavy. The trees grow easily from seed. Raised as a pure stand.
Piliostigma thonningii *(common name: [Lugbara and Madi] maza)*	0	0	0	1	1	Fuelwood, charcoal, poles, timber (houses), food (pods), drinks (leaves, pods), fodder (pods, shoots), bee forage, medicine (leaves, bark, roots, pods), mulch, soil conservation, ornamental, nitrogen fixation, tannin, dye (pods, seeds, bark, roots), rope (bark, root fibres)	A good tree that can be grown mixed with Annona spp., Grewia spp. and Combretum spp. Competes very little with maize when left in fields and pollarded to reduce shade. The pulp surrounding the seeds is edible and, under famine conditions, the leaves, crushed green pods and seeds can be eaten. Pods and seeds produce a blue dye and roasted seeds a black dye.
Pseudocedrela kotschyi *(common name: [Lugbara] mala, [Madi] ala)*	0	5	0	0	5	Fuelwood, charcoal, timber (joinery), utensils (mortars, etc.), poles, shade, ornamental	A species that is easy to grow in semi-arid savannahs. The timber is attractive, resembling mahogany but harder and heavier and is suitable for high-quality joinery. Mortars are made from the trunks. Can be grown as pure stands, for shade, as an avenue tree or interplanted with mango trees, Cassia spp. and cashew nut trees.

Rhus natalensis	4	1	0	0	5	Fuelwood, timber, utensils, tool handles, food (fruit), medicine (roots, bark, leaves), fodder, oil (seeds), live fencing	A useful tree for semi-arid areas, as it is drought resistant. The wood is heavy, hard and very durable. The seed contains up to 60 percent of a non-drying oil suitable for soap and lubrication. It is also used as body and hair oil and for softening leather.
Senna spp.	0	0	0	2	2	N/a	N/a
Sterculia setigera	0	5	0	0	5	Fibre (bark), beehives (coppice shoots)	Once the bark is removed, the stem dies. The bark is used to make baskets.
Strychnos spinosa (common name: [Madi] lombo)	2	1	0	0	3	Fuelwood, charcoal, timber (furniture, boxes), fodder (leaves), food (fruit), medicine (fruit, leaves, bark, roots), musical instruments (dry fruit shell)	Although the fruit is edible, the seeds are toxic and unripe fruit may also be. The fruits are often eaten by wild animals. The wood is straight-grained and planes well but has not been used much for carpentry in Uganda.
Tamarindus indica (common name: [Madi and Lugbara] iti)	7	0	0	0	7	Fuelwood, charcoal, poles, timber (furniture, boats, general purposes), food (pulp for drink, fruit, spices), fodder (leaves, fruit), medicine (bark, leaves, roots, fruit), mulch, nitrogen fixation, shade, ornamental, windbreak, tannin (bark)	The dark brown heartwood is hard and heavy, well grained and easy to polish. The pulp is rich in vitamin C. It is recommended for homestead planting and along riverbanks.
Terminalia glaucescens	0	0	0	1	1	Fuelwood, charcoal, beehives	Produces excellent charcoal. The timber is yellow–brown, hard, durable, tough and easily worked.
Unknown Lannea	1	0	0	0	1	Fuelwood, charcoal, utensils (durable mortars), live fencing	The planting of this species should be encouraged to improve fuelwood supplies. All types of Lannea are very fire resistant and coppice easily.
Ximenia americana var. americana *(common name: [Lugbara] ochik, [Madi] ichu ilzo, icho)*	0	3	0	0	3	Fuelwood, timber (utensils), tool handles, food (fruit), medicine (roots, bark, leaves), fodder, oil (seeds), live fencing	A useful tree for semi-arid areas, as it is drought resistant. The wood is heavy, hard and very durable. The seed contains up to 60 percent of a non-drying oil suitable for soap and lubrication. It has also been used as body and hair oil and for softening leather.

Ziziphus abyssinica *(common name [Lugbara] ela, [Madi] liria)*	7	0	0	0	7	Fuelwood, charcoal, timber (furniture, interior work, carving), poles, food (fruit pulp and seeds), live fencing, bee forage, dye (bark)	The spiny branches make this plant useful as a protective live fence. The leaves and fruits are used as fodder. The bark yields a cinnamon-coloured dye. The timber is heavy, hard and resistant to termites and borers.

Note: the common names are adapted from **Katende, A.B., Birnie, A. & Tengnas, B.** 1995. Useful trees and shrubs for Uganda: identification, propagation and management for agricultural and pastoral communities. Nairobi, Regional Land Management Unit and Stockholm, Swedish International Development Cooperation Agency.

Annex 3: Site suitability for forestry - checklist for Bidibidi refugee settlement, Yumbe District

Subcounty: .....Parish: .....Village: .....

Plot number: ..... GPS coordinates: ..... N.....E.....

Category	Site suitability description	Unsuitable	Marginally suitable	Moderately suitable	Suitable	Highly suitable
	Class	**V**	**IV**	**III**	**II**	**I**
	Mean annual increment (m3/ha)	**< 15**	**15–25**	**25–30**	**30–40**	**> 40**
	Parameters that limit plantation productivity	**Very severe**	**Severe**	**Moderate**	**Slight**	**Negligible**
Climate	Maximum annual precipitation (mm)	< 600	600–1 000	1 000–1 200	1 200–1 500	> 1500
	Mean annual precipitation (mm)	< 500	500–800	800–1 000	1 000–1 200	> 1200
	Drought (minimum precipitation [mm])	Common (< 400)	Often (400–600)	Sometimes (600–800)	Rarely (800–1 000)	None (> 1000)
	Maximum annual temperature (°C)	< 10	> 40	30–40	25–30	15–25
	Mean annual temperature (°C)	< 5	> 35	25–35	20–25	10–20
	Frost (minimum temperature °C)	Heavy (< 0)	Medium (0–2)	Light (2–4)	Light (4–10)	None (> 10)
	Precipitation distribution (consecutive months)	< 1 month	1–2 months	2–3 months	> 4 months	> 4 months
Soil	Soil depth (mm)	Very shallow (0–250)	Shallow (250–500)	Moderate (500–750)	Deep (750–1 000)	Very deep (1000–1250)
	Soil drainage status	Very poor	Poor	Rapid	Good	Very good
	Moisture availability	Very low	Low	Moderate	High	High
	Mottling	Very distinct	Distinct	Faint	Faint	Nil
	Soil fertility	Very low	Low	Moderate	High	Very high
	Soil texture	Very light	Light	Heavy	Medium	Medium
	Soil structure	Very poor	Poor	Moderate	Good	Very good
	Consistency	Very loose	Loose	Sticky	Moderate	Moderate
	Soil stone content in profile	> 90%	50–90%	30–50%	20–30%	< 20%
Terrain	Slope (%)	35–60%	35–60%	15–35%	< 15%	< 15%
	Slope position	Ridge top exposed to strong winds and shallow	Ridge top	Valley bottom to mid-slope	Valley bottom to mid-slope	Valley bottom to mid-slope
	Surface roughness (boulders, rock outcrop) as a percentage of land surface	> 50%	30–50%	20–30%	10–20%	< 10%
	Altitude (m)	< 800	> 800	> 800	> 800	> 800
Other plants	Indicator spp. performance	Poor	Below average	Average	Good	Excellent
	Natural vegetation cover (natural forest or grassland)	Undisturbed	Slightly degraded	Moderately degraded	Degraded	Severely degraded
Accessibility	Distance from road	Further	Far	Close	Closer	Closest
	Condition of road	Poor	Below average	Average	Good	Excellent
	Distance from settlement	Further	Far	Close	Closer	Closest

Annex 4: Management of, and fuelwood characteristics for, woodlot tree species

<table>
<tr><th>Tree species</th><th>Management and fuelwood characteristics</th></tr>
<tr><td>Eucalyptus camaldulensis</td><td>
<table>
<tr><th>Calorific value (kcal/kg)</th><th>Ash content (%)</th><th>Wood density (kg/m³ at 12% moisture content)</th><th>Annual biomass growth (m³/ha)</th></tr>
<tr><td>4 800</td><td>0.64</td><td>900–980</td><td>30</td></tr>
</table>
Fuelwood: suitable for domestic use and makes good-quality charcoal, although it burns too quickly.

Management: this species is fast-growing and can be managed by coppicing and pollarding. Young trees require protection from termites.
</td></tr>
<tr><td>Eucalyptus (GC) hybrid clones</td><td>
<table>
<tr><th>Calorific value (kcal/kg)</th><th>Ash content (%)</th><th>Wood density (kg/m³ at 12% moisture content)</th><th>Annual biomass growth (m³/ha)</th></tr>
<tr><td>3 991</td><td>0.18</td><td>567–735</td><td>40</td></tr>
</table>
Fuelwood: suitable for domestic use and makes good-quality charcoal, although it burns too quickly.

Management: species is fast-growing and can be managed by coppicing and pollarding. Young trees require protection from termites.
</td></tr>
<tr><td>Gmelina arborea</td><td>
<table>
<tr><th>Calorific value (kcal/kg)</th><th>Ash content (%)</th><th>Wood density (kg/m³ at 12% moisture content)</th><th>Annual biomass growth (m³/ha)</th></tr>
<tr><td>4800</td><td>Unknown</td><td>400–560</td><td>18–25</td></tr>
</table>
Fuelwood: the wood burns quickly, and the charcoal burns well and without smoke, but leaves a lot of ash.

Management: fast-growing and moderately drought resistant once established. G. arborea is planted mostly for fuelwood, at a spacing of 2 × 2 m. Trees coppice well, with vigorous shoot growth. It can be managed by pruning, lopping, coppicing and pollarding (while young). Young trees need protection from livestock.
</td></tr>
<tr><td>Grevillea robusta</td><td>
<table>
<tr><th>Calorific value (kcal/kg)</th><th>Ash content (%)</th><th>Wood density (kg/m³ at 12% moisture content)</th><th>Annual biomass growth (m³/ha)</th></tr>
<tr><td>4 800–4 950</td><td>0.76</td><td>540–720</td><td>25</td></tr>
</table>
Fuelwood: G. robusta is popular for fuelwood and charcoal. The calorific value of sapwood is about 4 800 kcal/kg, while that of heartwood is 4 950 kcal/kg.

Management: moderate- to fast-growing, can be managed by pollarding, lopping, coppicing and pruning. Only young trees coppice well. G. robusta has a deep rooting system and can therefore be successfully intercropped with shallow-rooted agricultural crops.
</td></tr>
<tr><td>Corymbia citriodora</td><td>
<table>
<tr><th>Calorific value (kcal/kg)</th><th>Ash content (%)</th><th>Wood density (kg/m³ at 12% moisture content)</th><th>Annual biomass growth (m³/ha)</th></tr>
<tr><td>4 598</td><td>1–2%</td><td>596–640</td><td>10–21</td></tr>
</table>
Fuelwood: the hard, heavy wood (specific gravity 0.75–1.1) burns steadily and makes good charcoal.

Management: fast-growing species, can be managed by coppicing, thinning and weeding.
</td></tr>
</table>

Corymbia maculata

Calorific value (kcal/kg)	Ash content (%)	Wood density (kg/m3 at 12% moisture content)	Annual biomass growth (m3/ha)
4 670	2.2	790	21–35

Fuelwood: suitable for domestic use.

Management: fire resistant species, although young seedlings are sensitive to fire. The tree coppices well and can survive most forest fires by resprouting from the base.

Melia volkensii and Melia azedarach

Calorific value (kcal/kg)	Ash content (%)	Wood density (kg/m³ at 12% moisture content)	Annual biomass growth (m³/ha)
5 100	Unknown	560–760	18–25

Fuelwood: suitable for domestic use and makes good-quality charcoal, although it burns too quickly.

Management: fairly fast-growing; can be managed by pollarding, lopping, coppicing and pruning.

Moringa oleifera

Calorific value (kcal/kg)	Ash content (%)	Wood density (kg/m³ at 12% moisture content)	Annual biomass growth (m³/ha)
4 600	Unknown	0.5–0.7	Unknown

Fuelwood: soft and light wood, burns smoke-free and is an acceptable fuelwood for cooking, but makes poor charcoal.

Management: extremely fast-growing tree; can be managed by pollarding, coppicing and lopping.

Senna siamea

Calorific value (kcal/kg)	Ash content (%)	Wood density (kg/m³ at 12% moisture content)	Annual biomass growth (m³/ha)
5354	12.93	600–800	20

Fuelwood: the dense wood makes good fuelwood, although the fire is smoky. Its charcoal is of excellent quality.

Management: fast-growing; trees respond well to coppicing. Fuelwood and charcoal plantations can be regenerated by pollarding or coppicing, leaving two to three shoots per stump after one year. This species is not eaten by wild animals.

Azadirachta indica

Calorific value (kcal/kg)	Ash content (%)	Wood density (kg/m³ at 12% moisture content)	Annual biomass growth (m³/ha)
4 978–6 940	Unknown	720–930	15

Fuelwood: the tree provides fuelwood, which is used to produce charcoal. Charcoal made from A. indica wood is of excellent quality.

Management: fast-growing; trees coppice freely and can thus be managed by lopping, coppicing and pollarding.

Pseudocedrela kotschyi

Calorific value (kcal/kg)	Ash content (%)	Wood density (kg/m³ at 12% moisture content)	Annual biomass growth (m³/ha)
Unknown	Unknown	750	10

Fuelwood: the tree provides fuelwood and is used to produce charcoal.

Management: fast-growing and easy-to-grow species for semi-arid savannahs. The species can be managed by pollarding and coppicing. The tree can be grown in pure stands or intercropped with mango trees, Cassia, etc. It is very fire resistant, surviving annual fires.

Gliricidia sepium

Calorific value (kcal/kg)	Ash content (%)	Wood density (kg/m³ at 12% moisture content)	Annual biomass growth (m³/ha)
4 500	4.58	750	4–5

Fuelwood: often used for charcoal production. The wood burns slowly without sparking and produces little smoke.

Management: tolerates fire well, and the trees resprout when the rains arrive. Pruning, coppicing and pollarding are the main management activities. Coppicing can be used to maximize fuelwood production. The tree tolerates lopping and browsing.

Annex 5: General minimum requirements for fire fighting tools and equipment

Item	25–100 ha	101–500 ha	501–1 000 ha	1 001–5 000 ha
Fire beater	4	8	10	20
Rake and hoe	3	6	8	15
Fire knapsack sprayer	2	4	6	10
Axe	2	4	5	6
Bush knife	2	4	5	6
Drip torch	0	0	1	2
Bow saw	1	1	1	2
Chainsaw	0	1	1	2
Torch	1	1	2	4
First-aid kit	1	1	2	4
Bakkie sakkie firefighting unit	1	1	1	2
Bulk water carrier	1	1	2	1
Fire tanker	0	0	0	1

Annex 6: Tools and equipment required to train local technicians

Item	Quantity	Cost/item (USD)	Total cost (USD)
Panga	10	4	40
Pick mattock	10	5	50
Sandvik pruning saw	10	32	320
Sprayer	10	95	950
Measuring tape (60 m)	3	8	24
Marking for pitting cable (80 m)	2	135	270
Billhook (parrot head slasher)	10	27	270
Earth auger	2	189	378
Planting trowel	5	7	35
Sulky	1	486	486
Felling axe	5	14	70
Hand axe	5	8	40
Hollow cone nozzle	10	7	70
Flat fan nozzle	10	7	70
Off-centre nozzle (swivel)	10	14	140
Horizontal spray boom	5	54	270
Spraying apron	10	11	110
Feather-edged file	5	8	40
Fire beater	10	22	220
Rake and hoe	5	38	190
Portable siren	1	135	135
Pocket weather meter (Kestrel 4000)	1	541	541
Suunto hypsometer	5	486	2430
Suunto clinometer	5	486	2430
Diameter tape	10	32	320
Diameter caliper	5	216	080 1
Chainsaw	1	2 432	432 2
First-aid kit	1	135	135
Felling lever	2	162	324
Felling wedge	2	108	216
Combi can	1	189	189

Annex 7: Land use form – template

Consent form: voluntary land contribution for settlement land offered by landlords

Name(s) of Landlord(s)	1.	2.
Village		
Subcounty		
District		
Location of Land		
Village		
Subcounty		
District		
Land tenure system (please tick)	Leasehold ☐ Public ☐ Customary ☐ Freehold ☐ Mailo land ☐	
Land holding size (ha)		
Confirmation of land ownership	I certify that this land legally or traditionally belongs to the following: .... _____ _____ Chairperson LC I Signature _____ _____ Chairperson LC III Signature _____ _____ Chief administrative officer Signature **Witness:** _____ _____ Settlement commandant Signature _____ _____ Refugee desk officer Signature	
Contribution type	Voluntary without compensation	
Period of use	Indefinite Number of years:	
Declaration of landowner(s)	I/We declare that this land belongs to me/us and I/we hereby contribute it voluntarily for a community project _____ _____ Name of landlord Signature _____ _____ Name of landlord Signature	

Name and type of development project	Name: ..... Type: .....
Affidavit of declaration of offer by landlord(s)	I/We declare and transfer land use rights of my/our land to the group without any conditions for the development and implementation of the community development project described above: _____ _____ Name of landlord Signature _____ _____ Name of landlord Signature

Annex 8: Resolution by Yumbe District Local Government to approve Forest Landscape Management Plan for Bidibidi Refugee Settlement

IN ANY CORRESPONDENCE ON THIS SUBJECT PLEASE QUATE NO...

YUMBE DISTRICT LOCAL GOVERNMENT
OFFICE OF THE DISTRICT SPEAKER
P.O. BOX 1 YUMBE UGANDA

22/11/2022

MINUTE EXTRACT FOR THE MINUTES OF 8TH SESSION OF THE 6TH COUNCIL OF YUMBE DISTRICT LOCAL GOVERNMENT HELD AT PRAFORD HOTELON 25TH AUGUST, 2022.

The Council meeting that was held on **25th, August, 2022** at PRAFORD Hotel under Minute Number **YDLG/DC.MIN 383/08/2022 Resolved** through a motion by Hon. Secretary for Finance, Planning, and Administration for the approval of District Forest Land Scape Management Plan for Bidibidi refugee settlement which was seconded by Hon. Male Councilor representing Arilo Sub County.

We hereby certify the above to be a true copy of the Minutes and that this resolution has entered in the Minute Book of Yumbe District Local Government.

FOR CHIEF ADMINISTRATIVE OFFICER
22 NOV 2022
P.O.BOX 1,YUMBE
DISTRICT LOCAL GOV'T

HON: Asiku Kassim
DISTRICT SPEAKER

Drajiga Raoul
ACAO/CLERK TO COUNCIL

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