

# Forests, trees and agroforestry for social resilience: A Case of National Forestry Project “Ewe Burundi Urambaye” in Burundi

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## ABSTRACT

Trees, forests and agroforestry (TFA) are key assets in the socio-economic life of farmers. They are crucial resources for farmers' resilience (*ex ante* and *ex post*) to shocks. This paper investigates the potential for farmer's resilience through the national reforestation project “Ewe Burundi Urambaye” in Burundi. The survey was carried out in four of the country's provinces during 2022. Primary data were collected through semi-structured interviews and focus groups with project coordinators and local communities. Field observation and secondary data complemented the data collection. The reforestation of bare state-owned areas demonstrates a strong potential for restoring the ecosystem and biodiversity (flora and fauna), with positive spin-offs in terms of improving farmers' well-being and resilience. The agroforestry practised is a significant element in income diversification. Participative governance involving all stakeholders is a key to the success of this project in addition to the weeding planted trees and in the education/training of farmers. Investment in the purchase of drones and training of drone users is an added value in the monitoring and evaluation of the project.

*Key words: Biodiversity, Burundi, Ecosystem, Non-timber forest products, Resilience*

## Introduction

Worldwide, it is estimated that 350 million people depend on forests as their primary source of income, food, nutrition and medicine (Ahenkan and Boon, 2010). Forest and tree products, such as timber and non-timber forest products (NTFP) - firewood, wild fruits, mushrooms, roots, leaves, bark, roots, etc. - are important safety nets. They are an integral part of income diversification strategies, especially for many communities in developing countries faced with climate variability and food shortages (Ticktin, 2004; Ruiz Pérez and Arnold, 1995; Quang and Anh, 2006). Farmers extract NTFP to diversify their nutri-

tion and meet a wide range of needs. Sources of income from NTFP are important for poor and/or vulnerable groups living in communities. They are particularly important for those who have unrestricted access to forest resources. In South Africa, poor households have few alternatives, and the use or sale of NTFP is a strategy adopted as a safety net (Paumgarten and Shackleton, 2011; Wunder *et al.*, 2014). Women in southern Nigeria are heavily dependent on NTFP. For many of them, this is the only way to earn their own income. People in Niger derive most of their income from NTFP in the form of food, fiber and medicinal herbs (Bisong and Ajake, 2001). In Malawi, households receiving an increase

in income (through remittances or a good harvest) were less dependent on the extraction of forest products than those who did not benefit from such resources (Fisher and Shively, 2005). In Nigeria, NTFP are crucial sources of income and food supplies, and remain essential to the socio-economic well-being of the population living in rural areas (Chukwuone and Okorji, 2008). In Ghana, NTFP play an important role in reducing poverty, improving nutrition and livelihoods, particularly during the lean season (Ahenkan and Boon, 2010; Anokye and Adu, 2014). Forest products include rattan, straw, bamboo, honey, mushroom, animal and parts like grass-cutter, medicinal plants, hide and skins and many others. It is estimated that 20% of economically active people derive income from NTFP and 38% of households market NTFP. Thousands of people, especially women, are involved in the collection and marketing of NTFP, and for most of them this provides the main source of income (Hoare, 2007). Forest products sold include mushroom, bush meat, snails, honey, leaves, food wrapping leaves, and chewing sticks, medicinal plants, etc. Other products are sold by men such as hides, grass-cutters and skins and other plant products like rattans and bamboo (Ahenkan and Boon, 2010; Anokye and Adu, 2014).

NTFP-based activities can be important in filling seasonal and other food or income gaps, can provide a buffer in times of hardship or emergency, be an activity of last resort, or can present an opportunity for improving household income and security. NTFP are used as seasonal gap fillers, i.e., extraction of products from the wild is higher during intra-annual periods of predictably low incomes, especially between crop harvests and other food or income gaps (Ruiz Pérez and Arnold, 1995; Belcher and Ruiz-Pérez, 2005; Wunder *et al.*, 2014). During and after dry season of 2005-2006 in the semiarid areas of Tanzania, households consumed forest products directly as a part of their food intake, and earned 42% in their total income from selling wild fruits, firewood, timber, and charcoal. In rural areas of Peru, the gathering of forest fruits, palm hearts, and other products is considered as an important strategy for coping with floods. Forest products also play a part in post disaster strategies in Honduras: rural households sold timber and other products to recover from land losses during Hurricane Mitch (Mutenje *et al.*, 2011). Riparian peasant households living in and around the Pacaya-Samiria National

Reserve in Peru, one of the largest protected areas in the Amazon, collect NTFP and fish. This is one of the main strategies after flood shocks (Takasaki *et al.*, 2004).

Idiosyncratic risks (e.g. illness in the family) leading to low production cause households to resort to NTFP by increasing consumption of forest products and/or selling these products to obtain the food needed. In the mountainous regions of Vietnam, economically active households affected by health and weather shocks extracted forest products, particularly firewood. In this locality, NTFP are an important source of income for rural populations living near forests, although the commercialization of collected products is likely to reduce the number of species in the forest (Volker and Waibe, 2010). In Zimbabwe, NTFP extraction is one of the coping strategies used by young, low-income rural households affected by HIV/AIDS. Many of the households responded to HIV-related economic crises by increasing NTFP extraction to smooth both consumption and income. On average, income from NTFP compensated for around 48% of a household's loss of income due to the impact of HIV or AIDS (Mutenje *et al.*, 2011).

On a socio-economic and cultural level, forestry (trees, forests) and agroforestry contribute considerably to the well-being of farmers and to the development of countries. Many forest-dependent communities around the world, including poor rural communities, indigenous people or ethnic minorities, smallholder farmers and pastoralists, rely heavily on informal forest-related activities, such as hunting, gathering or fuelwood collection, as important sources of livelihoods (Gitz *et al.*, 2021). In 2011, FAO estimated that, if considering both formal and informal sectors, the forest sector Gross Value Added (GVA) increased to almost USD 730 billion, including USD 33 billion from informal production for construction or energy and USD 88 billion from Non Wood Forest Products collection (FAO, 2014). For over a century, there has been a tradition of exploiting forest products for commercial purposes in northern Bolivia. Rubber and Brazil nut extraction is combined with subsistence farming, creating an agro-extractive system that supports a surplus lifestyle for forest inhabitants. Almost half of Brazil nut gatherers are currently seasonal migrants, mainly from the cities. Depending on access to land, forest resources and markets, income from extraction can contribute over 50% of overall household

income, particularly in the most remote forest areas (Stoian and Henkemans, 1998). In Malawi, forests play a crucial role: over 90% of the country's energy needs are met by firewood. Forests also supply the nation with poles and most of the wood needed for construction, carpentry and panel-making. Malawi's rural inhabitants, who make up the majority of the population (over 90%), rely heavily on the forests for their needs in fuelwood, bushmeat and other foods, building materials, agricultural tools and medicinal herbs (Chilongo, 2014). In terms of marketing, there is a strong demand for NTFPs from tropical forests - rattan, oils, resins, pharmaceutical extracts, etc. - and there is a strong likelihood that other species and other products of significant industrial value will exist from such a rich and diverse genetic resource - and there is a strong likelihood that other species and products of significant industrial value exist in such a rich and diverse genetic resource (Ruiz Pérez *et al.*, 1995). In the countries of the Congo Basin (Cameroon, Republic of Central Africa, Gabon, Congo Brazzaville, Democratic Republic of Congo and Equatorial Guinea) and more particularly in the humid tropics, NTFPs are extremely important for forest communities in terms of basic livelihoods. NTFPs provide a range of essential resources such as firewood, proteins, raw materials for household items and medicines (Hoare, 2007). In Colombia, the use of NTFPs is rooted in the country's culture in terms of resource diversification (food and income) and pharmacopoeia. NTFPs are used as food in the form of forest fruits or nuts (e.g. wild passion) as well as spices and other essences (e.g. mauby, peppers, vanilla). In other cases, NTFPs provide material for their traditional craft sector (e.g. sisal, calabash, roots, palm leaves). Various tree barks, flowers and resins are used to extract tannins or dyes. The country's poor derive their income from the sale of forest products, either in their natural state or through processing. These are mainly medicinal and aromatic plants, edible products (mainly exotic and natural fruits, bushmeat and bee products), ornamentals, utensils, handicrafts and construction material (John, 2005). In Ghana, the use of medicinal plants is a valid substitute for modern medicine: more than 90% of the sampled population used plant medicine to cure various ailments, including malaria, typhoid, fever, diarrhoea, arthritis, rheumatism, and snake-bite (Ahenkan and Boon, 2011).

In Burundi, the majority of artificial and natural

woodland has been lost to bush fires, the ever-increasing demand for wood products and the expansion of agricultural land. Farms have replaced the majority of natural forests. According to the Forest Resources Assessment (2010), Burundi lost 40.5% of its forest cover between 1990 and 2010. One of the largest remaining forested areas is the Kibira National Park, with the richest ecosystem biodiversity (Nduwamungu, 2011). Deforestation is a major threat to Burundi's ecosystem and biodiversity, jeopardizing the generation and supply of wood and non-wood products (mushrooms, fruit, honey, etc.). Protected areas that are not forested are normally considered as afforestation sites in the country. This paper aims to investigate the possibilities of strengthening the resilience (of rural and urban) households through tree planting and agroforestry undertaken by the National Forestry Project "*Ewe Burundi Urambaye*" program.

#### **National Forestry Project "*Ewe Burundi Urambaye*"**

The national forestry project "*Ewe Burundi Urambaye*" is an initiative of the Presidency of the Republic of Burundi and the Ministry of National Defense and Veterans Affairs of Burundi (MDNAC). The project is coordinated by the MDNAC through the Burundi National Defense Force (FDNB), in collaboration with other ministries including the Ministry of Public and Civil Security (MINISEC), the Ministry of the Civil Service of Burundi (MFPB), the Ministry of the Interior (MININTER), the Ministry of Water, the Environment, Spatial Planning and Urban Development (MINEEATU) and the Ministry of Agriculture and Livestock (MINAGRI). For better implementation of this project, these different ministries are mobilizing the various authorities under their authority in a hierarchical manner. For the MDNAC, the FDNB mobilizes the military regions. The latter mobilize the brigades and brigades in turn mobilize the battalions. The MININTER mobilizes provincial governors. The latter mobilize communal administrators. MINAGRI mobilizes the Provincial Departments of Agriculture and Livestock (DPAE) and MINEEATU mobilizes the foresters, etc. This hierarchical structure ensures better coordination of all stakeholders involved in the project, including the local community.

The "*Ewe Burundi Urambaye*" national reforestation project is designed to protect the environment

in the face of overexploitation of national forest resources. The intervention zone mainly concerns degraded areas throughout the national territory, in order to contribute to the regeneration of the ecosystem and ecology. The aim of the project is to improve the social, economic and environmental conditions of the country's population. To achieve this goal, objectives have been set, including increasing wooded areas, timber production and income-generating resources; stabilizing river banks and protecting existing natural forests; and promoting tourism. The reforestation project involves the planting of 21,000,000 shrub seedlings throughout the country, including city centers. The project will run for seven years (2017-2023). These tree seedlings must first be developed in germinators and nurseries before being replanted. Shrubs include agroforestry species associated with food crops and other tree species intended for planting only on bare state land. Agroforestry trees include *Grevillea*, *Maesopsis* and fruit trees such as *Mango*, *Avocado*, *Mandarin*, *Beefheart*, *Phoenicia*, *Calliandra*, *Jacquier*, etc. These species are distributed free of charge to farmers and to primary and secondary schools. In the city of Bujumbura, and mainly along the roads, the main species planted are false *Mango* and fruit trees, including *Avocado*, *Eucalyptus*, *Cassia*, *Callitris*, etc. are planted in bare state-owned areas. Other species for state-owned areas are bamboos planted along rivers. For this, farmers must leave 6 meters and 15 meters of river banks for small and large rivers respectively.

## Materials and Methods

The study was carried out by collecting primary and secondary data. Secondary data were collected by consulting documents and reports produced in the country. These were mainly documents that shed light on the current state of the country's forests and forest products (timber and non-timber). Primary data were collected in 4 randomly selected provinces - Kirundo, Rumonge and Bujumbura - of the country's 18 provinces during the year 2022. The data are based on semi-structured interviews with project coordinators, local authorities and farmers actively involved in reforestation through the "Ewe Burundi Urambaye" national reforestation project. Project coordinators were mainly questioned about the project's genesis, the difficulties they faced during project implementation, the tree species to be planted, the project's objectives and the project's

expected impact both nationally and on local communities. With regard to the local population, data was collected by means of semi-structured interviews during the planting of shrub seedlings in state-owned areas and/or during the distribution of agroforestry trees. Interviewees were randomly selected on the basis of age (over 50 years was our preference). This age criterion was chosen because the farmers could easily compare the present and the past in terms of forest species, plants and forest products that have disappeared, exist and/or are on the verge of extinction. The local population surveyed included both men and women. The information most sought from the local community was whether they expected the reforestation project to improve their well-being in the long term, or whether it was simply a matter of carrying out orders from the hierarchical authorities. The individual information was compared with the information gathered through the focus group. The aim was to check whether the individual information corroborated with the focus group information. An observation technique was also of crucial importance. Field observation enabled us to observe the landscape of the national territory. This gave us an idea of the real state of the country's ecosystem, biodiversity and agroforestry, compared with the secondary and primary data collected through interviews. Observation also enabled us to analyze the atmosphere that prevailed among the project's stakeholders (project coordinators, local authorities and farmers) during reforestation activities, an inspiration of the type of governance that underpins the interrelationships of stakeholders in the said project. Data were collected using Kobb collect software. They were analyzed and discussed.

## Results and Discussion

In Burundi, wood and non-wood timber make a significant contribution to the livelihoods of both urban and rural dwellers. Wood has many uses. It is used for service and timber (planks and poles for house building), cooking building materials (bricks and tiles), wood energy in agri-food processing (processing the green leaf of the tea plant, in bakeries, etc.), as guardianship and shade, the use of firewood and charcoal in urban and rural households for cooking food. These many uses of wood make it an inexhaustible source of income for those who own it. In the country, farmers with limited means of subsis-

tence who rely on the sale of firewood and charcoal as a resilience strategy in times of stress live in ecologically fragile areas. This dual combination of low ecological resilience and economic vulnerability brings into play the temporal dimension of environmental risk management (deforestation, erosion, climate change). In the long term, dependence on charcoal as a coping strategy for household shocks results in deforestation (Deweese, 2013). Faced with the absence of hydroelectric power in rural areas, farmers resort to firewood and charcoal as energy sources. The scarcity of firewood puts some households under stress when cooking - they gather banana straw, crop residues or biomass, a delicate situation especially during rainy periods. In Burundi, and particularly in rural areas, it's the women who look after firewood in households. Mainly from *Eucalyptus* and *Callitris*, households use firewood from their own plantations, family plantations, third-party plantations or state plantations. In state-owned plantations, farmers pick up fallen dry branches or young children do the pruning - climbing trees and removing dry branches. It is strictly forbidden to cut down trees on a state-owned plantation, under penalty of fine. The acquisition of firewood from others is by purchase or free of charge, depending on the friendly ties between the two parties. In the case of family plantations, family members agree on how the plantation is to be managed, to prevent misuse. The planting of trees through the "Ewe Burundi urambaye" project provides an opportunity to obtain firewood by collecting tree branches and/or pruning for cooking, in addition to the erosion control regularly mentioned by local communities. With the country's demographic pressure, very few households have their own plantations or family tree plantations.

Although no statistics are available, surveys and field observation have revealed a gradual disappearance of forest products, including wild fruits (guava, avocado, citrus, Japanese plum, etc.), termites, edible and inedible mushrooms, reptiles (snakes, mammals), etc., in state-owned and privately-owned areas. It is only the people living close to the protected areas, in particular near the Kibira forest, who benefit from forest products. They consume and/or sell them precisely at Bugarama, an area located close to the national road (RN1), which benefits from a national and regional customer base. Other areas

Annexe 1. Summary table of nursery preparation 2019-2020

Provinces	Eucalyptus	Grivellia	Cassia	Maesopsis	Callitris	Bamboos	Mango	Avocados	Mandariners	Total
Bubanza	125000	20000	0	9000	0	0	0	0	0	154000
Bujumbura Mairie	0	0	0	0	0	7200	2500	0	8500	18200
Bujumbura	142500	10000	45000	0	0	0	0	0	0	198900
Bururi	125000	10000	0	0	125000	0	0	0	0	260000
Cankuzo	750000	15000	0	0	250000	0	0	5000	0	1020000
Cibitoke	175000	20000	0	0	0	8000	5000	0	5000	213000
Gitega	325000	15000	0	0	0	0	0	2000	0	342000
Karusi	200000	15000	0	0	125000	0	0	0	0	340000
Kayanza	137500	20000	0	1500	0	4000	0	0	0	163000
Kirundo	100000	10000	0	0	0	12000	0	0	0	122000
Makamba	125000	5000	30000	0	0	0	0	0	0	160000
Muramvya	375000	10000	0	0	0	0	0	0	0	385000
Muyinga	162500	25000	0	7500	200000	2000	0	0	0	397000
Mwaro	137500	20000	0	0	0	0	0	0	0	157500
Ngozi	125000	10000	0	0	125000	12000	0	0	0	272000
Rumonge	25000	5000	135000	0	0	0	0	0	5000	170000
Rutana	0	5000	0	0	500000	0	0	0	0	505000
Ruyigi	250000	20000	0	0	250000	0	0	0	0	520000
Total	3280000	235000	210000	18000	1575000	46600	7500	7000	18500	5397600

Annexe 2. Summary table of nursery preparation 2020-2021

Provinces	Eucalyptus	Grivellia	Cassia	Maesopsis	Callitris	Bamboos	Mangos	Avocados	Oranges	Mandamiers	Total
Bubanza	62500	5000	0	5000	0	0	0	0	0	0	72500
Bujumbura Mairie	0	0	0	0	0	11375	1000	0	3500	4500	16875
Bujumbura	92500	5000	60000	0	0	11900	0	0	0	0	169400
Bururi	325000	10000	0	0	62500	0	0	0	0	0	397500
Cankuzo	437500	0	0	10000	150000	0	0	5000	0	0	602500
Cibitoke	62500	5000	0	10000	0	7000	3000	0	0	5000	92500
Gitega	312500	10000	0	5000	0	0	0	0	0	0	327500
Karusi	137500	10000	0	0	37500	0	0	0	0	0	185000
Kayanza	312500	5000	0	10000	0	3500	0	0	0	0	331000
Kirundo	125000	5000	40000	15000	37500	7000	0	0	0	0	229500
Makamba	437500	10000	60000	5000	0	0	0	0	0	0	512500
Muramvya	62500	0	0	25000	0	7000	0	0	0	0	94500
Muyinga	12500	0	3000	5000	0	10850	0	0	0	0	31350
Mwaro	50000	10000	0	3000	12500	0	0	0	0	0	75500
Ngozi	375000	10000	0	0	0	31325	0	0	0	0	416325
Rumonge	12500	5000	3000	25000	0	0	0	0	4020	4400	49900
Rutana	250000	5000	0	5000	500000	0	0	0	0	0	760000
Ruyigi	187500	0	0	15000	187500	0	0	0	0	0	390000
Total	3255000	95000	166000	138000	987500	89950	4000	5000	7520	13900	4754350

near the Kibira forest are landlocked, which hinders the marketing of these products. In some areas, cultural restrictions prevent the collection and consumption of forest products. The reforestation of the country is accompanied by a regeneration of NTFP. Some inhabitants are not subject to cultural restrictions, and therefore benefit from the collection, consumption and sale of these products. Consumption is either part of dietary diversification or can constitute the main meals, particularly during lean periods when mealtimes are reduced to twice or even once a day for some inhabitants.

Some plant species of crucial importance to the country's farmers are becoming increasingly extinct. Plant species such as the ferns *Pteridium aquilinum*, *Cyperus latifolius*, grasses, etc. are disappearing in areas devoid of forest trees. These decomposing plant species are an organic manure that promotes good crop production. These plant species decompose easily and completely, and the soil has no further need for mineral fertilizer to be fertile. Thanks to their decomposition, ferns and grasses are preferred for bedding in domestic animal stables. Currently, some farmers use *Eragrostis* in their cowsheds, a constraint for them as *Eragrostis* decomposes neither in the cowsheds nor in the fields. These species (*Pteridium aquilinum*, *Cyperus latifolius* and grasses) are therefore inputs that promote resilience by increasing agricultural production for farmers living in rural areas, especially as arable land is becoming increasingly infertile due to an over-exploitation. Increased production through these plant species benefits the country's economy as a whole. In fact, food prices have soared as a result of lower productivity in addition to the demographic pressure. The use of lime and/or chemical fertilizers can complement organic fertilizers to increase soil fertility. However, its use is reserved for farmers who have the financial means to acquire it. In addition, chemical fertilizers should only be used at a certain dosage, to avoid undesirable effects on ecosystem and biodiversity (Rebulard, 2018). The regeneration of extinct plant species can therefore be achieved by reforesting denuded areas. The permanent stabling measure is an added value to boost, regenerate and develop extinct species. The practice of agroforestry (the association of food crops with shrubs that are

not harmful to them) has intrinsic advantages. The association of food crops with agroforestry species (*Grevillea robusta*, *Calliandra*, *Leucaena*, fruits) is of twofold benefit. Ecologically, the association of these species with food crops enables soil conservation, avoiding environmental degradation and controlling erosion, diseases and pests (Singh *et al.*, 2019). These species - e.g. *Grevillea* - have multiple functions: they act as mulch and shade, thereby improving fertility and soil and water conservation. In economic terms, these species enable income diversification. They are perennial cash crops, mainly for the project's fruit trees (beef hearts, mandarins, oranges and avocados). They are likely to generate income for future generations. Some species (e.g. *Calliandra*) can also be used to feed livestock, especially since a permanent stabling measure has been introduced in the country since 2021 for farmers who do not have enough grazing space. Although the practice of agroforestry offers intrinsic economic and environmental benefits, some farmers are unaware of it. Some farmers who had been lucky enough to exploit the state-owned areas deliberately refused to combine agroforestry trees with crops. They planted them but uprooted them as soon as the project coordinators left. There are various reasons for refusing to combine food crops with agroforestry trees. Some farmers consider that combining agroforestry trees with food crops leads to lower production and/or productivity. Some claim that these trees consume nutrients intended for food crops, while others claim that the trees prevent crops from receiving sufficient light. So, to tackle this bad practice, these farms were then given to other farmers on condition that they combined food crops with agroforestry trees. Mandating farmers to practice agroforestry calls into question the management and investment decisions of family farmers. Indeed, some of these agroforestry trees require special care and protection - the policy of planting fruit trees (e.g. avocado trees) in state-owned areas in 2008 - was not so successful. The role of agronomists and trainers is therefore decisive in informing rural farmers of the importance of agroforestry and of species harmful to food crops. The free distribution of agroforestry trees to primary

Annexe 3. Summary table of nursery preparation 2021-2022

Provinces	Eucalyptus	Grivellia	Cassia	Maesopsis	Callitris	Bamboos	Phenecies	Cœur De Bœufs	False Mangos	Avocados	Mandar-niers	Total
Bubanza	112500	15000	15000	3000	0	2210	0	0	0	0	0	147710
Bujumbura Mairie	0	0	0	0	0	12750	0	0	2500	0	0	15250
Bujumbura	50000	0	24000	0	12500	8330	0	0	0	0	0	94830
Bururi	287500	10000	0	3000	0	0	0	0	0	1000	0	301500
Cankuzo	387500	10000	0	0	50000	0	0	0	0	2000	0	449500
Cibitoke	250000	0	3000	15000	12500	3060	0	0	0	0	0	283560
Gitega	162500	5000	0	3000	0	3000	0	0	0	1000	0	174500
Karusi	200000	15000	0	0	0	0	0	0	0	500	0	215500
Kayanza	87500	5000	0	0	25000	3740	0	0	0	0	0	121240
Kirundo	100000	5000	45000	3000	150000	2040	1000	0	0	0	0	306040
Makamba	212500	10000	15000	0	62500	0	0	0	0	0	1000	301000
Muramvya	175000	5000	0	15000	0	4420	0	0	0	1000	0	200420
Muyinga	87500	5000	15000	0	0	1360	0	1000	0	0	0	109860
Mwaro	100000	5000	0	0	25000	3400	0	0	0	500	0	133900
Ngozi	125000	10000	0	0	125000	6800	0	0	0	1000	0	267800
Rumonge	87500	5000	33000	15000	0	0	0	0	0	0	1000	141500
Rutana	187500	5000	0	3000	62500	0	0	0	0	0	0	258000
Ruyigi	150000	0	0	6000	300000	0	0	0	0	1000	0	457000
Total	2762500	110000	150000	66000	825000	51110	1000	1000	2500	8000	2000	3979110

Annexe 4. Summary table of nursery preparation 2022-2023

Provinces	Eucalyptus	Grivellia	Cassia	Maesopsis	Callitris	Bamboos	Jacquiers	Calliandra	Avocados	Aligned Trees	Total
Bubanza	75000	0	3000	30000	0	3400	3000	3000	0	0	117400
Bujumbura Mairie	0	0	0	0	0	16490	1000	0	0	0	17490
Bujumbura	112500	0	3000	0	0	9350	1000	0	0	0	125850
Bururi	75000	0	0	25000	112500	0	2000	0	0	0	214500
Cankuzo	37500	0	0	20000	187500	0	3000	0	1000	0	249000
Cibitoke	125000	0	0	18000	0	0	1000	3000	0	0	147000
Gitega	112500	0	0	6000	0	5100	2000	0	0	0	125600
Karusi	137500	10000	0	25000	50000	0	3000	0	2000	0	227500
Kayanza	75000	0	0	1000	25000	3400	2000	0	1000	0	107400
Kirundo	187500	0	9000	20000	0	2550	0	0	0	0	219050
Makamba	187500	0	0	5000	100000	0	2000	0	1000	0	295500
Muramvya	200000	0	0	10000	0	2550	2000	3000	0	0	217550
Muyinga	37500	0	0	0	37500	0	3000	0	0	1750	79750
Mwaro	53000	0	0	20000	12500	0	2000	6000	500	0	94000
Ngozi	50000	0	0	0	0	7650	2000	0	0	0	59650
Rumonge	50000	0	12000	35000	0	0	3000	0	0	0	100000
Rutana	237500	0	0	10000	0	850	3000	0	0	0	251350
Ruyigi	150000	0	0	5000	25000	0	2000	0	0	0	182000
Total	1903000	10000	27000	230000	550000	51340	37000	15000	5500	1750	2830590

and secondary schools enhances the well-being of learners by providing shade, and improves their means of earning a living, especially as the heads of these schools have low budgets for procuring fruit.

Planting trees in the city absorbs carbon dioxide from industry and provides positive externalities for city residents exposed to pollution. The country's economic capital - Bujumbura - has fairly high temperatures, hovering around 29° on average throughout the year. False mango and fruit trees - avocado trees - planted in this city have a positive impact in regulating the climate and the often extreme temperatures; the temperature reduction oscillating between 2.7 and 3.3 °C with mature tree canopies (Pramova *et al.*, 2011). Fruit trees improve the means of subsistence. Trees planted in the city reinforce the action of trees and grass planted by some local residents, whose effects in terms of shade and temperature reduction remain insufficient.

Bamboos, planted mainly along riverbanks, protect riverbanks from floods and rising waters that wash away land and market garden crops. The province of Kirundo, and more specifically the commune of Nyamurenza and Marangara, justify the intrinsic value of bamboos in the fight against erosion. Initially, the bamboos grown along the Kanyaru river in the above-mentioned communes were uprooted by the farmers. In fact, leaving 6 meters and 15 meters at each end for small and large rivers respectively is a constraint for farmers with less than one hectare of arable land. They see in this measure the loss of arable land as a result of the country's demographic pressure. In addition, bamboos are shrubs that multiply rapidly, resulting in the loss of arable land in their vicinity. Another threat cited by farmers is that bamboo trees are likely to harbour predators - birds - and pests harmful to food crops (beans, maize, peas, etc.). When heavy rains caused the loss of some 15 hectares of arable land, farmers have seen the necessity for bamboos. Faced with this shock, the farmers replanted them. The farmers had observed and noted that the bank of the Kanyaru river, located on the Rwanda side of the Burundi bor-



der, had not eroded during these natural shocks (high water & flooding), thanks to the bamboos planted along the banks.

Reforestation through the project represents an opportunity to boost the multiplication of medicinal herbs and other therapies derived from animal skins. These therapies are mainly supplied from protected areas - the Kibira forest. This supply is insufficient. Given the scarcity of these medicinal herbs, low-income households have little access to these therapists, and for some households, the use of traditional medicines precedes modern medicine. Local communities have to buy these medicinal products from neighbouring countries such as the Democratic Republic of Congo and Tanzania, which have fairly dense forests. Reforestation through the country's project will regenerate medicinal herbs. Local communities will be able to replenish their supplies in areas not far from the country, reducing transaction costs.

Safeguarding peace and national security in Burundi has positive ecological, economic, political and social impacts. Bushfires during socio-political crises have contributed to the disappearance of flora and fauna. These crises led to civil disobedience, the main cause of bushfires in state-owned forests. During socio-political crises, trees were cut down or destroyed to clear areas where rebels were supposed to be hiding, or to destroy enemy hideouts. Other farmers took advantage of the crisis and arbitrarily exploited forest areas. All these acts call into question the resilience of rural inhabitants who are likely to benefit directly or indirectly from forest products. Reforestation throughout the country in times of peace reinforces the restoration of ecosystems and biodiversity. Moreover, in the current context of climate change, trees can store carbon in the form of biomass (above or below ground) and in the form of organic content in the soil (Rebulard, 2018).

Some factories are energy-intensive in terms of the heat energy derived from forest trees. One example is the Burundi Tea Office (OTB), which transforms green leaf into black tea. The huge consumption of heat energy is mainly due to the drying operation, which aims to break the temperature of the fermented tea, to fix its properties and to obtain the black tea itself. This operation, which completely halts the oxidation process, is the most energy-intensive phase. During this phase, firewood is essential. *Eucalyptus* is the most widely used because of its high calorific value (temperatures can reach 150°C).

Trials to use energy from vegetal biomass (peat) to replace firewood did not produce the expected results. A total of 920 steres are used to produce around 227 tonnes of dry tea, i.e. 4 steres/tonne of dry tea. OTB factory has his own tree plantations, but not in sufficient quantities - it sometimes obtains wood from private sector. In the areas where the tea factories are located, there is a steady deforestation of village areas to meet the growing need for firewood and/or the quest for income resources through the sale of trees to the factory or to private individuals wishing to satisfy construction needs. Other factories in the country (e.g. FOMI) use firewood - *Eucalyptus* - in the process of transforming inputs into outputs. Artisanal bakeries, while having positive effects in terms of entrepreneurship for unemployed young people, require the use of trees for baking. The use of wood in tea processing leads to deforestation in the long term, the consequences of which are erosion, drought, loss of biodiversity, food insecurity, etc. A tree and forest management policy is therefore essential, especially for industries setting up in Burundi, which need to use heat energy from trees to process raw materials. Despite the fact that wood needs are being met by factories through reforestation, all factories should invest in reforestation rather than buying trees planted by public authorities, such as those provided by the national reforestation project, or by private companies. The supply of wood, subject to ever-increasing demand, could therefore contain a significant proportion of demand. In addition, an improvement in the natural ecosystem would result.

Another factor linked to growing wood consumption is large-scale urbanization, which requires the use of wood and people living in these houses use large quantities of charcoal, which amplifies deforestation. Minimizing the use of wood as a source of heat energy for households is quite essential. Initiatives to produce charcoal from biodegradable waste do exist, but are less developed. Public authorities should support such initiatives in order to develop entrepreneurship, but also to make users more resilient, especially as the costs associated with charcoal use continue to rise. Public authorities can also exploit other means of limiting deforestation, such as the use of biogas, a practice highly developed in neighbouring Rwanda. The quality of the trees planted has a significant influence on the restoration, maintenance and/or disappearance of water. The farmers interviewed pointed to the existence of

certain tree species that are responsible for the disappearance of plant species (grasses) and the gradual disappearance of water in the areas where they have been planted. In the light of these experiences, the farmers were very appreciative of the reforestation carried out using forest species well known for their non-harmfulness to the vegetative species.

Forest governance is a tool for regulating the use, access, management and conservation of forest resources through a social approach, taking into account the social, economic and governmental interests of all stakeholders. Forest governance encompasses agreements (written and/or verbal) aimed at achieving objectives accepted by stakeholders, based on rules and standards, the rights and obligations of owners, how to participate in the decision-making process, accountability, etc. (Aguilar-Martinez and Valtiera-Pacheco, 2021). To optimize the full benefits of the project, enhanced forest governance is essential. The forest governance of the “*Ewe Burundi Urambaye*” project will produce positive effects if it is a participative governance. The ban and/or fine mentioned above take second place to a participatory approach to the sustainable management of ecosystem and biodiversity. The country’s rural population, with its low level of education - generally primary school level - does not at first understand the value of these formal bans on arbitrary forest exploitation (Nduwamungu, 2011). Community management of forest resources is a concern shared by government departments, rural populations who are the direct beneficiaries of these resources, and all other stakeholders. The free distribution of agroforestry seedlings to farmers on their own initiative demonstrates the empowerment and responsibility of family farms in decision-making on improving and diversifying their means of subsistence and income. The use of coercive means against rural inhabitants who do not understand the intrinsic benefits of trees - e.g. in Rumonge, the uprooting of agroforestry trees planted in state-owned areas - reflects a lack of awareness and training. Instead of imposing punishments on those who do not associate agroforestry trees with food crops, and giving state-owned arable land to those who agree to associate them with food crops, training in the intrinsic advantages of associating species that are not harmful to food crops should precede sanctions. For training/education, sketches for the benefit of the population with a low level of education are effective

tools. Gifts (loincloths, T-shirts) given to farmers who actively participate in reforestation work through the project are excellent incentives. Complementary means of raising awareness, such as radio, television, telephone messages, etc., should be exploited. The social, economic and environmental role of trees should be emphasized at regular weekly local authority meetings.

## Conclusion

Through agroforestry and/or forestry, trees are the guarantors of the economic, social and environmental life of the country’s inhabitants. On a socio-economic level, trees are a key factor in improving the well-being of farmers by providing them with food and financial resources. In environmental terms, trees play a key role in soil conservation, water catchment, carbon sequestration and recreational values. This article investigates the expected effects of the country’s reforestation through the ‘*Ewe Burundi Urambaye*’ project in terms of improving the living conditions of the country’s inhabitants. Through this project, it is possible to restore the natural ecosystem and biodiversity in denuded state-owned areas over the medium and long term. Farmers could therefore benefit from resources derived from wood and NTFP. In addition, agroforestry is a means of diversifying income, and to some extent provides income for generations. This project will be more profitable if certain measures are implemented. Planted trees must be maintained (weeding, protection, etc.). Participatory governance across all stakeholders is a key to success, in combination with farmer training. In these training sessions, the rights and obligations of the local community must be clearly defined. All factories that use wood as a raw material need to give a substantial boost to tree planting. Reducing the use of charcoal in households by exploiting other energy sources would also prevent deforestation in private areas. The use of drones in the country is still in its infancy. Investment in the purchase and training of drone users is a plus in the monitoring and evaluation of the national project.

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## References

- Aguilar-Martinez, S. and Valtiera-Pacheco, E. 2021. Composed indicator of community forest governance in San Miguel Topilejo, Mexico City. *Forests*.
- Ahenkan, A. and Boon, E. 2010. Commercialization of non-timber forest products in Ghana: Processing, packaging. *Journal of Food, Agriculture & Environment*. 8 (2): 962-969.
- Ahenkan, A. and Boon, E. 2011. Improving Nutrition and Health through Non-timber Forest Products in Ghana. *Heath Popul Nutr*. 29(2): 141-148.
- Anokye, R. and Adu, G. 2014. The Status of Non-Timber Forest Products (NTFPs) Development in Ghana. *Journal of Environmental Science, Computer Science and Engineering & Technology*. 3 (1): 144-155.
- Belcher, M. and Ruiz-Pérez, M. 2005. Global Patterns and Trends in the Use and Management of Commercial NTFPs: Implications for Livelihoods and Conservation. *World Development*. 33 (9): 1435-1452.
- Bisong, F. and Ajake, A.O. 2001. An economic analysis of women's dependence on forest resources in the rain forest communities of southern Nigeria. *Global Journal of Pure and Applied Sciences*. 7(2): 345-350.
- Chilongo, T. 2014. *Forests and Livelihoods in Malawi: Looking Beyond Aggregate Income Shares*. Thesis at School of Economics and Business Norwegian University of Life Sciences.
- Chukwuone, N. and Okorji, C.E. 2008. Willingness to pay systematic management of a community forests for conservation of non timber forest products in Nigeria's rainforest region: Implication for poverty alleviation. Dans R. Dellink, & A. Ruijs (eds.). Nigeria: Springer.
- Deweese, P. 2013. Forests, trees and resilient households. *Unasylva*. 64 (2): 46-53.
- FAO, 2011. *Burundi: Forestry management practices*.
- FAO, 2014. *State of the World's Forests. Enhancing the socio-economic benefits from forests*. Italy: Rome.
- Fisher, M. and Shively, G.E. 2005. Can income programs reduce tropical forest pressure? Income shocks and forest use in Malawi. *World Development*. 37(7): 1115-1128.
- Gitz, V. 2021. Contribution of forests and trees to food security and nutrition. *Research Program on Forests, Trees and Agroforestry*. 5: 1-28.
- Hoare, A. 2007. *The use of non timber products in the Congo Basin: Constraints and Opportunities*. London: United Kingdom: The Rainforest Foundation Imperial Works.
- John, L. 2005. *The potential of non timber forest products to contribute to rural livelihoods in the Windward islands of the caribbean*. Caribbean natural Resources Institute. CANARI Technical Report n° 334.
- Mutenje, M.J., Ortmann, G.F. and Ferrer, S.R. 2011. Extraction of non-timber forest products as a coping strategy for HIV/AIDS-afflicted rural households in south-eastern Zimbabwe. *African Journal of AIDS Research*. 10(3): 195-206.
- Nduwamungu, J. 2011. *Plantations Forestières et Ilots Boisés au Burundi*. African Forest Forum. Working Paper Series. 1(11): 76.
- Paumgarten, F. and Shackleton, C.M. 2011. The role of non timber products in household coping strategies in South Africa: The influence of household wealth and gender. *Population and Environment*.
- Quang, D. and Anh, T.N. 2006. Commercial collection of NTFPs and households living in or near forests : Case study in Que, Con Cuong and Ma, Tuong Duong, Nghe An, Vietnam. *Ecological Economics*. 65-74.
- Rebulard, S. 2018. *Le défi alimentaire: Ecologie, Agronomie et avenir*. Paris: Belin Education.
- Ruiz Pérez, M. and Arnold, J.E.M. 1995. Current Issues in Non Timber Forest Products Research. *Proceedings of the Workshop "Research on NTFP"* (p. 275). Zimbabwe: Center for International Forestry Research (CIFOR).
- Singh, R. 2019. Feasibility of rubber and tea intercropping during immature phase of rubber. *Int. J. Curr. Microbiol. App. Sci*. 8 (3): 173-179.
- Stoian, D. and Henkemans, A.B. 1998. Between Extractivism and Peasantry: Differentiation of Rural Settlements in the Bolivian Amazon. *International Tree Crop Journal*.
- Takasaki, Y., Barham, B.L. and Coomes, O.T. 2004. Risk coping strategies in tropical forests: floods, illnesses, and resource extraction. *Environment and Development Economics*. 9: 203-224.
- Ticktin, T. 2004. The ecological implications of harvesting non-timber forest. *Journal of Applied Ecology*. 4: 11-21.
- UNEP, ADB and UNECA, 2019. *Climate Change Impacts on Africa's Economic Growth*. African Development Bank. V., G. e. (s.d.).
- Volker, M. and Waibe, H. 2010. Do rural household extract more forest products in times of crisis? Evidence from the mountainous uplands of Vietnam. *Forest Policy and Economics*.
- Wunder, S., Börner, J., Shively, G. and Wyman, W. 2014. Safety Nets, Gap Filling and Forests: A Global-Comparative Perspective. *World Development*. 64: S29-S42.