A PLATFORM FOR STAKEHOLDERS IN AFRICAN FORESTRY

FOREST PLANTATIONS AND WOODLOTS IN BURUNDI

AFRICAN FOREST FORUM WORKING PAPER SERIES

VOLUME 1

ISSUE 11, 2011

African Forest Forum
P.O. Box 30030 00100 Nairobi GPO KENYA
Tel: 254 20 7623900
Fax: +254 20 30677-00100
www.afforum.org

FOREST PLANTATIONS AND WOODLOTS IN

BURUNDI

by

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December 2011

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ACRONYMS

ACF	Aid and Cooperation Fund
ADB	African Development Bank
AGCD	Administration Générale de la Coopération en Développement (Belgium)
CATALIST	Catalyze Agricultural Intensification for Social and Environmental Stability
CCAF	Climate Change Adaptation Fund
CDM	Clean Development Mechanism
CTFT	Centre Technique Forestier Tropical (France)
DF	Département des Forêts (Forestry Department)
DGIS	Netherlands Directorate General for Development Cooperation
DRC	Democratic Republic of Congo
EDF	European Development Fund
ERA	Ecosystem Restoration Associates
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FIDA	International Fund for Development (IFAD)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GTZ	German Technical Cooperation Agency
ICRAF	World Agroforestry Centre
IDA	International Development Association
IFAD	International Fund for Agricultural Development
IFDC	International Centre for Soil Fertility and Agricultural Development
IGEBU	Institut Geographique du Burundi (Geographic Institute of Burundi)
ILO	International Labour Organization
INECN	Institut National pour l'Environnement et la Conservation de la Nature
ISABU	Institut des Sciences Agronomiques du Burundi (Burundi Agricultural Research Institute)
IUCN	World Conservation Union (Formerly International Union for Conservation of Nature)
LDCF	Least Developed Countries Fund
MINAGRI	Ministry of Agriculture and Animal Resources
NGO	Non Governmental Organisation
PNR	Programme National de Reboisement
PSTP	Projet Services Travaux Publics
REDD	Reducing Emissions from Deforestation and Forest Degradation
SEW	Sustainable Energy Production through Woodlots and Agroforestry in the Albertine Rift
SRD	Société Régionale de Développement
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework on Climate Change Convention
UNHCR	United Nations High Commission for Refugees
USAID	United States Agency for International Development
VCM	Voluntary Carbon Market
WB	World Bank

PREFACE

Forest plantations and woodlots are an integral part of the landscape of Burundi. Most natural vegetation having been cleared and the remaining being protected, most of the forest products used by the people of Burundi come from forest plantations, woodlots and agroforestry. These tree resources are therefore of vital importance for the livelihoods of the people of Burundi even though its contribution to the economic growth (or the Gross Domestic Product) remains underestimated (about 2%). This is partly due to the fact that most forest products are often directly consumed and never reach the market system. This report is a comprehensive study to characterise and document information on current status, challenges, opportunities and options for future management of forest plantations in Burundi.

The main issues covered include the evaluation and analysis of the current public and private forest plantations situation; surveys of wood products market and wood processing industries; the current licensing and revenue collection systems, management arrangements and pricing mechanisms for roundwood and industrial forest products; current income and employment and potential for future income generation and employment creation; incentives that could favour rapid forest plantation establishment by public and private sectors, and outgrower/woodlot schemes by individual farmers; options for establishment, expansion and improved management of public and private forest plantations; and, processing of industrial round wood from forest plantations and its current and potential capacity.

The information and data contained within this report were gathered from various sources including several publications and reports on the mentioned key issues addressed, national market surveys of wood products, supply and demand scenarios and interviews with key informants including forest professionals and various central and local government authorities. The targeted units included Ministries, Government agencies, National Banks, forest projects, wood processing plants, wood products business people (wood dealers), workshops and various NGOs involved in forest or agroforestry, environmental protection and conservation projects. The author is deeply grateful to all the people who willingly cooperated and provided views and information, both during field surveys and through secondary data collection. While some people are mentioned in the report, not all those who helped in this work could be mentioned, and the author is emphatically thankful to all the people who in one way or another assisted in realising the work.

The author is also indebted to the African Forest Forum (AFF) for initiating and providing the financial support which enabled the carrying out of this study. It is sincerely hoped that the information contained in this report will be useful for effective planning of future interventions geared towards better and sustainable management of forest plantations and woodlots in Burundi.

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Executive Summary

Burundi is a small landlocked country in Central Eastern Africa. It is located between 29°00' and 30°54' East and 2°20' and 4°28' South and covers an area of 27 834 km² (RB, 2005). The country has a mild tropical equatorial climate with rainfall and temperature heavily influenced by altitude varying from 773 m to 2 670 m above sea level. The rainfall varies from 800 mm in the depressions to around 2 000 mm in higher altitudes. Average annual temperatures vary with altitude from 17 to 23°C. In August 2008, Burundi's population was estimated at 8 037 000 inhabitants with a density of 289 people per km². The country's GDP was US$ 1.1 billion in 2008 with 35% derived from agriculture. Coffee and tea are major exports, accounting for 70-85% of foreign exchange earnings. Since 1993, an ethnic-based war has resulted in many deaths, forced thousands of Burundians to become refugees in neighbouring countries, mainly Tanzania, and left others as internally displaced in the country. The country has joined the East African Community and is progressively recovering stability and democratisation. Much of Burundi's forest land has been lost due to ever growing demand for wood products and expansion of agricultural land. According to official statistics, about 6% of Burundi's total land (152 000 ha) is forested with about 14% made up of natural forests and the remaining 86% are plantation forests. The remaining natural forests are now protected by law and banned for timber harvesting.

This study assessed the current situation of public and private forest plantations/woodlots in the country with respect to the distribution and location of these plantations, species planted and sources of seedlings and seeds, age distribution of forest plantations, their management and quality of stands and other features. The Government of Burundi has made a lot of efforts to establish forest plantations since the colonial period with increasing intensity towards the late 1970s and the 1980s. This was geared towards achieving two major objectives, viz. environmental conservation and production of forest products needed by the growing population. The landscape of Burundi is richly endowed with trees and woodlots scattered on farmlands. Major forest plantations are located in proximity of protected areas and urban areas such as Bujumbura in order to ensure not only provision of wood products and fuelwood but also effective protection of fragile ecosystems. Major funders that have helped in afforestation projects from 1976 onwards include Belgium, Saudi Arabia, France, the European Union, IDA, ILO, World Bank, UNDP and others. However, due to the war situation that has prevailed since 1993, these forest plantations have not been well managed and several illegal excision, encroachment and harvesting activities are reported by the Forestry Department.

Most tree seeds used in public and forest project nurseries are supplied by the Tree Seed Centre (*Centrale de Graines Forestières et Agroforestières*) which is managed by the Forestry Department. Major species found in plantations, woodlots and agroforestry include: *Pinus patula, P. caribaea, P. kesiya* and *P. elliottii; Eucalyptus grandis, E. camaldulensis, E. maideni, E. saligna, E. urophylla* and *E. microcorys; Callitris robusta* and *C. calcarata; Cupressus lusitanica; Acacia mearnsii, A. decurrens* and *A. mangium; Maesopsis eminii, Casuarina equisetifolia; Grevillea robusta, Leucaena leucocephala, L. diversifolia, Calliandra calothyrsus, Senna siamea, S. spectabilis, Cedrella serrulata, C. odorata, Entandrophragma excelsum* and *Markamia lutea.*

Nevertheless, it was noted that the statistics on the extent of forest plantations and their ownership are not well known because no forest inventory has been carried out since 1976. Many documents contain different statistics for the same theme such as areas, ownership, management systems and resulting projection estimates on production and consumption. This is one of the most critical problems that should urgently be addressed in order to have adequate basis for planning and development of the forest sector in the country.

The study further assessed the existing incentive schemes that could favour rapid forest plantation establishment by public and private sectors, and outgrower schemes by individual farmers. Particular attention was given to availability of land for forest expansion and of quality germplasm, financing mechanisms for plantation forestry, private sector involvement, policy and environmental issues including land and forest and tree tenure issues, biodiversity considerations, and legislation and governance issues. The study suggested options for establishment, expansion and improved management of public and private forest plantations, including ways to overcome existing and potential constraints. It was noted that the policy of free seedling distribution has greatly contributed to the development of woodlots and agroforestry. The major constraints to forest plantation expansion are reported to include land scarcity for large scale plantation, political

instability and inadequate human and financial resources capacity. As a result, forest investment in Burundi is perceived as too risky for private ventures and therefore more incentive packages including fiscal and business facilitation are required in order to attract investors. The potential for additional revenues from carbon trade projects was also explored and found to be remarkable in the context of prevailing climate change environment. It was noted that some carbon projects under the ERA carbon offset company have been initiated in some parts of the country.

Based on market and literature surveys, the study determined supply scenarios and demand projections for plantation wood for 2015, 2020, 2025, and 2030. The current revenue collection systems, revenues collected annually, licensing/concession procedures, forest and tree tenure, management arrangements and pricing mechanisms for roundwood and industrial forest products were also analysed in order to find out ways of improvement to increase the visibility of the sector in the economy. The study pointed out that the supply of wood products is not adequate in terms of quality and quantity and the gap might widen with time if appropriate measures are not taken. It was noted that the lack of adequate and systematic recording systems of forestry business transactions is a great handicap to the development of forestry in the country. The forest fiscal system was also criticised by many stakeholders and needs to be revised if more revenues are to be collected from the forestry business and attract more forest investors.

The study presented current income and employment data and provided estimates of the potential for income generation and employment creation in 2015, 2020, 2025, and 2030. The study also analysed the processing of industrial round wood from the plantations in the country, ownership, its current and potential capacity, wood raw material supply (sources, types, and adequacy), product lines and quality of produce, potential for future investment in the sub-sector, constraints facing the sub-sector, future of the processing industry, growth and constraints. It was observed that there are no large scale forest industries in the country and still the supply of quality timber is inadequate. Most of the premium timber and other finished wood or wood simulated products are imported from neighbouring countries (mainly from DRC and Tanzania) or Kenya, Dubai and China. Nevertheless, there are huge opportunities for investment in order to develop the forest sector in the country. Some such investments may include introduction of modern sawmills, wood based panel plants and timber treatment plants, and ecotourism. The country also has an opportunity to benefit from the growing carbon trade initiatives in order to raise funds for tree planting.

In conclusion, the study proposes the following ways forward:

- To pursue the reforestation effort in order to attain the forest policy target of 20% or more forest cover;
- To carry out a comprehensive forest inventory and assess the tree resources outside forest;
- Establishment of a forest cadastre linked to a Geographic Information System (GIS) that would ensure that all classified forests are well managed and monitored;
- Introduction of more incentive schemes including financial credit systems and special clearance of forest products and equipment;
- To promote participatory forest management as being piloted in some parts of the country;
- Improvement of the recording system of forestry business through capacity building of forest actors including both public and private institutions on the relevance of a good recording system;
- To finalise the revision of the forest legislation with immediate effective implementation;
- To revise the forest fiscal system and ensure an equitable and transparent taxation system;
- Introduction of limited industrial activities such as wood based panel plants, timber treatment plants, modern sawmills and ecotourism;
- Development of human resources capacity in terms of quality and quantity; and,
- To take advantage of the growing carbon trade initiatives in order to raise funds for tree planting.

1. INTRODUCTION

1.1 Background information

Burundi is a small landlocked country covering 27 834 km² of which 25 200 km² are terrestrial. It is located in the Great Lakes region of Africa between 29°00' and 30°54' East and 2°20' and 4°28' South (RB, 2005). Burundi is positioned between the Republic of Rwanda to the north, the Democratic Republic of Congo (DRC) to the west, and the United Republic of Tanzania to the east and south. It borders Lake Tanganyika, covering 32 600 km², of which 2 634 km² is within Burundian waters (Figure 1). According to the general census of August 2008, Burundi's population was estimated at 8 037 000 inhabitants comprising 51.1% women and 48.9% men. The density of 289 inhabitants per km² makes Burundi one of the African countries with highest population densities (RB/UNDP, 2010).

Burundi has a mild tropical equatorial climate with rainfall and temperature heavily influenced by altitude which varies from 773 m to 2 670 m above sea level and averages around 1 700 m (RB/UNDP, 2010). Average annual temperatures vary with altitude from 17 to 23°C, but are generally moderate. The rainfall varies from 800 mm in the depressions to around 2 000 mm in higher altitudes. The relief of Burundi is typical of the Great Rift of eastern Africa, which gave place to the formation of Lake Tanganyika. The topography is dominated by hills and mountains interspersed with seasonal and permanent wetlands in the low-lying areas. The country territory extends into 11 natural regions that can be grouped into five climatic and ecological areas, namely, the low Imbo flat country, the steep mountainous area of Mumirwa, the mountainous Congo-Nile watershed area, the central plateaux and the Kumoso and Bugesera depressions (RB, 2005). This diversity of ecological conditions allows for a great richness of natural ecosystems and plant and animal species. The climate and soils are generally favourable to agriculture, allowing growth of a wide range of food and cash crops (Beck *et al.,* 2010).

Burundi has significant mineral resources, though currently largely unexploited. In addition to various precious metals including Nickel and other minerals, there are phosphate and calcareous deposits which could be extracted and put to use to improve the fertility of the acidic soils. Lake Tanganyika also provides many options for sustainable economic development around trade and fisheries. Ecotourism has a high potential in Burundi. However, the economy remains predominantly agricultural with more than 90% of the population dependent on subsistence agriculture. In 2008, Burundi's growth domestic product (GDP) was US$ 1.1 billion, with 35% derived from agriculture, 20% from industry, and 45% from services (World Bank, 2009). Coffee and tea are major exports, accounting for 70-85% of foreign exchange earnings (Beck *et al.,* 2010).

Since 1993, an ethnic-based war has resulted in many deaths, forced thousands of Burundians to become refugees in neighbouring countries, mainly Tanzania, and left others as internally displaced in the country. Recent political stability and progressive democratisation of the country as well as entrance in the East African Community block have improved aid flows and economic activity is generally on the increase (Beck *et al.,* 2010).

Much of Burundi's forest land has been lost due to an ever growing demand for wood products, and expansion of agricultural lands. Plantations have replaced most natural forests. FRA (2010) has reported that between 1990 and 2010 Burundi lost an average of 5 850 ha, or 2.02%, of forest per year. In total, between 1990 and 2010, Burundi lost 40.5% of its forest cover (FRA, 2010). One of the largest remaining natural forestlands is the Kibira National Park which, together with the adjacent Nyungwe National Park in Rwanda forms one of the greatest remaining tracts of mountain forests in East Africa and the most biodiversity rich ecosystem in the Albertine Rift. According to official statistics, about 6% of Burundi's total land (152 000 ha) is forest. About 14% of this forest cover is made up of natural forest and the remaining 86% is plantation forest, which has been expanding since 2000 in an effort to meet the needs of the population for fuelwood and timber and to restore tree cover (USAID, 2011).

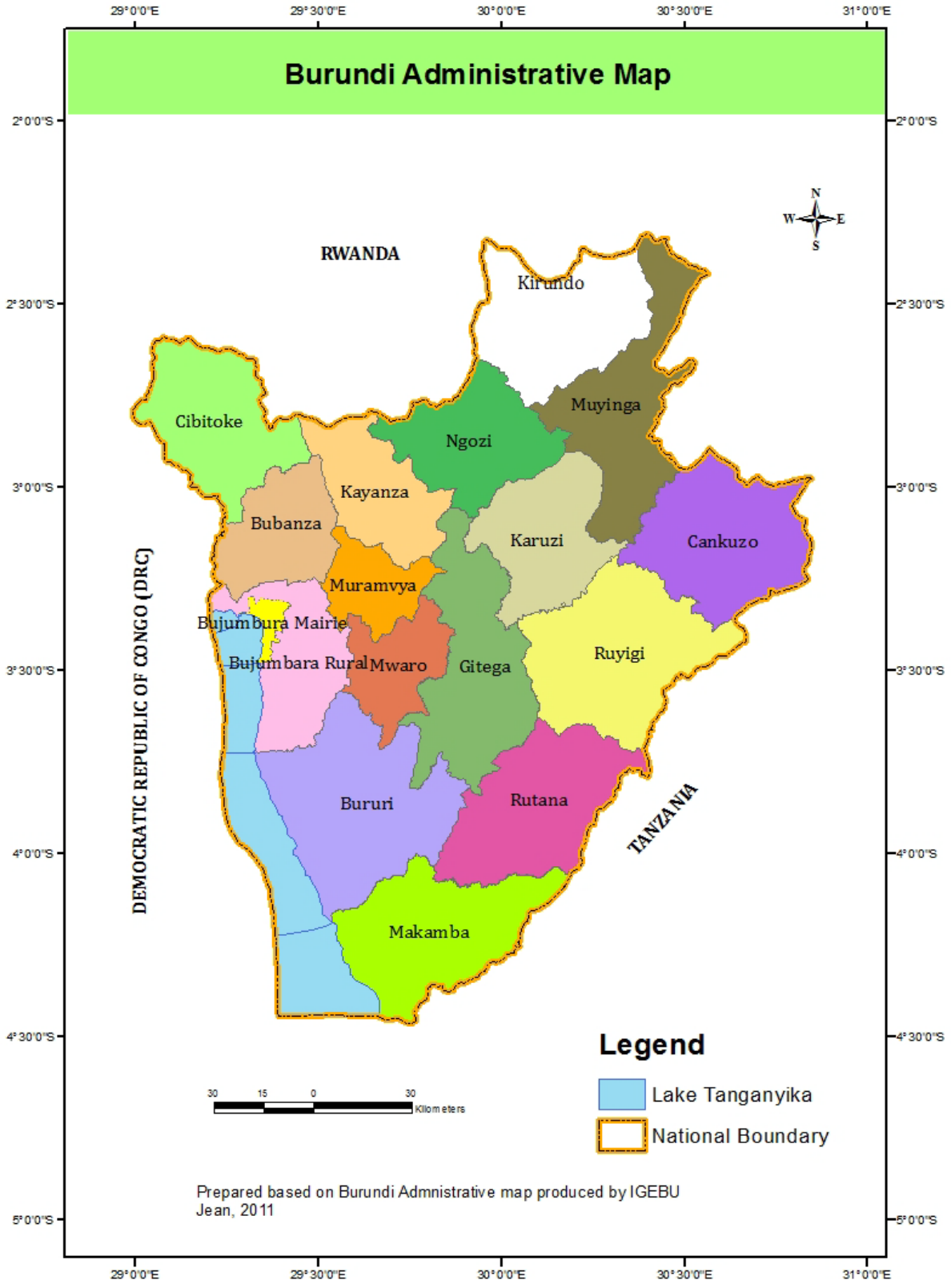

Figure 1: Administrative map of Burundi. (Source: IGEBU, 2011)

1.2 Objectives of the study

The specific objectives of the study are as follows:

i. Undertake a study of the current public and private forest plantations situation, specifically with respect to the distribution and location of these plantations, species planted and sources of seedlings and seeds, age distribution of tree species, their management and quality of stands, and other features;

ii. Undertake market surveys to determine supply scenarios and demand projections of plantation wood volumes for 2015, 2020, 2025, and 2030 (by tree species, private and public sources), including prices of local and imported timber and wood products and sources of such products;

iii. Evaluate the current revenue collection systems, revenues collected annually during the last 5-10 years, licensing/concession procedures, forest and tree tenure, management arrangements and pricing mechanisms for roundwood and industrial forest products;

iv. Provide income and employment data during the last 5-10 years and estimate the potential for income generation and employment creation for 2015, 2020, 2025, and 2030;

v. Evaluate and propose incentives that could favour rapid forest plantation establishment by the public and private sectors, and outgrower schemes by individual farmers. In this case consideration should also be given to:

- Availability of appropriate land;
- Availability of quality germplasm;
- Financing for plantation forestry;
- Private sector readiness in plantation forestry;
- Policy and environmental issues, including land and forest and tree tenure issues, biodiversity considerations, and legislation and governance issues; and,
- Potential for additional revenues from carbon trade.

vi. Provide options for establishment, expansion and improved management of public and private forest plantations, including ways to overcome existing and potential constraints;

vii. Evaluate the processing of industrial round wood from the plantations, ownership, current and potential capacity, wood raw material supply (sources, types, and adequacy), product lines and quality of produce, potential for future investment in the sub-sector, constraints facing the sub-sector, future of the processing industry, growth and constraints, among other key considerations; and,

viii. Make a presentation, based on this work, in a workshop that will be organised by the African Forest Forum (AFF).

1.3 Scope and coverage

This is an in-depth study to characterise and document information on current status, challenges, opportunities and options for future management of forest plantations in Burundi. Key aspects covered include the evaluation and analysis of:

- the current public and private forest plantations situation;
- surveys of wood products market and wood processing industries;
- the current licensing and revenue collection systems, management arrangements and pricing mechanisms for roundwood and industrial forest products;
- current income and employment and potential for future income generation and employment creation;
- incentives that could favour rapid forest plantation establishment by public and private sectors, and outgrowers schemes by individual farmers;
- options for establishment, expansion and improved management of public and private forest plantations;
- processing of industrial round wood from forest plantations and current and potential capacity.

1.4 Approach to the study

The approach of the study consisted of data collection from various sources including several publications and reports on all aspects outlined in the specific objectives, national market surveys of wood products, supply and demand scenarios and interviews with key informants including forest professionals and various central and local government authorities. The targeted entities for gathering forestry statistics included Ministries, Government agencies, National Banks, forest projects, wood processing plants, wood products businesses, workshops and various Non-Governmental Organisations (NGOs) involved in environmental protection and conservation.

1.5 Structure of the Report

The report has the following structure:

An introductory Chapter 1 gives the background about forest plantations in the country;
Chapter 2 gives the current situation of forest plantations in the country;
Chapter 3 describes the status of out-grower schemes and other woodlots;
Chapter 4 explores forest and tree tenure systems in the country;
Chapter 5 analyses the financial and human resources for plantations and out-growers or woodlots;
Chapter 6 looks into incentives for plantation establishment in the country;
Chapter 7 analyses the supply and demand of forest products;
Chapter 8 deals with forest revenues systems;
Chapter 9 deals with produce processing issues;
Chapter 10 assesses socio-economic and environmental contributions of forests in the country; and,
Chapter 11 provides conclusions and recommendations as a way forward.

2. FOREST PLANTATIONS SITUATION

2.1 Historical background

In Burundi, the history of forest plantations dates back to the early twentieth century. FAO (2002) reports that tree planting started in 1919 with the objective of meeting fuelwood demand. At that time tree planting consisted of rows of roadside trees (Figure 2) and some community woodlots with mainly *Eucalyptus* species. In order to enhance reforestation, the establishment of community woodlots was made compulsory in 1931 by the colonial government. In addition to the supply of fuelwood, during the colonial period forest plantations aimed at protecting the remaining natural forests against further encroachments and protecting farmlands from soil erosion.

Figure 2: Line plantation of *Callitris spp.* along the road to Ngozi (Northern Burundi).

In 1948, in a move to halt the deforestation of natural forests, the colonial government created a service primarily responsible for preserving natural forests and managing forest plantations. Unfortunately, public plantations established under the colonial era experienced management problems after independence. The farmers tried to annex part of the afforested areas, and the new State was still too weak to enforce the law that would have ensured their protection. After independence, reforestation efforts also relatively declined. However, as wood products became progressively scarce in the late 1960s, the Government had to act in order to define a clear forest policy and consequently a forestry sector development white paper was produced in 1969. During the 1970s, several measures were taken to stabilise the boundaries of forest reserves and to protect them from encroachment and annexure by local communities. The first forest symposium was organised in 1973. With the support of external donors, a vast afforestation programme was launched in 1978 by the Government of Burundi with a target to restore tree cover over 20% of the country's land (de Ligne, 1992; Vauron, 1992; FAO, 2002).

Official efforts in forest conservation and rehabilitation continued in the 1980s and environmental protection legislation was initiated by the government. The Decree Law n°1/6 of 3 March 1980 established National Parks and Nature Reserves. Other laws enacted during this period include the forest code n°1/02 of 25 March 1985, the land code of 1986 (Law n°1/008 of 1 September 1986) revised and promulgated in August 2011 and the Decree Law n°100/188 of 5 October 1989 which established the National Institute for Nature Conservation and Environment (INECN). The forest code revoked all prior and conflicting legislation, especially the decree of 18 December 1930 covering the cutting and sale of wood, the law of 23 January 1962 concerning compulsory community reforestation, the Decree n°1/22 of 31 July 1978 concerning reforestation schemes, the 24 July 1979 Decree Law on soil protection and rehabilitation and Ordinance n°53/5 of 9 April 1915 on the conservation of forest species.

The second Forest Symposium in 1982 set the following targets: private tree planting at a rate of 300 trees per household (making roughly 200 000 ha of family woodlots), afforesting 300 000 ha, protecting 41 000 ha of moist montane forest and 15 000 ha of wooded savannah, i.e. a total of 556 000 ha, which is equivalent to approximately 20% of the country's area. By the end of the 1980s, the Burundian forestry sector had made substantial progress and involved local people in various forestry activities (Vauron, 1992; FAO, 2002).

By 1992, public forest plantations had reached around 95 000 ha, and total forest cover had expanded to around 210 000 ha which is nearly 8% of the country area (FAO, 2002). Unfortunately, starting from October 1993, the afforestation efforts were interrupted by the eruption of a violent civil war which ravaged the country in terms of physical and human resources. Due to disruption of law and order in the country, there were widespread unauthorised forest cutting and forest fires. The influx of refugees from Rwanda in 1994 also contributed to high rate of deforestation during their stay in Burundi (RB, 2005). The forest cover is now estimated at 152 000 ha of which 14% is natural forest. The protected areas have expanded to only 4.5% of the total land area and include national parks, forest reserves and protected landscapes (USAID, 2011).

2.2 Location, areas and species composition

2.2.1 Location and climatic conditions

Burundi is characterized by five eco-climatic regions based on topography and average annual rainfall (RB, 2005; Beck *et al.,* 2010). These include the lowlands of Imbo, the steep region of Mumirwa, the mountainous Congo-Nile divide, Central highlands plateaux, and depressions of Kumoso and Bugesera (Table 1 and Figure 3). This diversity of ecological conditions is conducive for hosting high biodiversity and various types of forests.

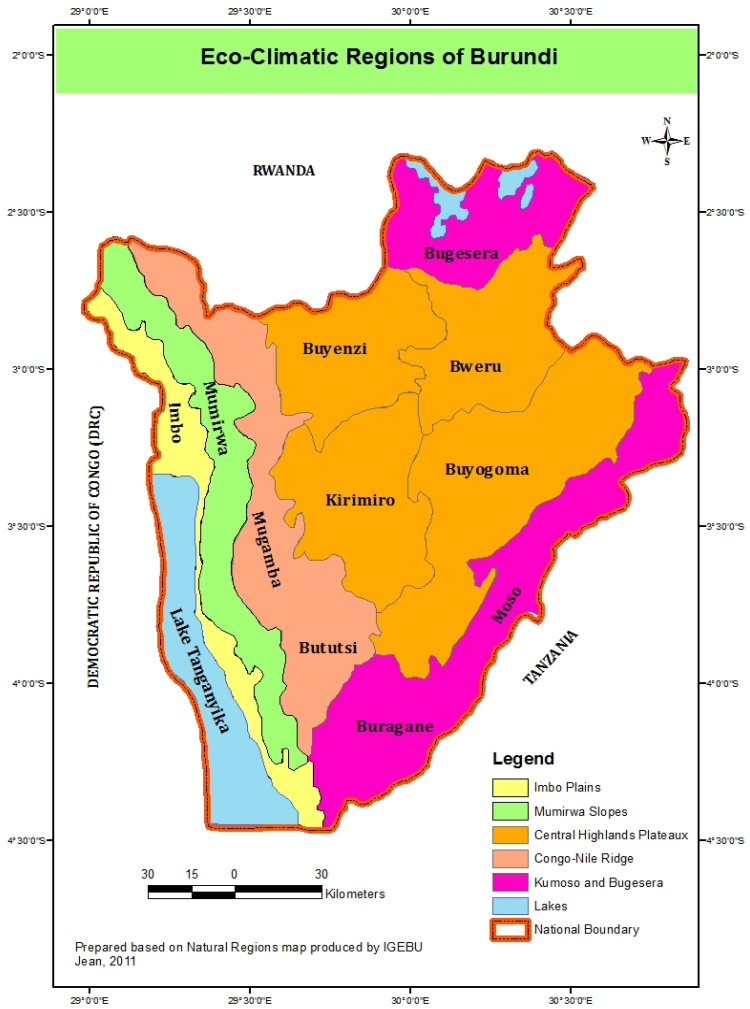

Figure 3: Map of Burundi showing Eco-climatic regions. Source: IGEBU (2011), Beck *et al*. (2010).

Table 1: Burundi: Eco-climatic regions. Sources: RB (2005), Beck *et al.* (2010)

Eco-climatic region	Name of region	Per cent of total	Altitude (m)	Rainfall (mm)	Temperature (^{0}C)	Soils
Imbo plains	Imbo	7	774-1 000	800-1 100	23	Fluvent and Vertisols
Mumirwa slopes	Mumirwa	10	1 000-1 900	1 100-1 900	18-28	Vertisols
Central highlands plateaux	Buyenzi, Kirimiro, Buyogoma, Bweru	52	1 350-2 000	1 200-1 500	17-20	Oxisols/ Ultisols
Congo-Nile divide	Mugamba and Bututsi	15	1 700-2 500	1 300 -2 000	14-15	Oxisols/ Vertisols
Kumoso and Bugesera	Moso, Buragane, Bugesera	16	1 100-1 400	1 100-1 550	20-23	Oxisols/ Alfisols/ Ultisols

Most forest plantations were established in proximity of protected areas and urban areas such as Bujumbura as a way of reducing pressure on remaining natural forests by ensuring provision of wood products and fuelwood but also at the same time allowing the protection of fragile ecosystems. Major development partners that have helped in afforestation projects from 1976 onward include Belgium, Saudi Arabia, France, European Union (EU), International Development Association (IDA), International Labour Organisation (ILO), World Bank, United Nations Development Programme (UNDP) and others. By 1992, about 65 000 ha of industrial forest plantations in units ranging from 200 to 5 000 ha, often located on steep slopes, had been established by various forest projects (Vauron, 1992). Table 2 provides location, establishment period and site conditions of major forest plantations based on available records.

Table 2: Burundi: Location, establishment period and site conditions of major forest plantations. Sources: Vauron (1992); Koyo (2004), Albéric, Nyengayenge (Pers. Communication).

Forest plantation/ management unit	Years planted	Location	Altitude range (m)	Mean annual rainfall (mm)	Mean annual temp (^{0}C)	Soils	Accessibility
Belgo-Arabe project*	1978-86	Mugamba-Bututsi (Muramvya-Gisozi)	1700-2500	1300 -2000	14-15	Oxisols/ Vertisols	Generally difficult
EDF/EU project	1987-90	Mosso-Rutana	1100-1400	1100-1550	20-23	Oxisols/ Alfisols/ Ultisols	Generally good but some sites are difficult
Belge-AGCD project	1988-90	Gishubi-Ryansoro					
ILO-PSTP project (IFAD/GTZ funding)	1985-87 1986-90	Muramvya Ruyigi - Cankuzo	1350-2000	1200-1500	17-20	Oxisols/ Ultisols	Some sites are easy others difficult
World Bank / SRD project	1981-89	Bujumbura, Bururi, Muramvya	1000-2000	1000-1800	14-23	Oxisols/ Vertisols	Various, some sites easy, others difficult
Action-Aid project	1981-90	Many Provinces	-	-	-	-	-
INECN/ACF (France)	1979-90	Kibira NP	1700-2500	1300 -2000	14-15	Oxisols/ Vertisols	Generally difficult
World Bank/ACF/EU	1980-90	Mageyo, Gakara, Ryarusera, Vyanda, Vugizo, Mabanda Bukinanyana	-	-	-	-	Various, some sites easy, others difficult
Rugazi forest Project (EDF_CTFT-France)	1978-82	Rugazi (Mumirwa)	780-2000	1000-1800	14-23	Oxisols/ Vertisols	Various, some sites easy, others difficult
Bukirasazi Forest project (ADB)	1988-	Bukirasazi	-	-	-	-	-
UNHCR project	1993-97	Kayanza					Generally difficult
Private plantations: SEW/CATALIST/ IFDC project	2009-10	Bujumbura, Bururi, Mwaro, Muramvya, Karuzi, Kayanza	-	-	-	-	-

*- Some Projects are referred to by their funders or implementers

- Most Projects had also a component of helping private rural farmers to establish woodlots and agroforestry and therefore have contributed to the creation of private plantations.

2.2.2 Areas, ownership and species composition

Forest statistics for Burundi are generally estimates from various sources and vary from one source to the other. For example, differing estimates of total forest cover vary significantly between 4.6% (128 400 ha) of the national territory to 6% (180 000 ha) to 7.4% (206 000 ha) (RB/UNDP/GEF, 2008; RB, 2008; RB, 2009). In fact, there has been no forest inventory since the late 1970s (Habonimana, B. and Department des Forêts, personal communication). Ndabirorere (1999) reported the last forest inventory in Burundi was carried out in 1976. The most recent and reliable account on the situation of forest plantations in Burundi is found in a special issue of a magazine (Revue) "*Bois et Forêts des Tropiques, n°233, 3e Trimestre, 1992*" (Nzojibwami, personal communication). However, even in this document forest plantation area estimates were not based on mapping and field inventory but largely on number of seedlings produced and planted by various forest projects (Blanchez, 1992; Vauron, 1992).

In 1992, about 65 000 ha of industrial project plantations had been established in Burundi through the cooperation of several donors including World Bank, Belgium, Saudi Arabia, France, European Union, IDA, UNDP and many others (Vauron, 1992; Beck *et al.* 2010). Productive plantations included 8 600 ha of pines (*P. patula, P. caribaea, P. kesiya* and *P. elliottii*) and 5 000 ha of Eucalyptus (mainly *E. grandis* and *E. camaldulensis*) on the Congo-Nile ridge. Protective plantations extended to about 17 500 ha of *Callitris robusta and C. calcarata* (600 ha) on shallow and steep soils, and on the least poor soils, *Pinus patula* (1100 ha) and some Eucalyptus (*E. maideni, E. saligna and E. microcorys*) and *Acacia mearnsii* on the quartzite ridges above large farming valleys in the central plateaux and in the Mosi depression in the East (Vauron, 1992). These forest plantations were primarily intended for fuelwood for local consumption, soil stabilisation, as well as for pulp wood supply for a paper industry (Beck *et al.,* 2010). Unfortunately, the paper industry was never developed for many reasons, the major reason being insufficient material to justify significant capital investment in a paper mill. Table 3 provides estimates of forest plantations area by ownership, species and management objectives. Since no specific plantation areas are available for different management objectives, statistics for management objectives are not provided (NA). Figure 4 illustrates the distribution of major forest species in public plantations (80 829 ha).

Table 3: Burundi: Forest plantation areas by ownership, species and management objectives 2010*.
Sources: Besse and Guizol (1991), Vauron (1992), Koyo (2004), Reports from the Forestry Department of Burundi, Albéric, Nyengayenge (Personal Communication).

Forest plantation / management unit	Total area (ha)	Sawn timber area (ha)	Fuel-wood area (ha)
Public plantations			
World Bank / ACF project	**10 523**		
Eucalyptus sp.	4 764	-	4 764
Grevillea robusta	151	151	-
Other hardwoods	38	-	38
Pinus sp.	5 261	5 261	-
Cypress	29	29	-
Callitris sp.	280	280	-
Other softwoods	-		-
Rugazi (EDF / EU) project	**3 908**		
Eucalyptus sp.	560	-	560
Grevillea robusta	171	171	
Other hardwoods	154	-	154
Pinus sp.	2 240	2 240	-
Cypress	673	673	-
Callitris sp.	110	110	-
Other softwoods	-	-	-
Magamba-Bututsi project	**7 367**		
Eucalyptus sp.	7	-	7
Grevillea robusta	-	-	-
Other hardwoods	-	-	-
Pinus sp.	1 933	1 933	-
Cypress	-	-	-
Callitris sp.	5 427	5 427	-
Other softwoods	-	-	-
Bukirasazi project	**2 020**		
Eucalyptus sp.	132	-	132
Grevillea robusta	42	42	-
Other hardwoods	10	-	10
Pinus sp.	93	93	-
Cypress	32	32	-
Callitris sp.	111	111	-
Other softwoods	1 600	1 600	-

INECN project at Kibira	**3 519**		
Eucalyptus sp.	272	-	272
Grevillea robusta	1 205	1 205	-
Other hardwoods	-	-	-
Pinus sp.	1 127	1 127	-
Cypress	363	363	-
Callitris sp.	537	537	-
Other softwoods	15	15	-
ILO-PSTP project	**11 500**		
Eucalyptus sp.	310	-	310
Grevillea robusta	-	-	-
Other hardwoods	140	-	140
Pinus sp.	250	250	-
Cypress	440	440	-
Callitris sp.	8 600	8 600	-
Other softwoods	1 760	1 760	-
Action Aid project	**3 023**		
Eucalyptus sp.	281	-	281
Grevillea robusta	80	80	-
Other hardwoods	15	-	15
Pinus sp.	153	153	-
Cypress	208	208	-
Callitris sp.	1 094	1 094	-
Other softwoods	1 192	1 192	-
SRD project	**14 570**		
Eucalyptus sp.	5 187	-	5,187
Grevillea robusta	30	30	-
Other hardwoods	219	-	219
Pinus sp.	211	211	-
Cypress	109	109	-
Callitris sp.	6 282	6 282	-
Other softwoods	2 532	2 532	-
UNHCR project	**2 300**		
Eucalyptus grandis	2 300	-	2 300
Other public forest projects	**22 099**		
Eucalyptus sp.	15 572	-	15 572
Grevillea robusta	634	634	-
Other hardwoods	1 197	-	1 197
Pinus sp.	1 160	1 160	-
Cypress	1 190	1 190	-
Callitris sp.	1 666	1 666	-
Other softwoods	680	680	-
Sub-total	**80 829**	**49 671**	**31 158**
	Private plantations		
SEW/CATALIST/IFDC (Mainly *Eucalyptus* and *Grevillea; others include Alnus sp., Senna sp., Calliandra, Leucaena sp. etc.*)	**4 226**	1 056	3 170
Out-growers / Other woodlots (*Eucalyptus sp., Grevillea sp., Pinus sp., Cupressus sp.; Callitris sp., Acacia sp.* and others)	**61 000**	15 250	30 500
Sub-total	**65 226**	**16 306**	**33 670**
Grand Total	**146 055**	**65 977**	**64 828**

Notes:

- There are no records of recent statistics but according to Nyengayenge (Personal communication), many plantations that were established in the 1980s have not been harvested yet. However, some plantations were illegally clear-felled or destroyed due to security issues (during the war some forests were burned as a strategy to destroy hideouts for the enemy). Estimates of forests destroyed by fires and other causes during the Burundi years of crises vary from 8 000 to 32 000 ha (Banderembako, 2006; USAID/REDSO, 2003).
- It is assumed that all softwoods (*Pinus, Callitris, Cypress*) and *Grevillea* are mainly managed for sawn timber production while all *Eucalyptus* and other hardwoods plantations are managed for fuelwood production. However, in some cases some softwood trees are used as fuelwood while *Eucalyptus* timber is very common on the timber markets of Burundi.
- It has also been assumed that only a quarter (1/4) of trees planted in the private sector, including agroforestry and woodlot outgrowers, is for sawn timber, another quarter for non-wood forests products (NWFPS) (mainly fruits), and the remaining half is for fuel-wood. For the SEW/CATALIST/IFDC project, it is assumed that only one quarter is for sawn timber production.

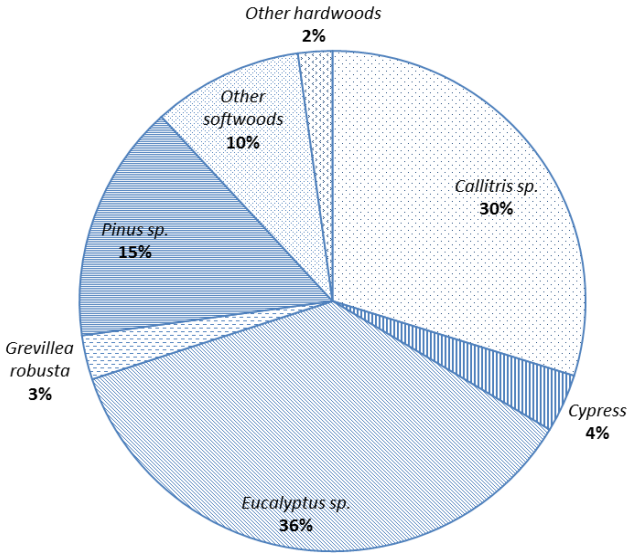

Figure 4: Distribution of major tree species in public forest plantations (80 829 ha).

In the absence of records on age distribution of species in forest plantations in Burundi, Table 4 was compiled on the basis of information from Vauron (1992), Koyo (2004), and Albéric, Nzojibwami and Nyengayenge (Pers. communication). Most plantations were established in the 1980s but due to the crisis in the 1990s, they did not receive adequate silvicultural treatment, e.g. pruning and thinning (Ngendabanyikwa, Pers. communication). Moreover, although most of the plantations are yet to be harvested, it is not clear how much and which forest plantations are still standing after the long political crisis. A comprehensive forest inventory is therefore needed to gather baseline data on forest situation in Burundi in order to set up clear strategic plans for the development of the forest sector. In the last 20 years, since 1990, it appears as if less than 10 000 ha have been planted.

Table 4: Burundi: Age distribution of tree species in forest plantations. For species distribution in various projects, see Table 3 above. Sources: same as Table 3.

Forest plantation / management unit	Total area (ha)	Years planted
World Bank/ACF project	10 523	1981-1989
EDF project	3 908	1987-1990
Magamba-Bututsi project (Belgo-Arabe)	7 367	1978-1986
Bukirasazi project (ADB & Belgium)	2 020	1988-1990
INECN project Kibira (ACF)	3 519	1978-1992
ILO-PSTP project	11 500	1985-1990
Action Aid project	3 023	1981-1990
SRD project	14 570	1981-1989
UNHCR project	2 300	1993-1997
Other public forest projects	22 099	1978-1992
SEW/CATALIST/IFDC project (mainly *Eucalyptus*, *Grevillea*)	4 226	2009-2010

Data on encroachments and excisions of forest plantations are scanty and although this practice is frequently reported no exact figures are provided for any specific period or location. For example, the Forestry Department (Annual report 2009) talks about illegal distribution of forest lands at Kanyosha plantation including sites like Ntaruko I, Sabutukura, Nyabiti, Kanga, Kamutwe, Gatwaro, Rwangage and Nyamutendere but no figures are provided on size of area illegally given away. Beck *et al. (*2010) reported that state forest land is often given away by the Governor or the Communal administration and harvested or simply converted into other land uses such as pastures or settlements. Moreover, the war situation and the resulting lawlessness have led to the loss of forest plantations through arson fires, annexation or illegal clear felling. In fact, during the 1990s, Burundi experienced the highest deforestation rate in the world at about 9% (Athman *et al.,* 2006). Estimates of forests destroyed during the civil war vary from 8 000 to 32 000 ha (Banderembako, 2006).

2.3 Plantation management

2.3.1 Establishment

In Burundi, forest plantations are generally established on marginal sites, on steep slopes, along roads and in the buffer zones of protected areas such as the Kibira National Park. Most tree seeds used in public and forest project nurseries are supplied by the Tree Seed Centre (*Centrale de Graines Forestières et Agroforestières*) which is managed by the Forestry Department (General Directorate of Forestry and Environment). The Tree Seed Centre is mandated to collect locally from seed stands established throughout the country and to import other quality seeds for supply to individuals, private and public institutions of Burundi (Ngendabanyikwa, Pers. Communication). Table 5, which presents the seed stock movement during 2010, shows that *Eucalyptus, Grevillea, Calliandra* and *Maesopsis sp.* were the most sold which probably means that these species are the most sought and planted in Burundi.

Table 5: Tree seed stock movement in 2010; figures in kg (rounded to nearest kg). Source: DF (2011).

Species	In (purchased or collected)	Out (sold or used)
Acacia mangium	4	1
Acacia mearnsii	8	12
Calliandra calothyrsus	941	1 238
Callitris calcarata	165	1 093
Senna siamea	42	11
Cedrella serrulata	164	79
Senna spectabilis		1
Eucalytus camaldulensis	49	85
Eucalytus grandis	350	360
Eucalytus maideni	10	14
Eucalytus saligna	113	116
Grevillea robusta	568	507
Leucaena diversifolia	835	112
Leucaena leucocephala	48	147
Maesopsis emini	2 823	922
Pithecelobium dulce	1	
Entandrophragma excelsum	2	
Acacia decurrens	6	
Casuarina equisetifolia		7
Cedrella odorata		11
Cupressus lusitanica		38
Eucalytus urophylla		-
Markamia lutea		13
Malacouja		2
TOTAL	**5 375**	**3 783**

The Forestry Department is responsible for the distribution of tree seeds and the follow up of the production of seedlings in several nurseries spread throughout the country either through its staff in the six Regional Forest Inspectorates (Bujumbura, Bururi, Gitega, Muyinga, Ruyigi and Ngozi) or through staff based at headquarters in Bujumbura (DF, 2011). The number of seedlings produced throughout the country since 2000 are provided in Table 6. The seedlings include both forest and fruit species. For example, in 2010, the National Reforestation Programme produced 6 027 000 forest species seedlings, 2 174 000 avocado seedlings, 171 000 mango seedlings and 590 000 citrus seedlings (DF, 2011).

Table 6: Burundi: Number of seedlings produced in Burundi from 2000 to 2010. Sources: IMF (2010), DF (2010, 2011).

Year	Number of Seedlings produced and distributed or planted (1000s)
2000	15 768
2001	16 051
2002	12 185
2003	15 365
2004	25 860
2005	36 129
2006	55 392
2007	57 321
2008	51 653
2009	40 676
2010	16 927*

* For 2010, some partners had not yet reported the number of seedlings produced and planted or distributed

Generally, most funded forest projects and the Government (both local and central) acquire tree seeds from the Tree Seed Centre hosted by the Forestry Department which collect seeds either from seed stands or seed orchards. Seed orchards of *Eucalyptus grandis, Acacia mangium, Calliandra calothyrsus* and *Grevillea robusta* have been established at Simba and Kamushiha (Koyo, 2004). However, some farmers also use seed collected from clear felled trees (Nyengayenge, pers. communication). On the basis of trial results in various parts of the country and observations made in Gisozi arboretum (Burundi) and Ruhande arboretum (Rwanda), the following *Pinus sp.* have been recommended for plantation in Burundi (Blanchez, 1992):

Altitude	**Species**
1. >1 800 m	*P. patula*
2. 1 600 – 1 800 m	*P. elliottii, P. kesiya*
3. 1 200 – 1 600 m	*P. caribaea*
4. 1 000 – 1 200 m	*P. oocarpa*

Seedlings for tree planting used by projects are usually raised in temporary nurseries in proximity to planting sites in order to minimise transport costs and accessibility problems (most planting sites are on steep slopes which cannot be reached by vehicles). The main nursery technique used in nurseries is seed sowing on seedbeds and transplanting plants into clear polythene tubes (25 cm x 12 cm x 0.04 cm) for example after 30 to 40 days for *Pinus* species (Blanchez, 1992).

Other pots such as black polythene tubes are also used by horticulturalists whereas banana sheaths, bamboo pots and clay pots ('*boulette*' method) have been used occasionally in rural areas (RB, 1984). The most common soil mixture used in Burundi is a mixture of topsoil from agricultural fields or forests (rich in organic matter), sand and manure at a ratio of 2:1:1. In many cases insecticides (generally aldrine or dieldrine at a rate of 0.8kg/m^3) are also applied in order to prevent damage by termites to young seedlings. In some cases, mineral fertilisers (NPK 15.15.15; 20.20.20 or 14.28.14) are also applied to improve growth (RB, 1984).

Before seed sowing, various treatments are generally applied to seeds to break seed dormancy so that germination becomes more rapid and uniform. The most common types of seed pre-treatment in Burundi is soaking in hot or cold water. Two sowing methods are used depending on seed size and time for germination, namely direct sowing into containers (filled pots) for large size seeds (e.g. Avocado and Mango) and sowing into seedbeds (broadcast sowing) for smaller sized seeds (e.g. *Eucalyptus, Pinus, Cypress* and *Casuarina*). Other standard nursery practices include regular watering, pricking out of seedlings sown in seedbeds, weeding, shading, root-pruning, hardening off and grading before transportation to planting site (RB, 1984).

Tree planting spacing normally varies with species, site, and the purpose of the forest plantation. Common practice is closer spacing in fuelwood plantations on fertile soils and high rainfall while larger spacing is recommended for timber plantations, on infertile soils and in low rainfall areas (RB, 1984). In Burundi, the initial forest plantation spacing of 3.0 x 3.0 m is recommended for all species and management objectives (RB, 1984), however the following spacings are also practiced: 2.0 m x 3.0 m, 2.5 m x 3.0 m and 2.75 m x 2.75 m. This spacing is applied on flat and gentle slopes, but when the slope exceeds 50%, the spacing along is adapted to follow contour lines and often become more rectangular (RB, 1984).

The planting season is generally between November and March. Planting pit size varies from 30 to 50 cm in three dimensions (RB, 1984). However, smaller sizes are often practiced by individual planting farmers often leading to poor survival rate or even poor early growth development. In fact, each year seedlings are freely distributed to all farmers who need them, particularly during the annual tree day institutionalised in 1979. Due to poor planting methods and inadequate monitoring, very low survival rates of seedlings are reported. Nevertheless, the policy has greatly contributed to increasing agroforestry and woodlot establishment in the country (Ngendabanyikwa, pers. communication). Beating up is usually done during planting season in March or the next planting season. Records on annual replanting rates and backlogs could only be traced for the 2010 National Reforestation Programme, which indicated a planted area of 4 640 ha. However, one could get an idea of annual planting rate from the number of seedlings distributed annually as shown in Table 6.

2.3.2 Weeding

Weeding is generally done in the first two to three years after planting in Burundi. Clean weeding along contour lines linking seedlings within 1 m wide strips is practiced using hoes. Grasses and herbs removed are piles between successive strips along the contour lines (Blanchez, 1992). Soils with *Eragrostis spp.* are not generally as demanding as those with *Hyparrhenia* grasses which require more frequent weeding. In general however, at least four to five weeding operations are needed during the first two years after plantation establishment (Blanchez, 1992). Beating up is done in the month of March of the following year just after the first weeding or the next planting season in November (Blanchez, 1992; Nyengayenge, pers. communication). Statistics on weeded areas and weeding backlog could not be found except for few plantation sites extracted from the Forestry Department annual report of 2009. Thus in the four areas Bujumbura, Giharo, Gitanga and Rutana, between 200 and 730 ha were weeded during that year. In addition, and in the same areas, between 25 and 75 kms of fire breaks were cleared and weeded.

2.3.3 Pruning

During the 1980s, many donors funded projects establishing forest plantations and carried out early management activities including weeding and pruning (Blanchez, 1992; RB, 2005). However, after 1993 following the civil war unrest, most forest plantations were abandoned in such a way that some now look like wild bush while other have succumbed to fires (Ngendabanyikwa, pers. communication). In 1992, Blanchez proposed pruning schedules for pines, which recommended a pruning height of 2.2 m at age 6-8 years, thereafter various pruning heights depending on pine species after first thinning (between 6 and 9 m), finally varying heights after 2nd thinning depending on performance. Nevertheless, these schedules are not practically followed and outgrowers or woodlot owners practice no specific pruning schedules since they have no forest management plans. In rural areas, partial pruning is often done by women in search of firewood (Blanchez, 1992).

2.3.4 Thinning

The Ministry of Agriculture and Livestock issued guidelines on thinning practices in 1984 mainly for *Eucalyptus sp.* and Blanchez (1992) reported thinning schedules provided in Table 7. However, it is not clear to what extent are these guidelines applied today (Figure 5). The common practice for private plantation owners is purposeful selective harvesting of merchantable sizes or simply usable sizes.

Table 7: Burundi: Thinning schedules.

Tree species	Initial stock	1st Thinning		2nd Thinning		3rd Thinning		Clear felling	
		Age (yr)	Intensity (remain)	Age (yr)	Intensity (remain)	Age (yr)	Intensity (remain)	Age (yr)	Average stock
Eucalyptus sp. (RB, 1984)	1110	5-7	555	10-14	277	-	-	16-20	277
Pinus sp. (Blanchez, 1992)	1550	9	970	11	622	13	500	30	-

Figure 5: Late thinning in a state plantation of pines recently allocated to local organisations in a move to involve local community in the management of forest plantations (Photo by Ngendabanyikwa).

2.3.5 Forest health

The dominant tree species in Burundi, including *Eucalyptus sp., Pinus sp., Callitris sp. and Grevillea robusta,* have not yet been hit by any serious fungal diseases or insect pests. Generally, cypress plantations which were greatly destroyed by the *Cinara cupressii* aphids throughout Eastern Africa in the late 1980s and early 1990s are so far considered as the most vulnerable in the country. Termites are the biggest problem for plantation establishment in most hot and arid areas of the country. Accordingly, only termite resistant species such as *Grevillea robusta* and *Senna sp.* are easily established there while others need to be planted with insecticides in order to be successful. No statistics on the destruction of forests by various biotic and non-biotic agents was available, except for forest fires, which destroyed a total of c. 9 000 ha in the period 2005-2009.

2.3.6 Maintaining long term site productivity

Harvesting of all forests and plantations is regulated by the forest law. Harvesting instructions are prescribed in the permits issued by forest authorities. Harvesting is allowed only either under government supervision by the forest services or by private parties. The forest legislation calls for public announcements of sales of standing volumes, specifies the concession subdivision to be cut, organizes the marking of reserved trees and supervises harvesting and other operations. Harvesting permit holders are instructed to ensure reforestation and protection of the site against soil erosion.

Timber or fuelwood harvesting operations are generally not mechanised. Handsaw or axes and machetes are used in tree cutting. Cut trees are de-branched and cut into different sections

depending on targeted products (sawlogs, poles or fuelwood pieces) on the site. In the case of charcoal production, the kilns are generally built in the clearfelled area while firewood pieces are piled along the access roads to be loaded by vehicles to users. In the case of saw timber, logs are often pit sawn on the site and only sawn timber is transported to road sides for further transportation. Generally, slash is either collected by local people for fuelwood (firewood or charcoal) or left on the site (especially leaves and twigs) (Ngendabanyikwa, pers. communication). During replanting on slopes, erosion is controlled, often by digging small ditches along contour lines which capture water and soil run off from higher up the slopes.

2.3.7 Growth, yield and rotation age

There are no systematic studies carried out to assess forest plantation productivity for most species in Burundi. However, values provided in Table 8 were gathered from various reports for some species. *Eucalyptus* plantations were reported to have exceptional performance of up to 60 $m^3ha^{-1}year^{-1}$ in some parts of the country at the age of five and eight (Vauron, 1992; De Ligne, 1992).

Table 8: Burundi: Overall productivity of major plantation tree species

Tree species	Productivity ($m^3ha^{-1}year^{-1}$)	Source
Eucalyptus sp.	12	Ndabirorere (1999)
	60	Vauron (1992), De Ligne (1992)
	10.6	Besse and Guizol (1991)
Callitris sp.	9	Ndabirorere (1999)
	6.3	Blanchez (1992)
	1.9	Besse and Guizol (1991)
Pinus sp.	9	Ndabirorere (1999)
	9.8	Besse and Guizol (1991)
Pinus patula	21.4	Blanchez (1992)
Grevillea robusta	8.9	Besse and Guizol (1991)
Cypress	6.6	Besse and Guizol (1991)

Meanwhile, Ndabirorere (1999) proposed estimates of yields for major plantation species at the first, second and rotation age as summarized in Table 9.

Table 9: Burundi: Yields of the main plantation species at different thinning schedules and rotation ages. Source: (Ndabirorere, 1999)

Species	First Thinning		Second Thinning		Final cut (rotation age)	
	Age (years)	Total production (m^3ha^{-1})	Age (years)	Total production (m^3ha^{-1})	Age (years)	Total production (m^3ha^{-1})
Eucalyptus sp.	6	20	13	70	25	220
Pinus sp.	8	20	13	60	30	190
Callitris sp.	17	15	-	-	30	45

The growing stock in forest plantations and woodlots as of 2009 (Table 10) was estimated based on the area covered by forests as reported by the Forestry Department for different categories of forests. The growing stock per hectare (m^3/ha) was estimated based on average stock per hectare provided in the Forest Resources Assessment (FRA) of FAO (2010) for different types of forests. The annual increment was also obtained from FAO (FRA 2010).

Table 10: Burundi: Growing stock, yield and increment of forest plantation species (m^3) in 2009. Sources: Nyengayenge (DF, pers. communication), FAO (FRA 2010)

Forest plantation / management unit	Area (ha)	Average stock m3 per ha	Growing stock (1000 m^3)	Increment ($m^3ha^{-1}yr^{-1}$)
Public				
Natural forests (protected)	55 000	100	5 500	2
State forest plantations	93 000	145	13 485	9
Commune forest plantations	18 800	145	2 727	9
Private				
Woodlots and agroforestry	61 000	200	12 200	15
Grand Total	**227 800**	N/A	**33 912**	N/A

2.4 Forest plantation expansion

2.4.1 New areas available for forest plantation expansion

The reforestation programme launched in the late 1970s and early 1980s had the focus to attain 20% national forest cover by year 2000. These efforts made it possible to raise the forest cover from 3% in 1978 to 8% in 1992 (Gahengeri and Ndihokubwayo, 2011). However, the crisis which erupted in 1993 halted this progression and highly contributed to the degradation of established forest plantations. It is estimated that currently (2011), the forest cover is around 5% of the national territory (Gahengeri and Ndihokubwayo, 2011). Generally, Burundi no longer has enough space to establish large-scale reforestation programmes. According to Koyo (2004), the only available areas for such plantations are the bare hilltops and the other way of increasing tree cover in the country is to combine trees and food crops and to create line plantations. Currently all potential afforestation sites have been identified and will be mapped next year (Ngendabanyikwa, pers. communication).

Burundi is a small country with one of the highest population densities in Africa (315 people/km^2 in 2008) and the majority of the population (more than 90%) practice subsistence agriculture (WB, 2009). This has led to a shortage of arable land and there is practically no area remaining for forest plantation expansion. In principle, due to competition with agriculture, only marginal and protection areas which are not forested are normally considered as afforestation sites in the country. Agroforestry is therefore promoted in order to maximize production on fragmented farming land. There is no statistics on size and location of lands set aside for afforestation or reforestation, but in 2001, UNHCR funded a survey that established the area of public free land that could be either afforested or given to refugees retuning back (Table 11).

Table 11: Public free land areas in the 16 Provinces of Burundi in 2001. Source: Department of Land use planning (RB, 2005).

Provinces	Free land area (ha)
Bubanza	3 908
Bujumbura	5 564
Bururi	1 495
Cankuzo	30 750
Cibitoke	16 519
Gitega	8 972
Karuzi	7 680
Kayanza	2 098
Kirundo	13 241
Makamba	25 829
Muramvya	574
Muyinga	4 971
Mwaro	1 243
Ngozi	415
Rutana	21 612
Ruyigi	58 514
Total	**203 385**

2.4.2 Stakeholder views on establishment, expansion and improved management of forest plantations

The forest and tree resources in Burundi are characterised predominantly by multiple small forest stands (woodlots) scattered throughout the country and trees on farm either as lines (farm boundary and contour lines) or scattered individual trees in the fields. These off-forest tree resources constitute the main sources of domestic and even commercial forest products needs in the country (Gahengeri and Ndihokubwayo, 2011). The establishment of woodlots and agroforestry has been promoted by the policy of free distribution of seedlings to farmers since the 1980s. The tree planting day which was launched in 1979 (FAO, 2002) and was compulsory for some years afterwards has also contributed to the growing of private woodlots and agroforestry. However, it is

the view of many forest actors that forest plantation expansion in Burundi is difficult not only because of land shortage as a result of high population density but also due to the lack of attractive packages that would warrant the high risks associated with forest investment.
Generally, in sustainable management of forest ecosystems, restrictions prevail over the participatory approach. However, it has been shown that people fail to understand the interest of this formal ban on the exploitation of forestry formations through the restrictive approach to management which ignores their own interests (FAO, 2010b). Many forest stakeholders believe that communal management of forest resources ought to be a concern shared by the state services, the rural people who are the direct beneficiaries of these resources, and all partners in development. The current legislation, which is out of date (since 1985), sidelines people whose homes border on protected areas and public forests, giving no weight to public participation and decentralised management. According to FAO (2010b), there has so far been no effective public participation in matters concerning natural resource use and the environment.

Nevertheless, Gahengeri and Ndihokubwayo (2011) reported that pilot projects of participatory management of the state-owned forests were initiated in 1999 in two provinces in the North of the country and the results are promising. In fact, after more than ten years of implementation, this initiative has proved to be efficient in ensuring rational management of forest resources, enhanced livelihoods of beneficiaries, land tenure security and environmental protection. Based on lessons learned, participatory management is now being up scaled to other provinces and since the existing law has no provision for such kind of forest management, a ministerial ordinance has been issued on 15th May 2010, to serve as legal framework for participatory forest management. In this ordinance, the share of benefits from forest management is distributed as follows (Gahengeri and Ndihokubwayo, 2011):

1. If the community (*Groupement de gestion* forestière) has participated in the establishment of the forest plantation:
- 70% goes to the involved community;
- 20% to the government; and,
- 10% to the Commune.

2. If the community did not participate in plantation establishment:
- 40% goes to the involved community;
- 50% to the government; and,
- 10% to the Commune.

The Burundi Forest Policy of 1999 also promotes and aims to achieve effective management of forest resources. One of the major thrusts of this policy is to reinforce concerted management of existing forest resources in line with the situation on the ground, by ensuring effective public participation in the management of state-afforested areas and making sure that people get a fair share of the fruits of their work (Beck *et al.* 2010).

2.4.3 Constraints and opportunities for plantation expansion

The practice of forestry in Burundi is constrained by land scarcity in general and severe poverty of the people coupled with political instability. The other problems include lack of accurate forest statistics, insufficient financial and technical capacity of the government (human and financial resources), an out-dated forest law (enacted in 1985), land conflicts and political ambitions, population pressure, lack of forest management plans, disorganisation in the wood industry and lack of supporting research to help adapt forest production to needs and provide guidance to proper forest management (FAO, 2002; Banderambako, 2006). Burundi has limited government capacity to manage its forests or undertake forest-related programmes. In many communes, national forests are subject to unrestricted illegal harvesting, clearing for agriculture, and collection of fuelwood. In efforts to reduce unsustainable activities, the government has engaged local communities in plantation projects, but results have been mixed, with economic pressures on the population often overwhelming the government's capacity to manage sustainable use programmes (Banderembako, 2006).

Nevertheless, there are opportunities that could enhance forestry business in the country. Such opportunities include the mobilisation of the Burundian people and the international community for the promotion of sustainable environmental management (National Environmental Strategy and Environmental Action Plan approved); the existence of skilled human resources with varying levels

of expertise since the establishment of the Higher Institute of Agriculture (ISA); a pattern of rainfall (nine months of rain a year in many regions of the country) conducive to the rapid growth of many forest species; a growing awareness on the part of the government of the importance of better forest cover, guaranteeing action, funding, and training for intensifying reforestation and rural forestry programmes; versatility of Burundian peasant farmers, enabling them to engage in crop farming, stock-raising, and forestry activities simultaneously (Banderembako, 2006).

Table 12 shows overall perception on risks for private sector investment in commercial forest plantation in Burundi. In general, there are very high risks associated with forest investments because of the political instability in the country and the lack of financial incentives that could attract large investment in forestry ventures. The lack of sufficiently large block of forest land also makes it impossible for big investment in forestry business in Burundi. For example, some of the *Pinus* plantations established in the 1980s were intended for a pulp and paper plant but this objective was finally abandoned largely due to lack of reasonable amount of raw material that would warrant investment in such an expensive plant (Beck *et al*., 2010). Governance issues and fiscal policy also impose high risk to forest investment because of corruption at the level of local authorities and police.

Table 12: Perception on risks for private sector investment in industrial forest plantation. Table Adapted from ITTO (2009).

	Risk for forest investment		
	Low	**Medium**	**High**
SUPRA (Macroeconomy)			
Growth of GDP			X
Exchange Rate	X		
Interest rate			X
Free Trade Agreements	X		
Political Stability and Government Transparency			X
Governance issues[1]			X
Fiscal Policy			X
INTER SECTOR			
Economic infrastructure			
– Transportation			X
– Energy/Utility			X
Social infrastructure: (water, sanitation, education, health)	X		
Licenses and permits			X
Labour			
– Laws and labour contracts			X
– Wages		X	
– Labour productivity		X	
– Labour qualification			X
Access to credit		X	
Justice and law enforcement			X
Capital gain policy			X
Land and resource tenure			
– Land tenure			X
– Land market			X
– Land use as collateral	X		
Sectorial policies			
– Environment policies and restrictions			X
– Agricultural policies and restrictions			X
INTRA-SECTOR			
Forest Resources (availability)			X
Subsidies and Financial Mechanisms		X	
Trade Restrictions (on forest products)			X
Markets			X
Entrepreneurial Development Service	X		
Forest Vocation Land (land suitable and available for forest)			X
Legal and Institutional Basis			X

1) How effectively government policies and measures are being implemented

3. OUT-GROWER SCHEMES AND OTHER WOODLOTS

3.1 Extent and impacts of out-grower schemes/other woodlots

The forest law recognises three main types of forest ownerships in Burundi, viz. State forests, Communes forests (Local governments) and forests belonging to private individuals. The majority of private forests belongs to farmers and is usually managed as woodlots and agroforestry (Beck *et al*. 2010). These micro-plantations are extremely important to rural livelihoods because they currently supply more than 97% of forest products (Gahengeri and Ndihokubwayo, 2011). Other private forests comprise forest plantations owned by organisations such as religious groups (churches, religious congregations), schools, cooperatives and tea plantation companies. The most common tree species planted in woodlots and agroforestry are *Eucalyptus sp*. (mostly *E. saligna, E. camaldulensis, E. grandis* and *E. maidenii*). Other species planted in woodlots and agroforestry systems are *Grevillea robusta, Callitris sp., Acacia mearnsii, Senna spectabilis, S. siamea, Leucaena sp., Calliandra sp., Cedrela sp., Ficus sp.* and *Markhamia* sp. The extent of woodlots and agroforestry as of 2010 was estimated at an equivalent of just over 65 000 ha with an estimated standing volume of c. 13 million m^3 (Forestry Department Reports; Albéric & Nzojibwami, pers. communication; FAO, 2010).

3.2 Factors shaping growth of out-grower schemes and other woodlots

Most of the efforts to implement the 1999 forest policy have related to the development of agroforestry and plantations for reforestation and to provide wood for energy (Koyo, 2004; FAO, 2010). Generally, private forest owners target fuelwood production and building materials (poles) for domestic and commercial purposes (Den Biggelaar, 1996). Since the 1980s, the Government of Burundi made a point of intensely involving local communities and private individuals and organisations in the afforestation effort. Indeed, most rural development and forest projects had an agroforestry component. Agroforestry seedlings were distributed free of charge and, consequently, farmers increased the number of trees grown in association with crops and also established mini-woodlots of *Eucalyptus sp*. Currently, these mini-woodlots and agroforestry areas cover more than 60 000 ha based on the number of seedlings distributed each year. This policy has tremendously changed the landscape of Burundi (Figure 6).

Figure 6: The landscape near Bujumbura showing the extent of trees on farms and woodlots.

The most popular agroforestry species to date is *Grevillea robusta*, followed by other exotics *Calliandra, Leucaena* and *Cedrella*, and the native *Markhamia* and *Ficus sp.* Tree nursery efforts were mainly state-subsidized and the community contributed work in the communal afforested areas (FAO, 2010).

In addition to the need of forest products for domestic and occasionally for commercial purposes, the ecological conditions conducive for tree growing have also greatly contributed to the establishment of private forests and woodlots especially in those parts of the country with high rainfall. In fact, in some parts of the country MAIs up to 60 $m^3ha^{-1}year^{-1}$ were recorded for Eucalyptus stands in some parts of the country at the age of five and eight years respectively (Vauron, 1992; De Ligne, 1992).

4. FOREST AND TREE TENURE

4.1 Current forest/tree tenure systems

In Burundi, forest and tree tenure is regulated by the same legislation as land tenure. The 1986 Land Code (currently under revision) and the customary tenure system provide parallel structures regulating access to land. The Land Code recognizes customary rights to land including fallow land. Under the customary, community-based system, land is held by individual heads of households. However, the Code requires that land held customarily be registered in order to be officially recognized (USAID, 2011).

The Land Code of 1986 recognises state and private land. State land includes land classified as public land (e.g., rivers, lakes) and private state land, which includes all state land not classified as public, including vacant land, forests, land expropriated for public use, and land purchased by the state. Under the law, all land that is not occupied is considered state land. Temporary rights of occupation are available on land classified as private state land. Landowners have the right to exclusive use and possession, the right to transfer land freely, and the right to mortgage their land. The Land Code allows for usufruct rights, leaseholds, and concessions (RB, 1986).

Under customary law, land in Burundi is generally held individually, rather than by lineage. Families obtained land through clearing and using the land or purchasing land. Individuals may also own rights to pasture land and forest areas. Access to the forest and grazing land is generally shared with neighbours and relatives, who are permitted to use the land for grazing and collection of forest products. Although, customary law used to recognise tree tenure separate from land tenure (i.e. the person planting trees had the right to benefit from the production, regardless of land ownership), under the prevailing situation of land shortage, such separate tree and land tenure systems has disappeared (Ngendabanyikwa, pers. communication).

Generally, as mentioned above there are three major categories of forest ownerships in Burundi (USAID, 2011):
(i) State forests;
(ii) Communes forests; and,
(iii) Private forest plantations.

Indeed, under the Forest Code of 1985 (currently under review and updating), forest land and resources are owned by the state, communes (local authorities –local government), or private individuals. The Forest Code rules over all forests, regardless of ownership, and sets various restrictions on forest use. However, in most areas of the country, especially due to the political crisis which has prevailed in the country since 1993, the Forest Code is not enforced. In fact, the dependence of the population on forest resources for livelihoods is great, and the forest service lacks human and financial capacity to enforce the restrictions on access and use (Koyo, 2004).

State forests include natural forests, which are inalienable and within either national parks or protected forest reserves. State plantations are usually 10 or more hectares. All smaller state plantations (below 10 ha) have been allocated for management to Communes. Protected landscapes are areas that have integrated state forest land (primarily plantations) with private

agricultural and forest land in an effort to encourage local residents to protect the forests. Generally, the management of state and communal plantations and protected landscapes has been haphazard. The need for fuelwood, access to agricultural land, timber for construction and security has resulted in the loss of many plantations (Koyo, 2004; Athman *et al*., 2006). Private forests are usually managed as micro-plantations and agroforestry (Koyo, 2004). Although forest statistics on Burundi are not reliable because they vary from one author to the other (the last forest inventory was done in 1976 (Ndabirorere, 1999; FAO, 2010b), Tables 13 and 14 present statistics provided by the Forestry Department in terms of forest ownership distribution and forest use/management systems in 2010. It should be noted that in Table 14, forest plantations managed by local governments (18 810 ha) have been added to those under community management (1 095 ha, which were transferred from state forests to community organisations in 2010). There were no records on forestlands owned or managed under customary law.

Table 13: Burundi: Forest ownership structure (tenure) in 2010. Source: Forestry Department (2010), Nyengayenge (pers. communication).

Category of owner		Area (ha)	Per cent
State (Central government)	Natural forests	55 000	24%
	Plantations	93 000	40%
Communes (local governments)		18 810	8%
Private (farmers, schools, tea companies, churches, etc.)		65 226	28%

Table 14: Burundi: Forest use/management systems of natural forests and plantations in 2010. Source: DF (2011), Nyengayenge (pers. communication).

Category of manager/user	Area (ha)	Per cent
Exclusively Govt controlled	146 905	63%
Privately managed	65 226	28%
Community managed	19 905	9%

4.2 Impacts of forest/tree tenure on poverty alleviation and SFM

The current forest/tree tenure promotes establishment of private plantations and woodlots and is therefore conducive for raising income from tree planting activities. However, it has been noted that clearing or degrading of forests comes from a huge demand of wood energy (around 97% of fuel used) through firewood in the rural areas and production of charcoal for the urban centres (RB and UNDP, 2008). The harvest occurs both legally and more often, illegally, on state lands. The price of a bag of charcoal may be a good indicator to better understand the pressure and state of the forests. Five years ago, a charcoal bag in Bujumbura would cost around US$ 3 and today it may go up to US$ 10-25 (Beck *et al.,* 2010). The rising price of charcoal may contribute to degrading forests (particularly public ones) but also to the improvement of livelihoods of rural charcoal makers.

Fire has been reported as one of the important threats to the forests in Burundi (FAO, 2010; Beck *et al.,* 2010). Fires are generally more frequent on state owned forests than on private ones. Generally, private woodlots are more closely managed using firebreaks and other basic practices and are harvested once it is economically profitable. In fact, in addition to accidental bushfires (fire in savannahs for cattle grazing or slash-and-burn agriculture plots escaping beyond the intended area), intentional human-started fires (purposefully set fires) in State forest plantations as acts of civil disobedience or similar reasons were reported by Beck *et al*. (2010). The recent introduction of participatory forest management in parts of the country will likely contribute to reducing illegal activities currently reported in state forests.

Another threat to sustainable forest management in Burundi is the lack of physical demarcation of the different forest ownership and management areas. This lack of clarity opens the door to illegal and unsustainable uses of public forests. This will likely be addressed through classification of forest lands that was proposed in the 1985 forest code (but was never implemented) and which will probably feature in the new forest law being reviewed and a comprehensive forest inventory (Nyengayenge, pers. communication).

4.3 Suggestions for improvement of tenure system

Currently, the restrictive approach to sustainable management of forests prevails over the participatory approach. However, FAO (2010) argued that people fail to understand the interest of this formal ban on the exploitation of forests through the restrictive approach to management which utterly ignores their own interests. Joint management of forest resources should be a concern shared by the state services, the rural people who are basically the direct beneficiaries and all partners in development. Gahengeri and Ndihokubwayo (2011) have recently reported pilot projects of participatory management of the state-owned forests initiated in 1999 in two provinces in the North of the country which have shown promising results for effective sustainable forest management. In fact, after more than ten years of implementation, this initiative has proved to be efficient in ensuring rational management of forest resources, enhanced livelihoods of beneficiaries, land tenure security and environmental protection.

Other suggestions would be the revision and enforcement of prescriptions in the forest code, the land code and the environmental code which contain laudable guidelines but are often not implemented due to lack of human and financial resources. Moreover, establishment of physical demarcation of the different public forest plantations and management areas through a comprehensive forest inventory, classification of forest lands and creation of forest cadastre may help in limiting abuse and illegal ventures in forested areas.

5. FINANCIAL AND HUMAN RESOURCES FOR PLANTATIONS AND OUTGROWERS/WOODLOTS

5.1 Current financing mechanisms

Afforestation and reforestation activities in Burundi have been supported by the government since the colonial period. In fact, the establishment of community woodlots was made compulsory already in 1931. Later, a vast afforestation programme was launched in 1978 by the Government of Burundi with the support of various external donors. The objective of the programme was to restore forest cover over 20% of the national territory (FAO, 2002). However, during recent years, there is seemingly no big push for reforestation or expansion of protected areas in Burundi, which is possibly due to land availability and real or perceived land constraints (Beck *et al.,* 2010).

Currently, practically all national and internationally funded projects are promoting agroforestry techniques, primarily the contouring of hillside farms and creation of terraces to better stabilise soil while also improving soil fertility (Beck *et al.,* 2010). These projects include the Watershed Management Project (PABV) funded by the African Development Bank (ADB), the Agricultural Rehabilitation and Sustainable Land Management Project (PRASAB) funded by World Bank/Global Environment Facility (GEF), the Lake Tanganyika Authority and the Nile Basin Initiative under UNDP/GEF funding, and French cooperation projects. They operate on the assumption that improving and stabilising agriculture through integration with multiple benefit agroforestry is likely to lead to decreased pressure on remaining natural and plantation forests (Beck *et al.,* 2010).

In 2009, the government of Burundi granted approval to Ecosystem Restoration Associates (ERA), a subsidiary of the Canadian ERA Carbon Offsets Ltd, to proceed with the design of a reforestation carbon offset project within and adjacent to the Kibira National Park. ERA is implementing the project through the Green Belt Action Group (ACVE) and the Rural Development Foundation (FDMR) and has promised to use local labour for the establishment and maintenance of nurseries, planting, tending seedlings, and forest protection. The government transferred the rights to the carbon offsets to ERA, which will sell them on the voluntary carbon market. ERA has pledged to use a portion of the proceeds to create income-generating programmes for local communities (ERA, 2010). The Sustainable Energy through Woodlots and Agroforestry in the Albertine Rift (SEW) project and Catalyze Accelerated Agricultural Intensification for Social and Environmental Stability

(SEW/CATALIST/IFDC), with funding from the Netherland' DGIS and executed by staff of IFDC, was launched in 2009 and is operational in DRC, Rwanda and Burundi. It intends to establish 6 000 ha of private woodlots in each country by 2012 (Nzojibwami, personal communication).

The *Institut National de l'Environnement et de la Conservation de la Nature* (INECN) has engaged local communities in forest management programmes in Kibira National Park since the 1970s. The programme has had various components over the years, including plantation development and ecotourism activities (Nzojibwami, 2003). Burundi is a partner country within USAID's Central African Regional Programme for the Environment (CARPE) initiative aimed at promoting sustainable natural resource management in the Congo Basin. CARPE programmes help governments implement sustainable forest and biodiversity management practices, strengthen environmental governance, and work to monitor forests and other natural resources throughout the region. The National World Conservation Union (IUCN) Committee of the Netherlands initiated a € 68 680 Valorisation of Native Tree Species of Burundi project in 2009 to improve awareness, knowledge, and hands-on experience on the potential role of indigenous tree species in agroforestry in Burundi. The US Forest Service plans to partner with the government and United States Agency for International development (USAID) to assist in the development of improved watershed level resource protection efforts, including nurseries, reforestation, and erosion control, and strengthen the policy framework protecting forests of Burundi (Beck *et al.,* 2010). The last large watershed protection programme in Burundi was funded and managed by UNDP and Food and Agriculture Organisation (FAO) in the late 1990s and early 2000s. The project was active in five areas of the country and included components dedicated to reforestation of rocky ridges to reduce runoff and limit the impact of erosion (Koyo, 2004).

A number of local NGOs are also involved in tree planting and forest conservation in Burundi, including: Association of Women for the Environment in Burundi (AFEB), which sensitises people located near Kibira National Park on forest protection and other initiatives for the conservation of forests, water, and soil so as to prevent over-exploitation of Kibira's natural resources; ACVE (Action Ceinture Verte pour l'Environnement) which is currently revising the forest code; ENVIRO PROTEC, *Association Burundaise pour la Protection des Oiseaux* (ABO), *Organisation de défense de l'environnement au Burundi* (ODEB), *Association des Femmes pour l'Environnement au Burundi*, *Association pour le Développement Intégré et la Conservation de la Nature* (ADICN), and *Centre de Médecine Traditionnelle de Buta* (at an early stage of implementing two pilot IUCN Landscape and Livelihoods Strategy projects – one outside Kibira and another outside Bururi Natural Forest Reserve); CARITAS Belgium (helping local people plant trees marking the limits of Ruvubu NP near Muyinga) and *Reseau Burundi 2000 Plus* with UNDP Small Grants Programme funding (helping to protect the biodiversity of Ruvubu by providing improved wood stoves and economic alternatives for local populations in Mutumba) (Beck *et al.,* 2010).

Table 15 presents estimates of budget and expenditure on forestry activities in Burundi. It was neither possible to get detailed recurrent/development budgets nor detailed actual recurrent/ develop-ment expenditures from the documentation accessed.

Table 15: Plantation management budgets. Sources: DF (2011), Nzojibwami (pers. communication).

Funding sources and Programmes	Budgets in US$	Period
Government of Burundi		
➢ Support to Forest Investments project	38 342	2010
➢ Support to the management of Industrial Plantation Blocs project	33 333	2010
➢ Support to the promotion of Multi-functional Centres of wood production project	16 667	2010
➢ National Reforestation Programme (firebreaks opening/cleaning)	457 088	2010-11
Donors		
➢ Support for the Promotion of Periurban and Agroforestry Plantations for the Production of Fuelwood and Building Poles (FAO) funding	71 667	2010
➢ Integrated Watershed management project (PABV) (ADB)	9 000 000	2006-10
Private		
➢ SEW/CATALIST/IFDC	8,300,000	2009-12
TOTAL	**17 917 097**	

5.2 Potential financing mechanisms

Potential financing mechanisms of forestry activities in Burundi include the Climate Change Adaptation Fund, Least Developed Countries Fund (LDCF), the Green Fund, the Clean Development Mechanism (CDM) under the United Nations Framework on Climate Change Convention (UNFCCC), as well as the Voluntary Carbon Market (VCM) (Beck *et al.,* 2010). Already in 2009, the ERA, a subsidiary of the Canadian ERA Carbon Offsets Ltd, initiated a project through the Green Belt Action Group (ACVE) and the Rural Development Foundation (FDMR) which use local labour to establish and maintain nurseries, tree planting, woodlots management and forest protection within and around the Kibira National Park. ERA has pledged to use a portion of the carbon trade proceeds to create income-generating programmes for local communities (ERA, 2010).

5.3 Human resources

The majority of forestry sector professionals have been trained in two main higher learning institutions in Burundi: ISA (*Instutut Supérieur d'Agriculture* - Higher Institute of Agriculture) and ITAB (*Institut des Techniques Agricoles du Burundi* – Technical Agricultural Institute of Burundi). FAO (FRA 2010) reported that from 1985 to 2005, ISA had graduated 193 forestry technicians (Diploma level, A1) while ITAB had produced about 228 graduates (Certificate level, A2) by 2001 (Bigawa and Ndorere, 2002). However, these graduates are apparently notably deficient in professional modules including Forest Inventory and Cartography, GIS, Forest management planning, extension methods and forest certification.

INECN (*Institut National de l'Environnement et de la Conservation de la Nature*) and the Forestry Department are the main employers of forestry technicians. The two institutions have shortage of staff in terms of quantity and qualification (Table 16). Other forestry professionals are employed by the agricultural research institute (ISABU - *Institut des Sciences Agronomiques du Burundi*) while others are working in various projects with agroforestry or forestry components (Table 16).

Table 16: Burundi: Forest sector human resources (2010). Sources: Bigawa and Ndorere (2002); Forestry Department; Bernadette and Nyengayenge (pers. communication).

Institutions	Degree holders	Diploma holders	Certificate holders	Skilled workers	Gaps
Forestry Dept.	30	42	39	56 forest guards	128 degree 512 diploma 2 048 certificate 168 forest guards
INECN	11	15		166 forest guards 10 tourist guides	10 degree 60 diploma 10 tourist guides
ISABU	2	1			**2 936**
Subtotal (public):	**43**	**58**			
Local NGOs	10				
International NGOs	4				
Consultants	2				
Subtotal (private)	**16**				
Grand total	**59**	**58**	**39**	**232**	**2 936**

Note: The inventory of Forestry staff especially for those in the private sector has not been exhaustive.

5.4 Other resources

Burundi has abundant cheap unskilled labour for forestry work, from nursery to forest harvesting and products processing. Recently, compulsory communal work has been instituted so that every Saturday people have to do communal works including cleaning of roads and tree planting during planting season.

The Forestry Department has old offices that have to be renovated. There are also offices or old buildings left in various forest project HQs during the 1980s in different parts of the country. The

Forestry Department offices are connected to the internet but with very low or poor connectivity. The Department has several computers in its offices and laptops for some of the staff. Technicians working in the field are allocated with motorcycles. The Forestry Department has three Mercedes Benz Lorries and one Nissan Pick-up. Forest records are kept in some offices on poorly maintained shelves. The filing system of forest records need to be improved in order to allow for proper follow up of forest resources and ensure their proper management.

Most of the projects supporting the national reforestation programme have facilities such as vehicles, offices, computers and motorcycles that will be left to the Forestry Department at the end of project implementation periods. It has not been possible to make a full inventory of all these equipment and facilities.

6. INCENTIVES FOR PLANTATION ESTABLISHMENT BY PUBLIC/PRIVATE SECTOR AND OUTGROWERS

6.1 The rationale behind incentives

Incentives for tree planting and forest management are indispensable in Burundi mainly due to high population density and the resulting land shortage, forest use is facing huge competition with agricultural land use. In fact, more than 90% of the population practice subsistence agriculture and therefore need land for survival. Therefore, there is need to motivate farmers to plant trees on their precious land together with food crops.

Another common rationale for incentives is the long term investment nature of the forest plantation business. In most tropical countries like Burundi, it may take at least 5 years before any harvest of timber products. In many parts of Burundi, during this period, this afforested land could have produced agricultural crops for about ten growing seasons.

Furthermore, forests are public goods because they benefit not only the owner in terms of products harvested but also the public in terms of environmental services such as soil conservation, water catchment, carbon sequestration and recreational values emerging from the presence of forests. Incentives are therefore exceptionally relevant in order to motivate private and other corporations to establish and manage sustainably forest plantations and woodlots.

6.2 Current incentives: impacts and effectiveness

In Burundi, there are two major incentives practiced by the government and supporting projects, namely distribution of free seedlings during the tree planting season and initial woodlot establishment support (Table 17). Free distribution of seedlings has been practiced since the colonial period but more intensely during the late 1970s and early 1980s (FAO, 2002). More recently, between October 2008 and March 2009, c. 2 171 000 agroforestry seedlings were nursed and planted in Burundi through the CATALIST project (Helpage, 2009). This policy of availing tree seedlings to all interested citizens during tree planting season has greatly contributed to the transformation of the landscape which is tremendously endowed with trees and woodlots as lines or scattered on farms (Figure 7).

Table 17.: Incentives for plantation development. Sources: Nzojibwami (SEW/CATALIST/IFDC), Nyengayenge (Personal communication)

Type of incentive	Brief description of incentive	Source and period	Target group	Outcomes/impacts & shortcomings
Annual free seedlings distribution	Free seedlings are distributed during the tree planting season throughout the country	Government and projects annually	All interested people particularly rural farmers in proximity of protected areas	Thousands of trees are distributed and planted annually. Due to poor follow up or planting techniques there are low survival rates
Assistance to establish woodlots	Farmers provide land and about 20% of initial woodlot establishment and tending costs (in the form of labour)	SEW/CATALIST/IFDC since 2009. The project works also in DRC and Rwanda.	Farmers in selected Provinces where the projects are operational (Bujumbura, Mwaro, Bururi, Muramvya, Karuzi, Kayanza)	Farmers are happy about the scheme and about 4 250 ha have been established since the launching of the project in 2009

Figure 7: Free seedling distribution has highly contributed to increasing the practice of agroforestry (Photo near Bujumbura on the road to Bugarama).

The facilitation of establishment of woodlots on private lands is another incentive recently introduced by some NGOs and Carbon credit projects. Farmers are encouraged to avail land and the project provides labour for initial woodlot establishment and tending. For instance, the Sustainable Energy Production through Woodlots and Agroforestry in the Albertine Rift (SEW)/Catalyze Agricultural Intensification for Social and Environmental Stability (CATALIST) project funded by the Netherlands' DGIS and implemented by staff from the organisation IFDC (SEW/CATALIST/IFDC). This project pays 80% of initial woodlot plantation and tending while the owner contributes 20% generally in terms of labour.

6.3 Suggestions for improvement of incentives

There is need to sensitise more people on incentive schemes because in some instances some farmers become suspicious of the intention of the sponsors. In fact, some farmers think that the government may come afterwards to annex their lands (Nyengayenge, pers. communication). Currently, the private woodlot establishment facilitation project is implemented only in six provinces where the SEW/CATALIST/IFDC project operates. Given the success so far achieved, this incentive scheme should be extended to all the provinces of the country if financial logistics allow it. In the case of free seedling distribution, the Forestry Department should design a monitoring and evaluation system to ensure that freely distributed seedlings are well planted and well-tended

particularly in the few months following plantation. An accounting system of distributed seedlings should be established in order to reduce unnecessary expenditures on producing seedlings that will end up dying because they are not well planted or not planted at all.

7. SUPPLY AND DEMAND OF FOREST PRODUCTS

7.1 Supply scenarios and projections

In Burundi most forest actors including even forest projects and businessmen do not keep regularly records and therefore it is impossible to get reliable statistics on annual wood removals from plantations. Estimates provided in Table 18 have been compiled basing on the survey of wood processing mills, secondary information gathered from various documents from the Forestry Department and Ndabirorere (1999) with about 0.045 m^3, 0.02 m^3 and 0.80 m^3 per capita per year respectively for industrial roundwood, domestic poles and woodfuels. Proportions of removals were estimated on the basis of percentage of forest areas per category of plantations as follows 30%, 5% and 15% for state and commune forest each for industrial round wood, domestic poles and wood fuels respectively. Private institutions (such as Tea factories, Schools, etc.) are allocated only 5% contribution to annual removals while the remaining proportion is taken over by outgrowers/woodlots and agroforestry.

Table 18: Wood removals (m^3) from plantations and natural forests 2010. Sources: Forestry Department Reports, Survey 2011, Ndabirorere (1999).

Forest plantation / Management unit	Industrial round wood*	Domestic poles	Firewood and charcoal	Total
State Forest Plantations	191 496	14 185	1 701 187	1 907 868
Commune Forest Plantations	38 732	2 869	344 281	385 882
Sub-total (public sector)	230 228	17 054	2 046 468	2 293 750
Tea factories, prisons, schools, etc.	19 186	0	341 078	360 264
Out-grower /other woodlots	134 299	15 349	4 434 013	4 583 661
Sub-total (private sector)	**153 485**	**15 349**	**4 775 091**	**4 943 925**
Grand total	**383 713**	**32 403**	**6 821 558**	**7 237 675**

Note: Here industrial round wood = Sawtimber ***and*** industrial poles because there are no other forest industries.

The total population of Burundi was estimated to be c. 8.5 million in 2010 and the assumption was that all wood needs are met through local wood removals. It should be noted, however, that this may not be true because some fuel needs are met through other means, such as crop residues, prunings and thinnings that are not accounted for in forest production. Moreover, for industrial roundwood and poles, some demands are supplemented through imports from other countries.

The Annual Allowable Cut (AAC) on the basis of the Mean Annual Increment (MAI) from all forest plantations is provided in Table 19. It should be noted here that all natural forests are protected by the law and should not be harvested. Public plantations can be harvested through public auctions but not all public forest plantations can be harvested for ecological reasons. Moreover, not all tree resources outside forests (TRoF) can be harvested because some of them belong to the public domain like along roads, rivers and around lakes. Therefore, for the purpose of estimating potential supply of wood products, it was assumed that public forest plantations and private plantations/woodlots as well as other TRoF that are available for harvesting make up about three quarters (75%) of all these forest resources.

Table 19: Annual wood production based on MAI and forest areas (2010).

Forest plantation / management unit	Area (ha)	Average increment (m^3/ha/yr)	Annual total allowable cut (m^3)	Available annual allowable cut (m^3)
Natural forests (protected)	55 000	2	110 000	0
State forest plantations	93 000	9	837 000	627 750
Commune forest plantations	18 810	9	169 290	126 968
Woodlots and agroforestry	65 226	15	978 390	733 793
Total	**232 036**	**-**	**2 094 680**	**1 488 510**

In Table 20, two scenarios are presented for projected AAC for the years 2015-2030; *Scenario 1* shows AAC on the basis of total forest area (potential forest product supply), while *Scenario 2* projects AAC as sustainable forest product supply, i.e. AAC in real conditions where some forest plantations cannot simply be harvested for ecological or other reasons (it is assumed that only 75% of all forest plantations, woodlots and TRoF can be available for production). Since the political target of the country is to attain 20% forest cover of the country (560 000 ha), another general assumption made was that the area of forest plantation categories (natural forests are excluded) will grow at a rate of 5% annually until the forest cover reaches 20% of Burundi. The MAI is assumed to remain constant (as in Table 19) even though with improved forest management, it might also increase with time.

Table 20: Projections of potential and sustainable supply of forest products (1000 m^3). For description of scenario 1 and 2, see text above.

Forest plantation / management unit	2015		2020		2025		2030	
	Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2	Scen. 1	Scen. 2
State forest plantations	1 068	801	1 363	1 023	1 740	1 305	2 221	1 666
Commune forest plantations	216	162	276	207	352	264	449	337
Woodlots and agroforestry	1 249	937	1 594	1 195	2 034	1 526	2 596	1 947
Grand Total	**2 533**	**1 900**	**3 233**	**2 425**	**4 126**	**3 095**	**5 266**	**3 949**

Table 21 was compiled from various reports on wood consumption, wood market and sawmill survey 2011, and Forestry Department reports. A comparison of the total AAC in Tables 19 and 20 shows a great deficit and if the consumption estimates are realistic, forest resources will be rapidly depleted over the coming years. However, as mentioned above, not all forest products are acquired through harvesting of forest plantations. Most rural dwellers uses alternative sources of energy or simply uses those parts that are irrelevant in forest inventory such small branches, pruning and some thinning products. They often also use crop residues or other non-tree combustible products.

Table 21: Production, trade and consumption of wood and wood products (2010). Sources: Ndabirorere (1999), Survey 2011 and FAO (FRA 2010, FAOSTAT).

Forest product Plantations / woodlots	Production	Imports	Exports	Consumption
Woodfuel (firewood and charcoal) (1000m^3)*	1 174	NA	0.4	6 821
Industrial roundwood (1000m^3)	384	0.6	3.3	381
Sawnwood (1000m^3)	96	4	1.2	98
Pulp for paper (tons)	NA	137	NA	137
Paper and paperboard (tons)	NA	5 880	153	5 880
Domestic poles (1000m^3)	171	-	-	171

Note: Woodfuel (firewood and charcoal) (m^3) production is estimated as total Annual Allowable Cut sub-tracting the Industrial roundwood processed to sawnwood at 25% conversion efficiency and domestic poles consumption (and assumed equal to production).

The projections of wood products demand is based on 2010 baseline and population increment of 3% per annum reducing to 2.6% by 2020 and afterwards, increasing from 25% to 35% sawn wood conversion efficiency by 2020 (*Table 22*). The wood deficit will continue therefore to rise despite measures to increase forested areas and sawn wood conversion efficiency.

Table 22: Current and future demand of plantation and natural forest wood (1000 m^3).

Forest product Plantations/woodlots	2010	2015	2020	2025	2030
Woodfuel (firewood and charcoal)	6 821	7 907	9 167	10 422	11 849
Industrial roundwood	381	445	516	586	667
Sawnwood	98	111	129	205	233
Pulp for paper (tons)	137	159	184	212	245
Paper and paperboard (tons)	5 880	6 817	7 902	9 116	10 517
Domestic poles	171	198	229	261	296

7.2 Consumer prices 2010

There are no wood processing industries in Burundi with the exception of sawn wood (for furniture and other uses) and construction wood (such as building timber, poles and posts). The greatest proportion of sawlogs in Burundi is mainly processed by hand using the pit sawing technique with a frame constructed from poles set on a slope to allow access underneath the log.

The forest trade flow in Burundi is a mix of direct consumption, barter and sales. The prices of forest products vary from one place to another (generally being higher in major towns and the city of Bujumbura) and from one species to another. Nevertheless, transactions between private dealers often follow market price laws and can go up when there is a lack of products or go down when products overflows the market (Survey 2011; Nyengayenge, pers. communication) as shown in Table 23.

Table 23: Prices (US $ per m^3) of local and imported timber in Bujumbura in 2011. Sources: Forestry Department Staff (pers. communication), Survey 2011.

Forest product	Price (local)	Price (imported)	Countries of Origin
Industrial roundwood	100-180		
Sawnwood			
Grevillea	85-165		
Pinus	85-165		
Cypress	85-165		
Charcoal (1bag=35kg)*	10-25		
Milicia (Mvura/Mvule), Mahogany (Libuyu), Redwood (Licheche)		300- 450	DRC, Tanzania

Note: Charcoal making is done in both plantations/woodlots and natural forests (illegal).

7.3 Forest products trade

Table 24 shows statistics of wood and wood products trade gathered from mainly from FAOSTAT and Forestry Department. It is assumed that since harvesting in natural forests is prohibited, all the forest products originate from forest plantations and woodlots. In general, there has been increased imports of paper and paperboard in recent years, especially from 2008. The amount of wood-based panels imported is on the increase since 2007 probably as a result of the booming up of the construction industry following improving political stability. As for the exports, the industrial roundwood is the major wood product exported which remarkably rose up in 2002 though slightly went down in recent years (Table 24).

Table 24: Trade in wood and wood products 2001 – 2010. Sources: FAOSTAT (2011); Survey 2011.

Year	Sawnwood (m^3)	Industrial roundwood (m^3)	Wood-based panels (m^3)	Pulp for paper (tons)	Paper and paperboard (tons)
Imports					
2001	0		600	0	200
2002	0		600	0	228
2003	0		657	46	711

2004	1	234	897	240	2 681
2005	1	234	897	240	2 681
2006	1	235	608	240	1 148
2007	20	1 464	1 500	113	1 261
2008	22	44	1 429	137	2 004
2009	150	635	1 455	137	5 880
2010	4 000	635	1 455	137	5 880
Exports					
2001	0	0	0		0
2002	11	3 602	39		12
2003	1 013	4 505	39		12
2004	154	6 856	39		22
2005	154	6 856	39		22
2006	108	6 856	118		23
2007	99	3 201	125		89
2008	91	3 210	140		120
2009	1 154	3 270	33		153
2010	1 154	3 270	33		153

8. FOREST ROYALTIES AND OTHER REVENUES

8.1 Forest royalties and licences

8.1.1 Structure and amount of forest royalties and licences

The management of forests and forest products is the responsibility of the Forestry Department of the Ministry of Land Management, Tourism and Environment. There are generally two types of permit fees prescribed by the forest code of 1985: a felling permit (per tree cut by area or volume) and a forest products transport permit. These permits are issued by the Forestry Department and the costs depend on the species concerned and the quantity (Ngendabanyikwa, pers. communication).

Before 2000, royalties on standing wood were set simply on area basis and not on wood volume unit. The value was then 27 000 Burundi Francs per hectare (about 50 US$/ha). In 2000, harvesting permits for fuelwood and timber started to be based on standing wood volume, wood quality and distance from Bujumbura as follows (FAO, FRA 2010):

- 1 650 BUF (1.6 US$) per m^3 for wood located less than 50 km from Bujumbura;
- 1 150 BUF (1.2 US$) per m^3 for wood located between 50 and 150 km from Bujumbura;
- 800 BUF (0.8 US$) per m^3 for wood located beyond 150 km from Bujumbura; and,
- 9000 BUF (9 US$) per pole (industrial roundwood).

Starting from 2004, standing wood prices were revised and generalised as shown in *Table 25*.

Table 25: Fixed prices of standing wood for saw timber, fuelwood and lumber (2004-2010). Sources: Nyengayenge (pers. communication) ; FAO (FRA 2010).

Year	Fuelwood		Saw timber		Lumber	
	(BUF/m^3)	(US $/$m^3$)	(BUF/m^3)	(US $/$m^3$)	(BUF/m^3)	(US $/$m^3$)
2004-2006	1 400	1	4 350	4	2 950	3
2007-2010	2 414	2	5 495	5	4 000	4

Note: Average Exchange rate from 2004-2009: 1 US $=1 100 BUF (BUF= Burundi francs)

Before 2000, forest royalties/licenses, i.e. the money anyone needing to acquire a harvesting permit in a public forest plantation must pay, were set on an area basis, equivalent to c. US$ 50 per ha, After that year, the royalties and licenses were set in volume, viz. 3 US$ per m^3 between 2004 and 2006, and 4 US$ per m^3 after 2007. In general this is the money anyone needing to acquire a harvesting permit in a public forest plantation must pay.

8.1.2 Suggestions for improvement of forest charges and licences

The Forest Code is currently undergoing revision with the intention of adapting to current socio-economic conditions and the state of the environment, to favour competition within the timber trade, to set up more strict measures to control legal and illegal logging and increase timber revenues. Regulation and fiscal incentives are among the tools that could help enhance the perception of forest charges and licenses. Therefore, the current fiscal system on forest products commercialisation and transportation business should be revised. New fiscal regulations and incentives should be introduced in the new forest code as well as aspects of participatory forest management. In fact, most businessmen complain about various forest product taxes and would like them to be reduced as an incentive to invest in forestry business (Nzirikwa, 2005).

8.2 Forest concessions/permits

8.2.1 Current concessionaires/permit holders

Harvesting timber in public or state forest plantations requires acquisition of a permit delivered by the Forestry Department for state forests or by commune authorities for communal forests. The forest law instructs that there should be public announcements (public auctions) of sales of standing stocks. In such announcements, the concession subdivisions to be cut are specified and supervision of harvesting and other operations in the concession are carried out by staff of the Forestry Department or the Communes. The number of permits issued varies from year to year. There are no long duration concessionaires so far recorded in the country except the recent harvesting contract established with a number of forest entrepreneurs for harvesting line plantations (along principal roads) in Gitega, Cankuzo and Ruyigi (DF, 2011). For example, in 2010, forest harvesting permits for a total value of c. US$ 12 150 (14.5 million BUF) were issued to 14 different individuals and organisations to harvest poles, fuelwood and timber from these line plantations.

8.2.2 Monitoring of compliance

The management of all public or state forests and afforested areas is regulated by the forest code. Harvesting is permitted either under government supervision by the forest services or by private parties. The forest code requires for public announcements of sales of standing volumes, specification of the concession subdivision to be cut, organisation of tree marking and supervision of harvesting and other operations on the forest site (Nzirikwa, 2005). Afforested areas greater than 10 ha in size belonging to the private sector or public companies are also required to have a management plan agreed with the Forestry Department. Currently, harvesting in natural forests is prohibited because they are all protected by law.

Transportation of forest products, whether from private, communal or state forests require a transport permit and a copy of a valid harvesting permit or proof of forest ownership for private forest owners. There are several road blocks for controlling transport of forest products throughout the country and particularly on major entrances to Bujumbura and other important towns in the

country. The other purpose of the control road blocks is to register quantities of all forest products that transit through them. For example, in 2010, out of a total of 48 207 charcoal bags intercepted at road blocks on entrances to Bujumbura, 58% were legal and 42 % were illegal (DF, 2011).

8.2.3 Suggestions for improvement of concessions/permits

The forestry service, local and central administration and businessmen don't have the same interpretation of the objective of forest taxation (Nzirikwa, 2005). For the businessman there are many taxes to pay before and after acquiring the harvesting and transport permits. Thus, for the timber businessman, forest taxation is an administrative harassment and there is great temptation for corruption to pass smoothly across various control road blocks. Furthermore, while local and central governments consider forest taxation as a source of income, the forestry service considers forest taxes as a way of ensuring protection of forests against abuse and illegal timber removals (Nzirikwa, 2005). There is need to harmonise the views of all stakeholders in order to attract investment in the forest sector and sustainable forest management. Instituting a one tax policy would also be appreciated by forest products businessmen.

8.3 Administration of forestry revenue system

8.3.1 The process of setting forest royalties and taxes

Royalties and taxes are usually proposed by the forest service and approved by the Ministry in charge of forestry through ministerial instructions or ordinances (Nyengayenge, pers. communication). The harvesting and transport permits/licenses are usually issued by the Forestry Department after producing a deposit slip of required payment taxes on the Central Government revenue account in the Bank of the Republic of Burundi (BRB). For the harvesting permit, the payments are as shown in Table 25. As for the transport permit, the transporters of forest products pay 5% of the value of the products (Ndabirorere, 2005).

Nevertheless, in addition to government forest taxes (royalties), there are other taxes requested by local governments of Communes and town municipalities (particularly the city of Bujumbura). These taxes usually vary from one commune to another or from one municipality to another.

8.3.2 Monitoring and collection of revenue

As mentioned above, the Forestry Department runs several control road blocks for monitoring movement of forest products in the country, especially at entrances to major cities. On such control points, documents related to source of products, harvesting permit, forest ownership proof for private forest owners and transport permit are thoroughly checked and the quantities of products are registered (Forestry Department, 2010). Those who don't have proper documents are imposed penalties including fines or withholding the consignment and its public auction. In order to reduce incidence of corruption, all payments are normally paid in the bank and a receipt is issued upon exhibition of a deposit slip. Normally, no police or Forestry Department staff is allowed to receive cash. However, according to Nzirikwa (2005), there are many loopholes in the revenue collection system and many illegal forest product dealers either corrupt staff on control points or simply pass through other entrances circumventing the check points.

8.3.3 Total forest revenue collection

The exact amount of revenue generated from forestry business is not easy to know due to the nature of the business which is a mixture of direct consumption, barter or other informal exchange mechanisms and market sales. Furthermore, some taxes such as those for municipalities or Communes are often not well registered as from forestry per se but in the general basket of natural resource revenues.

The total amount of revenue recorded by the Forestry Department in 2010 from transport permits of forest products, harvesting permits, sales of wood and forest seed was estimated at an equivalent of c. US$ 210 000. However, this figure ignores other sources of income such as forest

exports, non-wood forest products and service including employment in the public and private sector. The value added in the forestry sector in Burundi in the 1990s was estimated at around US$ 35-45 million per year (between 4 and 6.5 % of GDP), whereas it dropped to 1.8 to 3 million US$ in recent years (c. 2 % of GDP). The reason for this decline is not quite clear. Actually, according to the Customs Department, the value of timber and wood products has increased greatly since 2005 and was estimated to about US$ 2 225 000 for the period from June 2005 to March 2007 (Forest Monitor, 2007) probably as a result of increased timber demand in the construction industry.

8.3.4 Suggestions for improvement of revenue collection systems

The introduction of a single forest tax could assist in reducing the complaints of forest businessmen of harassment and time wasting. This would probably attract more investment in the forest sector.

9. PROCESSING OF PRODUCE

9.1 Ownership and types of industries

The wood processing business sector in Burundi is generally characterised by individual businessmen and informal groups, there is no industrial scale processing. Even though the sector is employing a notable size of rural and urban dwellers, it is not formally organised and only individual initiatives based on market flow can be observed (Bararwandika, 2000). In fact, pit sawyers, secondary processors and charcoal makers are informally organised in cooperatives and self-formed associations.

The main commercialised forest products are firewood, charcoal, construction wood (poles, posts and lumber) and sawn wood for furniture. Thus, wood processing for furniture and construction timber is the only forest industry in Burundi (Table 26). In most harvesting sites, due to topography and undeveloped wood technology, sawlogs are generally sawn by hand using the pitsawing techniques (Figure 8). A few sawing and wood working machines are found in Bujumbura City for processing and finishing already sawn timber before final consumption by construction industry or further processing in carpentry, woodcraft workshops.

Table 26: Current and potential capacity of forest industries utilizing plantation and natural forest wood and NWFPs 2010. Sources: Survey 2011, Forestry Department (Nyengayenge, pers. communication).

Owner	Type of forest industry	Current capacity (m3)	Integration with forest plantation	Potential capacity (m3)
Individuals and associations (both in rural and urban areas)	Sawmills (Timber processing workshops) and carpentry workshops	80 000	Middlemen for sawn timber transportation	100 000

9.2 Raw material supply and quality

The supply of quality timber such as premium hardwood timbers including *Pterocarpus angolensis, Milicia excelsa*, Libuyu (various mahogany species like *Entandrophragma cylindricum, E. excelsum* and *Khaya spp.*) and Licheche (*Acotea lisambromis*) is not adequate. According to interviewed timber businessmen, this is probably why they are sold at extremely high prices especially in Bujumbura compared to local timbers. During the survey in March 2011, most workshops visited in

Bujumbura confessed the insufficient supply of sawn timber in general and of premium timber in particular. In fact, the recent ministerial ordinance was still in the news on how it is likely going to exacerbate the problem of inadequate supply of quality sawn timber in the country. This is the ministerial ordinance banning harvest and export of *Pinus* and *Callitris* timber issued in 2009 (ministerial ordinance n0. 770/1425/CAB) and revised in 2010 (ministerial ordinance n0. 770/989/CAB) (DF, 2011).

With the exception of major towns like Bujumbura where there are few wood working machines, wood processing is carried out mainly with hand tools. Most of the wood finished with hand tools has relatively low quality since the handling and conversion process is inefficient with considerable degradation. The lack of well-trained skilled artisans in the timber processing industry is also a factor for poor quality of products and a lot of wood waste during processing. The need for professional training was pointed out in many reports (Bararwandika, 2000; FAO, 2002; FAO, 2010; DF, 2011).

Figure 8: Pit sawing after clear felling a *Eucalyptus grandis* woodlot

9.3 Constraints facing the sub-sector

There are many challenges facing the wood processing sector in Burundi. These include:

- inadequate human and financial capacity;
- the predominance of hand tools in wood processing (even though replacing employment opportunities by mechanized systems may not be desirable in a country with abundant unskilled labour);
- poor accessibility to many industrial forest plantation blocks; and,
- the lack of exploitable blocks of forest plantations large enough to satisfy a profitable forest industry plant.

All these constraints limit the span over which large scale wood processing industry may be relevant and profitable in Burundi. Another issue is that many forest plantations are located on steep slopes and hence extraction costs may limit the level of mechanisation in order to modernise

timber processing. Modern sawmills can therefore face difficulty to operate competitively against pitsawn materials with low priced poor quality timber (irregular sizes and poor seasoning).

9.4 Potential for future investment

Given the ever increasing demand of good quality forest products, multiple investment opportunities exist in the country, especially in sawn timber processing. However, there is huge need for investment in human and social capital of the sector, a fact that was pointed out in the 2010 annual report of the Forestry Department (DF, 2011). This investment in human resources is likely to have great impact on quality of processed products and is probably more urgent than even the physical capital in Burundi. Table 27 provides estimates of future projections of capacity of wood processing industries based on a 2010 baseline and a 5% annual increase. A veneer factory and a treatment plant are also proposed with a capacity of 2 000 m^3 and 3 000 poles respectively in 2015 that would also increase at rate of 5% annually.

Table 27: Future projections of capacity of forest industries utilising plantation wood and NWFPs (2015-30).

Owner	Type of forest industry	Capacity 2015 (m^3)	Capacity 2020 (m^3)	Capacity 2025 (m^3)	Capacity 2030 (m^3)
Individuals/ associations (rural and urban areas)	Sawmills, timber processing and carpentry workshops	76 600	97 700	124 700	159 200
Forest investors	Veneer plant	2 000	2 500	3 200	4 100
Forest investors	Timber treatment plant (poles)	3 000	3 800	4 800	6 200

10. SOCIO-ECONOMIC AND ENVIRONMENTAL CONTRIBUTIONS OF FORESTS

10.1 Income generation

10.1.1 Current income

The reported income by the Forestry Department from transport permits of forest products, harvesting permits, sales of wood and forest seeds in 2010 is c. 250 million BUF (c. US$ 210 000). However, as mentioned earlier, this amount does not take into consideration other revenues from forestry business including imports and exports, the private sector, the illegal transactions and the employment in both the public and private forest sectors. The reported sum is therefore just a fraction of the actual income from forestry activities, which can be estimated to be around US$ 15 million per annum from forest plantations/woodlots and about US$ 5 million from timber processing industries (survey 2011) thus totalling about US$ 20 million (c. 2% of the GDP).

10.1.2 Potential for income generation

An annual income of US$ 20 million is still low and can be easily doubled in two to three years, as it was in the 1990s, provided that the political climate remains stable and the economic growth continues to be steady. In fact, it is believed that the demand for timber will quickly rise as a result of the boom in the construction industry currently experienced in Bujumbura. This will eventually increase the number of people employed in the forest sector and the income generated from the sector. Therefore, assuming an annual increment of 10%, the potential income from forest plantations is estimated in Table 28. There are no large forest industries operational in Burundi

except the sawtimber processing and furniture industries, which are more or less at artisan level. Nevertheless, the sub-sector is providing a remarkable income to thousands of Burundians in the range of 6% of all employment (Ndabirorere, 1999). It is assumed that the income from timber processing industries will increase at 10% annually from a baseline of about US$ 5 million (survey 2011) in 2010 (Table 28).

It is assumed that the current ban on harvesting natural forests will be sustained in the future and therefore no income is projected to come from this sub-sector. This is not, however, realistic because most of these natural forests are protected and used for recreation (especially ecotourism). In recent years, with progressive stabilisation of the political situation, the number of tourists has increased remarkably. For example, the Rusizi natural forest reserve receives around 1 500 tourists annually, while the East natural monuments register more than 3 000 tourists annually (UICN/PACO, 2011).

Table 28: Potential income from industrial forest plantations and processing industries 2015-2030

Sub-sector	Potential income (million US$)			
	2015	2020	2025	2030
Forest plantations	24	39	63	101
Forest industries	8	13	21	34

10.2 Employment

10.2.1 Current employment

There is no reliable statistics on current employment in the forestry sector, not only because no records are maintained by employers, particularly in the private sector, but also because of the informal nature of employment in forestry activities. Ndibirorere (1999) reported that, according to the Ministry of Labour, there were about 145 000 people employed in the forest sector, including in forest management activities, wood processing operations (carpentry, sawing, furniture, construction lumber, etc.), charcoal production and commercialisation of forest products. Bararwandika (2000) projected the level of employment in the forest sector to be as follows in 2020:

- More than 64 000 employments in rural areas in forest management activities and timber processing;
- 64 000 employments in wood working (artisan work) in rural areas;
- 20 000 employments in wood processing in urban centres;
- 10 000 employments in charcoal making; and,
- 60 000 employments in commercial activities of forest products.

Assuming that the estimates of Bararwandika (2000) and statistics from the Ministry of Labour in 1987 were realistic and that the construction industry and the economy are booming up with the improvement of the political climate, the estimated current employment in the forest sector is as shown in Table 29.

Table 29: Estimated employment in the forest sector 2010.

Sub-Sector	Activities	Number of people employed
Forest plantations	Forest management activities	50 000
	Commercialization of forest products	48 000
	Charcoal making	10 000
Forest industries	Wood processing in rural areas	40 000
	Wood processing in urban areas	16 000
	Total	**164 000**

10.2.2 Potential for employment creation

The potential for employment in the forest sector has been estimated based on statistics provided in Table 29 above and on the assumption of a 5% annual increment at the same pace with economic growth (Table 30).

Table 30: Potential employment in industrial forest plantations, natural forest management and processing industries (2015, 2020, 2025, 2030).

Sub-sector	Potential employment			
	2015	2020	2025	2030
Forest plantation	138 000	176 000	225 000	287 000
Forest industries	71 000	91 000	116 000	149 000

10.3 Plantations in forest conservation

The establishment of forest plantations may target many objectives, but in Burundi most forest plantations and woodlots were created for two major functions, viz. production and protection. In colonial times, the first plantations fostered the protection of natural forests while supplying the fuelwood that was cut in natural forests, and offering a means of protecting farmland from erosion (FAO, 2002). These objectives still prevail even though a number of industrial plantations were also established since the 1980s, comprising mainly *Callitris* (40%), *Eucalyptus* and *Pinus species* (Bararwandika, 2000). The national forest policy launched in1999 recognises the importance of forests for conservation and calls for the revisions to the legal framework governing forests, development of agroforestry, strengthening of forest management, protection of natural ecosystems, development of information systems to monitor natural resources and capacity building for forest personnel. Most of the implementation efforts of this forest policy have related to the development of agroforestry and plantations for reforestation and provision of fuel wood (Koyo, 2004; FAO, 2010).

As a result of high growth rates, many forest plantations with exotics, particularly with *Eucalyptus sp*. use big amounts of water daily to manufacture their biomass. This has led to concerns regarding the use of eucalypts to a point where some politicians recommend it to be uprooted and replaced with native species. However, in a recent regional workshop held in Bujumbura in early 2010 on *Eucalyptus* plantations, it was concluded that most of arguments against *Eucalyptus* are generalised and not well documented and that it is an important species that should continue to be planted in African landscapes (DF, 2011). In this workshop, the Burundi participants recommended some of the following actions in Burundi: (a) to prohibit planting of Eucalyptus in wetlands and along water courses; (b) establish mixed tree species plantations; (c) planting eucalypts on degraded and rocky terrains where other species can't survive, and (d) conduct research on water use efficiency of eucalyptus species in Burundi.

The role of forest plantations in carbon sequestration as a way to meet the challenges of prevailing climate change is being widely acknowledged and currently there are many carbon trade and REDD initiatives worldwide (SSEE & ROR, 2011). In 2009, the government of Burundi granted approval to ERA, a subsidiary of the Canadian ERA Carbon Offsets Ltd, to proceed with the design of a reforestation carbon offset project within and around the Kibira National Park. ERA will use local labour for the establishment and maintenance of nurseries, planting, tending seedlings, and forest protection. ERA will sell carbon on the voluntary carbon market (Beck *et al*., 2010).

11. CONCLUSIONS AND WAY FORWARD

11.1 Conclusions

The current public and private forest plantations situation was assessed with respect to the distribution and location of these plantations, species planted and sources of seedlings and seeds, age distribution, their management and quality of stands and other features. The Government of Burundi has made a lot of efforts to establish forest plantations since the colonial period with increasing intensity towards the late 1970s and the 1980s. This was geared towards achieving two major objectives namely environmental conservation and production of forest products needed by the growing population. The landscape of Burundi is richly endowed with trees and woodlots scattered on farmlands. The remaining natural forests are now protected by law and banned for timber harvesting.

However, statistics on forest plantations extent and ownership is not reliable because no forest inventory has been carried out since 1976. Many documents contain different figures for the same parameters such as areas, ownership, management systems and resulting projection estimates on production and consumption. This is one of the most critical problems that should be urgently addressed in order to have an adequate basis for planning and development of the forest sector in the country.

The existing incentive schemes that could favour rapid forest plantation establishment by the public and private sectors, and outgrower schemes by individual farmers, were assessed. Particular attention was given to availability of land for forest expansion and of quality germplasm, financing mechanisms for plantation forestry, private sector involvement, policy and environmental issues, including land, forest and tree tenure issues, biodiversity considerations, and legislation and governance issues; and potential for additional revenues from carbon trade projects. The study also provided options for establishment, expansion and improved management of public and private forest plantations, including ways to overcome existing and potential constraints.

Market and literature surveys enabled an assessment of supply scenarios and demand projections (2015, 2020, 2025, 2030) of plantation wood volumes and trends. The current revenue collection systems, revenues collected annually, licensing/concession procedures, forest and tree tenure, management arrangements and pricing mechanisms for roundwood and industrial forest products were also analysed in depth. It was noted that the lack of adequate and systematic recording system of forestry business transactions is a great handicap to the development of forestry in the country. The forest fiscal system needs to be revised if more revenues are to be collected from the forestry business and attract more forest investors.

Current income and employment data were provided as much as possible and estimates of the potential for income generation and employment creation (2015, 2020, 2025, 2030,) were established. The study also analysed the processing of industrial round wood from the plantations in the country, ownership, its current and potential capacity, wood raw material supply (sources, types, and adequacy), product lines and quality of produce, potential for future investment in the sub-sector, constraints facing the sub-sector, future of the processing industry, growth and constraints. It was noted that there are no large scale forest industries in the country and considerable premium timber and other finished wood or simulated products are imported from neighbouring countries (mainly from DRC and Tanzania) or Dubai and China. Nevertheless, there are huge opportunities for investment in order to develop the forest sector in the country. Some such investments may include introduction of modern sawmills, wood based panel plants, timber treatment plants, ecotourism, etc.

11.2 Way forward

The Government reforestation efforts initiated in the late 1970s should be continued in order to narrow the gap currently observed in the supply of and demand for forest products. The landscape of Burundi being mostly mountainous and fragile, protection of soil and biodiversity need to be tirelessly pursued.

There is urgent need for a comprehensive forest inventory and assessment of trees outside forest in order to get reliable planning statistics as a basis for sustainable forest management in the country.

There is need to establish a forest cadastre linked to a Geographic Information System (GIS) that would ensure that all classified forests are well managed and monitored. This would also facilitate collection of forest royalty and other forest taxes in the country.

The existing incentive schemes are not sufficient to attract more private investors in the forest sector and most people still find it too risky to invest in forest plantations. More incentive schemes, including financial credit system and special clearance of forest products and equipment, could possibly attract more investment in the forest sector.

The lack of adequate and systematic recording systems of forestry business transactions is a great bottleneck to the development of a profitable forest business in the country. Forest actors should be educated on record keeping so as ensuring easy monitoring and evaluation of the performance of the sector.

The forest legislation need to be updated and the forest fiscal system revised if more revenues are to be collected from the forestry business and attract more forest investors.

Given poor quality of forest products processed in existing wood processing workshops, there is need to introduce certification systems of forest products.

Even if the country is small and large block forest plantations are not possible, some industrial activities, for example installation of a veneer plant and a treatment plant; introduction of modern sawmills, development of ecotourism, are relevant initiatives in order to raise more income from forest plantations and also to limit dependence on imported finished forest products.

In the current context of climate change, the country has an opportunity to take advantage of the growing carbon trade initiatives in order to raise funds for tree planting. Therefore, carbon trade projects, especially the voluntary carbon market, should be initiated and up-scaled throughout the country.

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