

**VERIFICATION OF THE EXTENT AND EXPANSION POTENTIAL OF
FOREST PLANTATIONS IN TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN
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ABSTRACT

The study on the extent and potential of forest plantation in Tanzania was carried out in three selected zones of Southern highlands, Lake and Northern. It was specifically conducted to verify the current area of forest plantation under different ownership, assess the expansion potential of forest plantation under different ownership, and assess factors affecting expansion of forest plantation in Tanzania and propose interventions measures. Primary data were collected using prepared checklist, direct observations and informal discussion with key informants. NAFORMA data and final report and Management plans of government and large private forest plantations were used as the secondary data sources. Descriptive and inferential statistical analyses were used for quantitative data using Statistical Package for Social Sciences (SPSS) and Microsoft Excel software. The total planted forest plantation area is estimated to be 582 729 ha; the largest area being in the Southern Highland zone followed by Lake and Northern Zones. Out of this central government through Tanzania Forest service owns 105 625 ha, large private plantations companies own about 54 708 ha while individual woodlots occupy about 422 396 ha. The most important plantation species are pines, cypress, eucalyptus and teak. About 187 187.4 ha are available for expansion of the forest plantation whereby 122 793 ha and 64 394 ha are owned by Central government and private forest plantation companies respectively. In order to cover existing gap of annual wood deficit, government and private sector should put forward the best strategies to double the size of the forest plantation in the country.

DECLARATION

I, SAID ASIAD do hereby declare to the Senate of Sokoine University of Agriculture that, this dissertation is my own original work and has neither been submitted nor concurrently been submitted for any degree award at any other university.

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LIST OF ABBREVIATIONS AND ACRONYMS

CO ₂	Carbondioxide
DFM	District Forest Manager
DFO	District Forest Officer
FAO	Food and Agriculture Organization of the United Nations
FBD	Forest and Beekeeping Division
FDT	Forest Development Trust
KVTC	Kilombero Valley Teak Company
LMDA	Logging and Miscellaneous Development Account
MFA	Ministry for Foreign Affairs of Finland
MNRT	Ministry of Natural Resources and Tourism
NAFORMA	National Forest Resources Monitoring and Assessment
NGO	None Governmental Organization
PFP	Private Forestry Programme
SHFP	Sao Hill Forest Plantation
SUA	Sokoine University of Agriculture
TANWAT	Tanganyika Wattle Company Limited
TFCMP	Tanzania Forest Conservation and Management Project
TFS	Tanzania Forest Services Agency
TGAs	Tree Growers Associations
URT	United Republic of Tanzania
VEO	Village Executive Officer
WEO	Ward Executive Officer

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

According to NAFORMA (MNRT, 2015), the total forest area in Tanzania is 48.1 million hectares, which is 55% of the total land area of Tanzania main land. Woodlands occupy 44.7 million hectares (ha) which is 92% of the total forest area and forest plantations cover a total area of 554 500 ha which is 1.2% of the total forest area of Tanzania mainland.

Forest Plantation is defined as forest of not less than five hectares which has been planted and is developed and managed by human agency (MNRT, 2002). They are either of introduced or indigenous species regardless of the ownership and management. In Tanzania ownership of forest plantation can be divided into government (Central and local government) and private forest plantations. Private forest plantations can be further categorized into large scale owned by companies and small holders woodlots.

Main species planted in the plantations throughout the country include *Pinus patula*, *Cupressus lusitanica*, *Tectona grandis* and *Eucalyptus spp*. A survey in many places show that, tree species planted include those for timber, building poles, firewood, tanning, charcoal production and water sources protection and conservation. The demand of wood resources to meet household energy and raw materials is increasing fast due to rapid increase in the population and high urbanization rate. The forest plantations have a good potential that contribute to the national economy and rural

development (MNRT, 2001; Nshubemuki *et al.*, 2001). However, there is no clear and reliable information on the total area and potential of the forest plantations in Tanzania and other factors that drive investment in plantation forests especially private forest plantation. Also unreliable information on the increase in public and private forest plantations creates difficult situation to secure enough wood raw materials and this has created uncertainty for long term investments (Ngaga, 2011).

1.2 Problems statement and justification.

According to the recent Tanzania National Forest Resources Monitoring and Assessments (NAFORMA), the consumption of wood exceeds the sustainable supply, causing an annual wood deficit of 19.5 million m³ (MNRT, 2015). This deficit is covered by illegal harvesting from protected natural forest areas. Thus explains the degradation and deforestation of protected area (wildlife, catchment forests, nature reserves etc). This deficit on woody resources in Tanzania advocates massive tree planting in order to save the natural forests in protected areas, and consequently resulting into rapid increase in the total area of the forest plantation in Tanzania. Further observation show that the plantation area has increased from 250 000 ha (FAO, 2010) to more than 500 000 ha (MNRT, 2015). This includes both government and private forest plantations. These existing reported figures with big difference within a short time period may signal uncertainty regarding the actual size of the forest plantation in Tanzania.

The existing information shows that, total area available for all government plantation expansion is about 72 000 ha (Ngaga, 2011). However this area does not

include new area acquired by Tanzania Forest Service (TFS) in Mbizi, Korogwe and Ruvu forest plantations that are currently under establishment. This implies that it is difficult to estimate the prospect of the forest plantation in terms of total size and size by ownership and hence difficult to determine the role of each stakeholder in the forest plantation of the country.

This study aimed to verify current information on the extent and potential of forest plantation in Tanzania under different ownership. It also recommends on appropriate intervention measures to improve woody stocks in the country in order to cover the gap of the wood deficit through tree planting in high potential zones, regions and districts. The findings of this study are useful to different actors such as Forest and Beekeeping Division (FBD) in policy issues, Tanzania Forest Service (TFS), Non-Governmental Organizations (NGO) and private sector in establishment and management of forest plantations and research purposes.

1.3 Research objectives

1.3.1 The overall objective

To verify the extent and expansion potential of forest plantation in Tanzania.

1.3.2 Specific objectives

The specific objectives of the study were to:

- (i) Verify the current area of the forest plantation under different ownership.
- (ii) Assess the expansion potential of the forest plantation under different ownership.

- (iii) Assess the factors affecting expansion of forest plantation in Tanzania and propose appropriate interventions to promote forest plantation estate in the country.

1.4 Research questions

The following research questions were used to guide this study:

- a) What is the current size of the public and private forest plantation by Region and Zone in Tanzania?
- b) What is the expansion area of the forest plantation under different ownership?
- c) What are the factors that affect plantation expansion in Tanzania?
- d) What intervention measures are necessary to promote building up of plantation woody stocks in Tanzania?

1.5 Possible limitation of this study.

The study encountered limitation of lack of willingness to disclose private forest plantation information particularly during field data collection process. The private forest plantations management felt that their management strategies are secrets and should not be exposed anywhere. Therefore some of their information was obtained by visiting their websites. However, the researcher was quite familiar to the area and some of the plantation managers and hence resolved their doubts and provided most of the required data for the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of establishment of forest plantation in Tanzania

Plantation forests are renewable natural resources primarily managed for growing wood designed for a range of purposes. Their roles in providing ecosystem services including carbon sequestration and landscape rehabilitation are receiving increasing recognition (Nambiar, 2008).

Efforts to establish forest plantations in Tanzania go back to German colonial era with the establishment of trials of a few indigenous tree species. The main indigenous tree species planted were Cedar (*Juniperus procera*), *Podo* (*Podocarpus gracilior*), E.A. Camphor (*Ocotea usambarensis*), Mvule (*Milicia excelsa*), Cordia (*Cordia africana*) and various mangroves, while exotic species included teak (*Tectona grandis*), *Cassia* and *Eucalyptus spp.* (Mtuy, 1996). Also, it was at this time that pilot plantings with various exotic species started at Olmotonyi, Rongai, Mbeya, Mufindi and Shume.

The most important industrial plantation species in Tanzania today are pines (*Pinus patula*, *P. elliotii* and *P. caribaea*), *Cypress lusitanica*, *Eucalyptus spp* and *Tectona glandis*. Pines are the dominant species in most of the government and private plantations with about 78% of the total area planted and the remaining 22% is shared among hardwoods and other softwood species (Ngaga, 2011).

Forest plantations are the only sources which can plug the growing gap between wood demand and supply by complementing but not substituting the natural forests which are known to be diverse, resilient and stable.

2.2 Ownership of the forest plantations

In Tanzania ownership and management system of plantation can be categorized into Government and private ownership. Private forest plantations involve Industrial and Non Industrial (small scale forest plantation and woodlots) forest plantation (Ngaga, 2011).

2.2.1 Government forest plantations in Tanzania

There is a long history of planting exotic trees in the world, dating back to the mid-1800s with objectives focused on meeting fuel and timber needs (Farley, 2007). Efforts to establish forest plantations in Tanzania go back to German colonial era with the establishment of trials of a few indigenous tree species such as *Juniperus procera* and *Podocarpus usambarensis* (Nshubemuki *et al.*, 2001). Early introductions of exotic conifer species such as pines were not successful due to lack of suitable mycorrhiza. Large-scale establishment of forest plantations in the then Tanganyika commenced under the British rule (1920-1961) based on a few years of species and provenance trials, and successful inoculation with suitable mycorrhiza (Nshubemuki *et al.*, 2001).

In Tanzania, Government plantation involves all plantations owned and managed by central and local government. The central government of Tanzania owns 16 forest

plantations that are estimated to total gross area of 85 000 ha with *Pinus patula* as the major species. The central Government forest plantations in Tanzania are Sao Hill (SHFP), West Kilimanjaro, Meru/Usa, Shume, Ukaguru, Ruvu, Rubya, Rubare, Kawetire, Kiwira, Wino-Matogoro, Rondo, Longuza, Buhindi, Mtibwa and Rongai (URT, 1998). Most of the government forest plantations were established with the major objective of supplying raw materials for industrial and domestic uses in the country.

2.2.2 Private forest plantations in Tanzania

A decade ago, forest plantation and Small scale private forest plantation and woodlots development by private sector was not very common in Tanzania except for Tanganyika Wattle Co Ltd (TANWAT) that started a long time back. Two private forest plantations exemplify the recent private sector involvement in forest management (Malinga 2011). The first one is the Kilombero Valley Teak Company (KVTC) that started its operation since 1992 in Kilombero and Ulanga districts. The second is Green Resources Limited owning the Mapanda Forest plantation in Mufindi and Kilombero districts that started in 1996, which is a venture, financed by private Norwegian investors. However forest plantations owned by Green resources have been established with an objective to sequester CO₂ and generate revenue from trading carbon credits under the Kyoto Protocol Clean Development Mechanism. Therefore, the role of private sector in plantation forestry development does not rely solely on revenue generation, but also to embrace one of the objectives of the Kyoto Protocol of reducing the effects of greenhouse gases (Ngaga, 2011).

There are other private forest plantations in Tanzania most of them started in 1990s due to policy and institutional reforms which started in 1980s (MNRT, 2000). Most of other known private companies owning forest plantations are Mufindi Paper Mills and the New Forest Company.

Currently, there is no reliable information on the distribution of out-growers and woodlots in the country. However, it is estimated that there is about 80 000 to 140 000 ha in total of Small scale private forest plantation and woodlots (MNRT, 2011). Tree planting and woodlot establishment by farmers and communities has taken place in all the districts, but particularly in the Southern Highlands, especially in Mufindi, Njombe and Makete districts in Iringa region (Ngaga, 2011).

Privately owned industrial forest plantations are also common in South Africa, Swaziland and Zimbabwe. However, in Tanzania the total area established by the private sector is still marginal in relation to the potential that country has in terms of political stability, good land availability, inexpensive labour force, and good growing conditions in terms of soils and rainfall (Ngaga, 2011).

2.3 Extent and potential of the forest Plantation in Tanzania

United Republic of Tanzania covers a total area of 94 760 000ha including 6.4% area of an inland water bodies and some coastal waterways. Tanzania mainland accounts for 94 510 000ha (99.74% of the area) while the islands of Zanzibar (Unguja and Pemba) account for the remaining 250 000ha (0.26%) (NBS 2013). Tanzania mainland is endowed with a wide range of natural resources as well as ecological

and cultural diversity including extensive areas of arable land, wildlife reserves and parks, mountains, forests, rivers, and lakes. (MLHHSD, 2013).

The total forest area in Tanzania mainland is estimated to be 48.1 million ha, which is 55% of the total land area of Tanzania mainland. The government and private forest plantations occupy 1.2% of the total forest area of Tanzania mainland (MNRT, 2015).

The current agricultural land is estimated to be 39 650 000 ha which is 45% of the total land area in Tanzania (MLHHSD, 2013). This is the area which can also be converted into other land uses such as forest plantation establishment. In most cases agricultural land when faced with unfavorable climatic conditions and poor soil for crops production farmers decides to use it for forest plantation especially small scale private forest plantation and woodlots establishment.

Both government and private forest plantations have areas set aside for plantation expansion and planting have continued in both clear felled and new expansion areas. Planting in clear felled areas and annual planting target have depended on the harvesting speed.

The existing literature show that available land for expansion in both public and private plantations is 167 100 ha whereby government has 56 600 ha and private has 110 000 ha (Ngaga, 2011). However this information on the total expansion area is 5 years old now and with the introduction of Tanzania Forest Service and the rapid increase in the private forest plantation might have changed.

The growing demand for wood products domestically and internationally and expansion of industries together with carbon trade are some of potential factors that are likely to stimulate and promote expansion of forest plantations and woodlots in Tanzania (MNRT, 2011.). On the other hand, the economic growth coupled with the rapid population growth and high urbanization rate in Eastern and North Eastern African countries continue to stimulate fast growth in the industry and construction sectors could lead to increase demand for forest products (Chamshama, 2011). Therefore the demand of the forest products in the domestic and international market especially in many Sub-Saharan African countries are increasing due the robust economic growth caused by urbanization (World Bank, 2013).

In Tanzania, most of plantation tree species consumed by the construction sector, pulp and paper industry, furniture and joinery sector, packaging sector and in utility poles; additionally, some volumes are exported. However demand for *Tectona grandis* in the international market is high. A large market seems is India and most of the teak operators in Tanzania appearing to have connections with those markets. The main export *Tectona grandis* products are beams in large dimensions (Ngaga, 2011).

2.4 Factors affecting expansion of forest plantation in Tanzania

Although tree planting by government and private sectors has taken place throughout the country, the total forest plantation area is still marginal. This is due to the potential that Tanzania has in terms of good land availability and good growing conditions in terms of soils and rainfall (Chamshama and Nwonwu, 2004). Therefore, there are many constraints which affect it and need to be addressed.

One of the main constraints is financial and technical problem which have caused inadequate investment by both the government and private sectors in forestry. This is reflected by poor management of the existing industrial and nonindustrial plantations and availability of potential land for expansion which has remained idle for many years (Ngaga, 2011).

On the other hand, private investors are constrained by land shortage and unclear land tenure in some areas. The problem is compounded by lack of District Framework Plans (DFPs) and Village Land Use Plans (VLUPs) in many districts and villages. A district and village land use planning is critical to correct the unavailability of information regarding land for appropriate investment in private forestry at various scales.

Inadequate financial incentives and limited markets for wood products from private farms, in some places due to free wood supply from public lands, limits investment in tree growing which is considered financially unattractive (Ngaga, 2011). Conflicting extension messages for local communities that do not address their preferences in terms of selection of species for tree planting and management of native species has not been adequately promoted as compared to planting of exotic species (Chamshama, 2011).

Management of the forest plantation and woodlots involves financial implication. Therefore low budgetary allocations have resulted in the skipping of some silvicultural operations and use of seeds of inferior genetic quality (MNRT, 2001;

Nshubemuki *et al.*, 2001). This culminates to having trees of poor form, which do not supply enough quality wood to support the growing forest industries. Also according to Malimbwi *at al.* (2010), most farmers in Makete district harvest premature woodlots at the age of 8 years to solve family financial problems. For the same reason some farmers sell out their woodlots very cheaply while they are as young as 4 years.

CHAPTER THREE

3.0 MATERIAL AND METHODS

3.1. Study Site Description

The study aimed to obtain information on the total area of the government and private forest plantation in Tanzania. Description of study area highlights general characteristics of plantations in Tanzania involving gross area and distribution of forest plantations, location, temperature, climate, soil and accessibility as indicated in Appendix 6.

3.1.1 Gross area and distribution of forest plantation in Tanzania

The total gross area of forest plantations in Tanzania is estimated to be 554 500 ha (MNRT, 2015). About 85 000 ha owned and managed by central government through Tanzania Forest Services under MNRT. Large private plantations (such as the Tanganyika Wattle Company in Njombe District, Green Resources Ltd in Mufindi, Kilombero and Lindi, Mufindi Paper Mills in Mufindi district, Kilombero Valley Teak Company in Kilombero District and the New Forest Company in Iringa district) currently operates plantations which are estimated to cover a total area of 150 000 ha. Small scale private forest plantation and woodlots contains planted area which is estimated to be 120 000 to 140 000 ha. (TFCMP, 2008).

3.1.2 Location

Government as well as private forest plantations are scattered all over the country, at altitudes ranging from 160 to 3 125 meters above sea level. The Longuza Forest

plantation is located at the lowest altitude of 160 meters above sea level, while the highest parts of the West Kilimanjaro is at an elevation 3 125 meters above sea level (Chamshama and Nshubemuki, 2010).

Most of the large private forest plantations are located in Southern Highland Zone except Kilombero Valley Teak Company (KVTC) which is located in eastern zone (Morogoro region). Green resources manage three plantations block in different regions of Tanzania. This includes Mnyera which is located in Kilombero district in Morogoro region with average altitude of 1,100 meters above sea level, Idete and Mwenga located in Mufindi district and Lindi block which is located in the Southern part of Lindi region with the average altitude is 110 meters above sea level.

3.1.3 Climate

The climate is generally tropical with distinguishable seasons of long and short rains in the Northern parts of the country, while the further South one goes, the tendency is for one wet and one dry season. For example, the Longuza, Buhindi, Meru, Mtibwa, Rubya, Ukaguru, North Kilimanjaro and West Kilimanjaro plantations experience two rainy seasons, while the Sao Hill, Kiwira, Kawetire and Morogoro plantations have only one rain season lasting for about six months -from November to May. The Rubare forest's prevailing easterly winds, in combination with the topography have a great influence on the rainfall pattern. Mean rainfall per year in Rubare forest ranges from 700 mm in the Eastern parts of the project area to 2 100 mm on the shores of Lake

Nyanza (Lake Victoria). Generally, the rainfall distribution varies (considerably) from year to year and from plantation to plantation.

3.1.4 Temperature

Temperatures range between 4°C minimum and 32°C maximum recorded in the North Kilimanjaro forest plantations. Some plantations, such as Sao Hill, are characterised by long dry seasons. Unexpected showers can be received during the dry season and night frost may occur as in the Kiwira plantation. Seasonal trends in Kawetire show that between June to mid-August, temperatures experienced at night are very low (down to -5°C) thus resulting in frosts. In some plantations, the mean day temperatures of the hottest month October/November are around 30°C, with maximum recorded of 35°C. In some plantations, e.g. West Kilimanjaro, temperatures within the plantation are affected by the elevation as most of the area is above 1 500 meters above sea level.

3.1.5 Soils

Soils in many plantation areas are generally fertile with varying amount of organic matter, mineral content and soil pH. In Rubare forest, soils are chemically poor and have low pH due to long time of leaching and poor parent material. Together with the above, the soils vary considerably from one plantation to another.

3.1.6 Accessibility

Almost all government forest plantations in Tanzania are easily accessible by roads throughout the year. Shume can be reached by both roads and the Tanga railway,

while Mtibwa forest accessibility is through the Tanzania highway road, and the Uhuru and Central railway line (Appendix 6).

3.2 Research design

Cross sectional design was employed whereby designed checklists were administered during data collection. In a cross sectional design, data are collected at a single point in time without repetition from a sample selected to represent some large population (Kothari, 2008). This design was preferred in this study because it aims at obtaining the current extent and potential of forest plantation in Tanzania. Also is considered useful for descriptive purposes and determination of relationship between variables (Oliver, 2006).

3.3 Sampling techniques

This study involved all government and private forest plantations in Tanzania. It was carried out in the districts with high potential in forest plantation. Purposive selection of districts in these zones was conducted based on the number of sample plots falling on plantation as reported by NAFORMA (Appendix 1 and 2) bearing in mind that, about 77%, 12% and 6% area of the forest plantation in Tanzania are found in the Southern Highlands, Lake and Northern zones respectively (MNRT 2015). Also with the help of district forest officials, researcher's experience during my field visit and literature it was easy to identify these districts.

3.4 Data Collection

Both Primary and Secondary data were collected in this study whereby information on the size of the planted and expansion area, species composition, spacing and factors affecting plantation expansion were collected.

3.4.1 Primary data collection

Method used for primary data collected was interviews of key informants by using prepared checklist (Appendix 3) as main tool in acquiring this type of data. The collected data included planted area and species composition of the forest plantation, together with factors affecting plantation expansion in Tanzania. In this part, key informants were project managers of the government and private forest plantations, District Forest Officers (DFO), Village Executive Officers (VEO) and the woodlot and owners. Direct observations and informal discussion with key informants were also conducted for the purpose of enriching and supporting the findings.

3.4.2. Secondary data

Secondary data was obtained through management plans of the government forest plantations, NAFORMA final report and other published and unpublished documents. Also annual tree planting reports in visited districts and region were also used as a secondary data source. The secondary data were used as a valuable source of information for providing baseline and comparing results obtained from analysis of primary data.

3.5 Data analysis.

All Primary data were coded and fed into Excel and Statistical Package for Social Sciences (SPSS) computer software for analysis. Descriptive statistical analyses were used in exploring the data on planted and expansion area of the forest plantation. All these analysis were summarized to fulfill objectives of the study. Graphical presentations of frequency distribution were used to summarize the results where histograms and pie chart were used to elaborate the result. Therefore comparison in terms of plantation size between government and private sector were calculated.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter presents distribution of forest plantation in Tanzania and discusses the results of the study including current area of the forest plantation based on the ownership, expansion potential of the forest plantation by ownership, factors influencing expansion of the forest plantation and challenges affecting expansion of forest plantation in Tanzania.

4.1 Distribution of forest plantation in Tanzania

The total forest plantation area in Tanzania estimated from this study is 582 729.9 ha and the largest area is in the Southern Highland zone followed by Lake Eastern and Northern Zone (Table 1). This figure compares well with 554 500 ha estimated by NAFORMA considering that, data for the later was collected in 2011 to 2013 while estimate from this study were done in 2016. It also indicates progressive tree planting.

Table 1: Distribution of forest plantation in Tanzania by zone

Zone	Area per zone (Ha)	%
Southern Highlands	405 518.01	70
Lake	61 578.25	11
Eastern	38 072.93	7
Northern	37 192.63	6
Western	19 511.18	3
Southern	12 706.20	2
Central	8 149.80	1
TOTAL	582 729.00	100

About 405 518 ha which is 70% of total area of the forest plantation in Tanzania is located in Southern highlands zone (Table 1). This is due to presence of large government forest plantations (Sao Hill, Kawetire and Kiwira) and large private forest plantation companies including Green Resources, New forest, Mufindi paper mills, TANWAT) and availability of the appropriate land for plantation establishment. Lake, Northern and Eastern zone have 61 579 ha, 38 073ha and 37 193 ha of forest plantation respectively.

The study has also revealed that, Iringa and Njombe region of Southern highlands zone have largest area of the forest plantation with total of 207 657.55 ha and 188 107.61 ha which are 34.5% and 32.7% of the total forest plantation in Tanzania mainland respectively (Table 2). Therefore these are regions with high potentials in Forest plantations in the country followed by Kagera, Morogoro and Tanga with 6.9%, 6.5% and 3.3% respectively. It was then revealed that Shinyanga, Dar es Salaam, Pwani, Tabora, Singida and Simiyu have the least forest plantation area as indicated in Table 2. Most of the area in these regions is dominated by natural forest except Dar es Salaam which is mostly urbanized. Location of these large forest plantations took cognizance due to several aspects, including suitable climatic, land availability and soil conditions for the various tree species and the need to meet wood requirements of the various parts of the country.

Table 2: Distribution of the forest plantation area by region

Region	Total area (Ha)	%
Iringa	207 657.55	35.6
Njombe	188 107.61	32.3
Kagera	40 490.02	6.9
Morogoro	36 523.60	6.3
Kilimanjaro	16 606.91	2.8
Tanga	14 203.89	2.4
Kigoma	13 287.65	2.3
Mara	9 927.25	1.7
Mwanza	8 307.27	1.4
Ruvuma	7 344.50	1.3
Arusha	6 381.31	1.1
Mbeya	6 226.00	1.1
Manyara	3 717.20	0.6
Rukwa	3 526.65	0.6
Katavi	3 373.07	0.6
Dodoma	3 308.36	0.6
Lindi	2 896.20	0.5
Geita	2 854.31	0.5
Mtwara	2 465.39	0.4
Tabora	1 376.06	0.2
Singida	1 124.23	0.2
Dar es Salaam	1 017.33	0.2
Simiyu	950.23	0.2
Pwani	532.00	0.1
Shinyanga	524.37	0.1
TOTAL	582 729.00	100

The dominant tree species is mainly Pine in most of the government and private plantations covering about 65% of the total planted area, *Eucalyptus sp* contributed 15% followed by *Tectona glandis* with 7% of the species composition (Fig. 1), and the remaining 13% is shared among hardwoods and other softwood species. The study revealed that, pines are most preferred plantation species due to their fast growth which varies considerably depending on site conditions as well as

management practices (Plate 1). Also they are mostly used for timber, pulp and paper manufacturing, particle board and wood wool manufacturing.

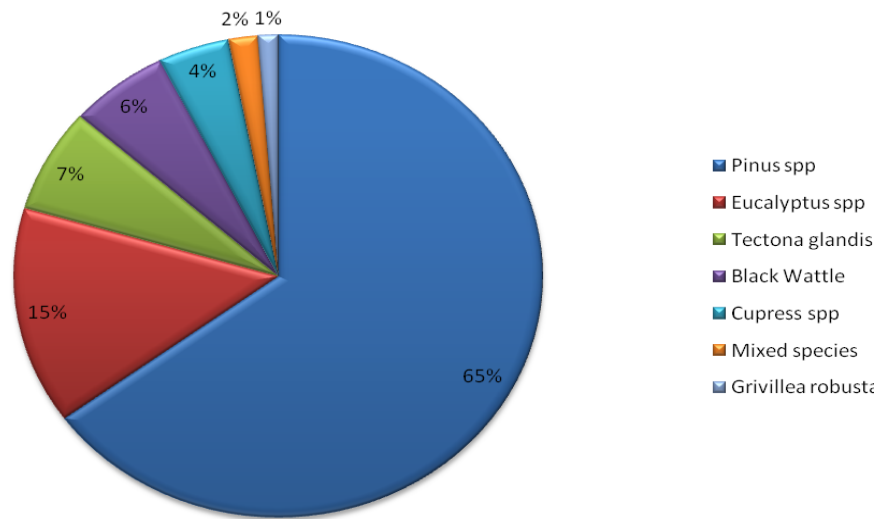


Figure 1: Distribution of dominant tree species planted in Tanzania by area



Plate 1: Stand of *Pinus patula* in Lemosho range West Kilimanjaro forest plantation in Tanzania.

Furthermore it was observed that, in Southern Highlands Zone some forest plantations are originating from singling of sprouting seedlings in the harvested area and the area nearby matured forested and harvested plantation. This is very common for pines plantation in Sao Hill, Kiwira and Shume which are the sites best for pines. According to Malimbwi *et al.* (2010.), it has been observed that more than half of current young woodlots in Makete come from natural regeneration after the mother trees have been harvested. Some of these seedlings are being used for the establishment of woodlots elsewhere, while some are left to grow *insitu* as the next woodlot. To ensure future quality crop seedlings with straight, vigorous, and non multiple stems with few balanced branches must be selected to remain in the field or for planting elsewhere.

Due to high risk of wild fire, field observation in this study revealed that, most of the small scale woodlot owners are currently planting more *Eucalyptus* sp due to its coppicing ability after being burnt. However, *Eucalyptus* sp are sometimes criticized that they may deplete nutrients and soil water on the site they grow (FAO 1989). According to Singunda (2010), in Mufindi District of Southern Highlands Zone, people preferred the pines because after harvesting they could plant agricultural crops for three seasons without using fertilizers unlike the *Eucalyptus*.

Studies have shown that proper selection of planting material has great potential to improve growth and yields of pines. It has been observed that even with adequate precipitation, optimal temperatures, and suitable soils, it is possible that other factors will influence the type of tree grown. This is well depicted by (Steiner, 1984; Dean *et*

al., 1995, and Katherine, 1997) that there may be economic concern such as commodity prices, social factors like consumer taste and preference, tradition or even political reasons. Also, price stability can determine the tree species choice that a farmer makes.

4.2 Distribution of forests plantations by ownership

This study categorized the management of the forest plantation of Tanzania into government and private ownership. Government plantation involves all plantations owned and managed by central and local government. Private forest plantations, involves Large industrial forest plantations and individual woodlots.

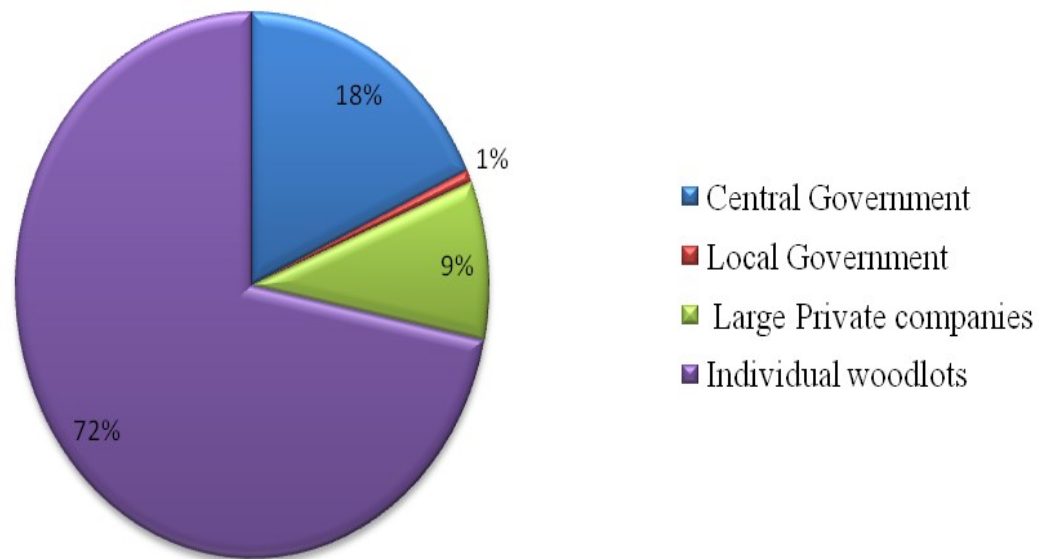


Figure 2: Distribution of the forest plantation area in Tanzania mainland by Ownership

The results of this study indicate that, government own 19% of planted area of all forest plantation in Tanzania while the rest is owned by private sector. Central government through Tanzania Forest Services (TFS) owns 18% while Local government owns 1% of the total planted area of the government forest plantations. However, area owned by local government is very small compared to other ownership. This is because in most of the districts, forestry is not a priority sector in district development plan. Therefore no proper management strategies for forest plantation establishment and management.

On the other hand, the study revealed that, private forest plantations contribute about 81% of the total planted area in the country. In private plantation small scale forest (individuals woodlots) own 72% of the planted area of the forest plantation while 9% is owned by large private companies as shown in Figure 2. This distribution by ownership indicates the significant contribution of each sector in the management of forest plantations in Tanzania. Figure 3 indicates that, central and western zones of Tanzania have no government forest plantation. This is because zones are the main component of miombo woodlands of Tanzania.

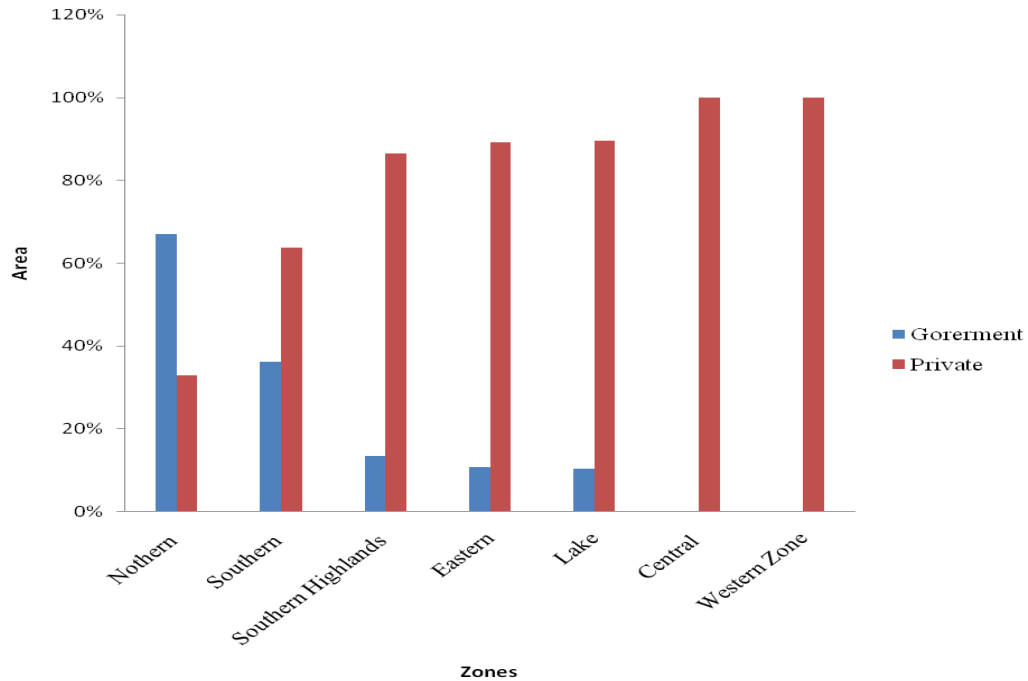


Figure 3: Distribution of the forest plantation area in the zones by ownership

4.2.1 Government forest plantations

The study results show that government of Tanzania through TFS owns and manages 18 industrial forest plantations and two proposed forest plantations with a total of 228 179 ha of plantable area (Table 3). The proposed are Buhigwe Forest Plantation in Kigoma and Morogoro fuel wood plantation in Morogoro regions which are expected to be planted by TFS in the financial budget of 2016/2017. This will make the total of 20 forest plantations owned by the government under TFS. Korogwe and Mbizi Forest plantations were established after the formation of TFS. Plantable area according to this study includes planted and expansion area.

Table 3: Extent and geographical distribution of the government plantations

PLANTATION NAME	AREA (Ha)				
	GAZETTED	PLANTABLE	PLANTED	EXPANSION	RESERVED
Buhindi	21 477	10 597	5 126	5 471	10 880
Buhigwe	13 000	12 000		12 000	1 000
Kawetire	4 872	3 709	2 911	798	1 163
Kiwira	3 028	2 784	2 756	112	20
Korogwe	10 821	10 805	237	10 568	16
Longuza	2 749	2 340	2 073	267	409
Mbizi	12 158	3 089	1 216	1 873	9 069
Meru/Usa	8 195	6 566	6 382	184	1 629
Morogoro fuelwood	12 000	9 000		9 000	3 000
Mtibwa	3 115	2 369	2 341	28	746
North Kilimanjaro	8 069	7 564	6 489	1 075	505
North Ruvu	32 000	20 000	272	19 728	12 000
Rondo	14 721	2 979	1 538	1 441	11 742
Rubare	6 374	3 450	2 008	1 442	2 924
Rubya	2 149	2 021	1 894	127	128
Sao Hill	135 903	86 003	57 574	28 429	49 900
Shume	4 509	4 425	4 353	72	84
Ukaguru	2 157	2 157	1 183	974	-
West Kilimanjaro	7 212	4 337	4 250	87	3 295
Wino-Ifinga and Mkongotema	39 038	32 000	2 883	29 117	7 038
Total	343 947	228 419	105 625	122 794	115 528

In the plantable area, a total of 105 625 ha which is 46% of the total area of the forest plantation owned by government have been planted with different species including *Pinus spp*, *Eucalyptus*, *Cupressus spp*, and other tree species. However the total planted area of the government forest plantation occupies only 18% of the total planted area in Tanzania. This indicates that the largest part of the forest plantation in Tanzania is under the private sector in different ownership including individual's woodlots and private companies.

Sao Hill Forest Plantation (SHFP) is the largest accounting for about 10% of the total planted area of the Country and currently accounts over 55% of the total planted area of the government forest plantation in Tanzania.

Pinus patula is still a dominant species almost in all the government plantations except Mtibwa and Longuza forests, where only hardwood species are grown and *Tectonal grandis* being the dominant species.

Furthermore the study revealed that, about 115 528 ha under the government ownership is a reserved area for catchment and settlements purposes. Large part of this reserved area is located on the slopes (steep and gentle slopes) of mountains or in the wetlands where there are important water sources for different water streams and rivers. It is covered with natural vegetation which is normally determined by the amount of rainfall received in the area. It is mostly dominated by different species such as *Entandophragma excelsum*, *Ficus thorningii*, *Ekebergia capensis*, *Syzgium guinensis*, *Albizia gumifera*, *Olea capensis*, *O. africana*, *Hagenia abyssinica*, *A. schimperana*, *Croton sp* and many others.

This study found that, about 61% of the planted area of the government forest plantation is found in the Southern highlands zone and the smallest size is in western zone constituting 4% of the total planted area (Table 4).

Table 4: Planted area in the government forest plantations by zone

Zone	Planted area (Ha)	%
Southern highlands	64 595.68	61
Northern	23 784.02	23
Lake	9 028.50	9
Southern	4 421.20	4
Eastern	3 795.60	4
Total	105 625.00	100

The rest, Northern, Lake and Southern zones contribute about 23%, 4% and 4% respectively of the planted area (Table 4). This indicates that governments through TFS have more forest plantation in Southern Highlands Zone than the rest of the zones. Iringa is one of the important regions in Southern Highland Zone with large area of the government forest plantation (Appendix 7).

The entire government plantations were established with the aim of supplying raw materials to the small and large scale industries. However there is no reliable information on the forest plantations owned by local government in Tanzania.

4.2.2 Private forest plantations

The private sector initiatives and performance in tree planting is gradually increasing. This indicated the large area of the forest plantation owned and managed by the private sectors in Tanzania. The study revealed that the total planted area under management of private forest plantation is 477104 ha which is almost 82% of the total planted area of all forest plantation in Tanzania. Njombe and Iringa have the

largest area constituting of 39.2% and 32.7% followed by Kagera, Morogoro and Kigoma with 8.1%, 6.98% and 2.8% of the total planted area owned by private forest plantations respectively. On the other hand Arusha, Mbeya and Shinyanga have the least private forest areas compared to other regions although these regions except Shinyanga have large government forest plantations.

At the zonal level, about 71% of the total planted area of the private forest plantation is in Southern Highlands zone while 11% and 7% are in Lake and Eastern zone respectively. The Southern and Centrol zones have very smaller planted area of the private forest plantation constituting of only 1% and 2% respectively (Table 5). These results indicate the progressive increase in the area of private forest plantation as compared to past 5 years records. The results of this study divided the ownership of the private forest plantations into two major categories; large private company forest plantation and individual woodlots.

Table 5: Area of private forest plantations by Zone

Zone	Area per zone (Ha)	%
Southern Highlands Zone	338 039.35	71
Lake zone	53 500.78	11
Eastern zone	34 277.33	7
Western zone	18 561.15	4
Northern zone	13 645.70	3
Centrol zone	8 149.80	2
Southern zone	6 815.00	1
Total	472 989.09	100

4.2.2.1 Large private forest plantations

Large private forest plantation involves all industrial forest plantations owned by large private companies. In Tanzania the large private forest plantations are owned by large companies such as TANWAT, Green Resources Limited, Mufindi Paper Mills, Kilombero Valley Teak Company(KVTC) and Matekelezachang' a and company. Figure 4 indicate that, large scale private forest plantation occupies about 9% of the planted area in Tanzania. Therefore they account only small portion of the planted area of the forest plantation in the country as compared to other ownerships where the largest area is owned by individuals woodlots.

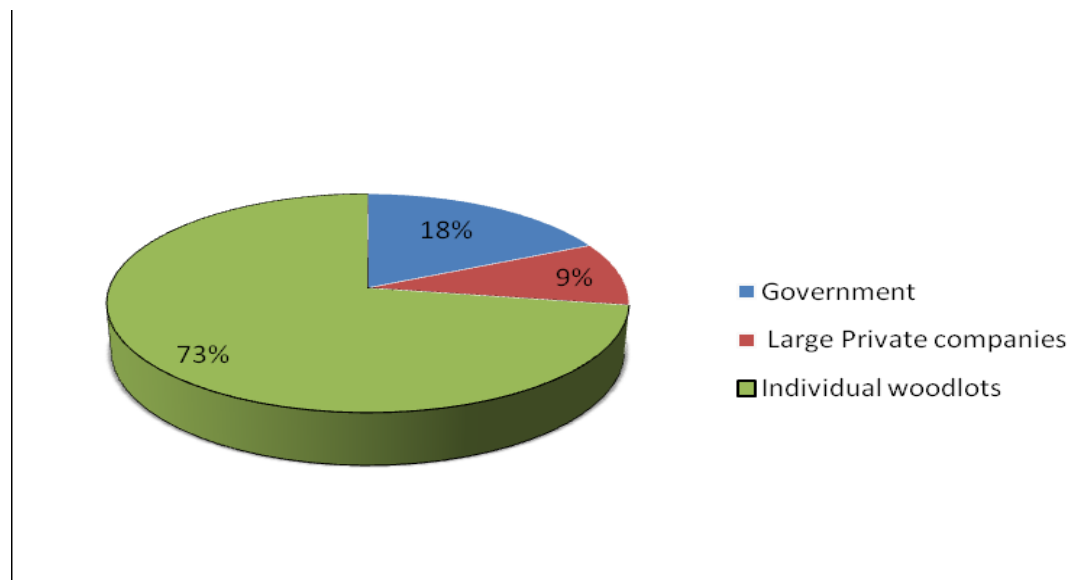


Figure 4: Distribution of the planted area of the government and private forest plantations

This study revealed that, large private companies own a total of 118 332 ha of plantable area in the country. Also it was revealed that, about 54 708ha which 46% of the total area owned by private forest plantations, is planted with different trees

species and 54% is the expansion area and therefore they can double the size of the planted area. The study finding shows that, Matekeleza Chang'a and Company is an indigenous Forest plantation company owning 11% of the total planted area owned by large private forest Company which is almost equal to the area owned by Mufindi Paper mills Company in Mufindi District.

Table 6: Area of large private forest plantations

Name of the Company	Area of plantation (Ha)	
	Total plantable area(Ha)	Total planted area (Ha)
Green resources ltd	36 772	18 352
Tanganyika wattle company ltd (TANWAT)	15 560	14 656
Kilombero Vally teak Companyu (KVTC)	14 000	8 200
Mufindi Paper Mills	34 980	6 000
Matekeleza chang' a and company.	6,520	6,000
New Forest Company ltd	10 500	1 500
Total	118 332	54 708

The study found that, in large private forest plantation *Pines spp* are the most planted species accounting for 44% of the area planted with species followed by *Eucalyptus sp*, Black wattle (*Acacia mearnsii*) as shown in Figure 5.

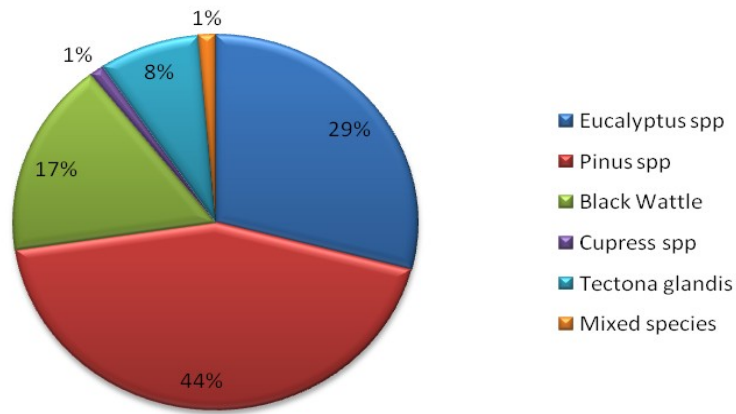


Figure 5: Distribution of area by dominant tree species planted in large private forest plantations

4.2.2.2 Individual woodlots.

The number of individual woodlots is increasing quite rapidly in Tanzania. It is observed that, there are small-scale woodlots and medium-sized plantations owned by local farmers, business people, schools and NGOs)

The study findings show that, individual's woodlots contain 72% of all planted area in Tanzania (Fig.4) and 88% of all planted area of the private forest plantation in Tanzania (Table 7). This area is also equal to 73% of all planted area of the forest plantations managed by government and private ownership in the country (Fig. 4). Tree planting and woodlot establishment by farmers and communities has taken place in all the districts, but particularly in the Southern Highlands, especially in Mufindi, Njombe and Makete districts in Iringa region.

Table 7: Distribution of large scale forest plantations and individual woodlots

Ownership	Total planted area	%
Individual's woodlots	422 396	89
Large private companies	54 708	11
Total	477 104	100

The study revealed that, individual's woodlots are expanding rapidly in the rural, especially in Southern Highlands and Lake Zone of Tanzania. This is apparently because sparsely populated villages still have thousands of hectares of land for forest plantation establishment. Also in these zones, there are several tree planting programs such as Private Forest Programs (PFP), Forest Development Trust (FDT) that are facilitating tree planting to individuals and tree growers associations (TGAs) (Plate 2) in Southern Highlands Zone while in lake zone there is tree planting programs including village tree planting by Vi Agroforestry Project in Mara region. Also the National Forest Policy has created an enabling environment for private forestry in Tanzania by encouraging establishment of private sector woodlots and plantations.

However individual's woodlots have not received much facilitation and support in terms of establishing their own grassroots associations/organizations and other models (Nganga, 2011).

The most important plantation species are pines (*Pinus patula*, *P. elliottii* and *P. caribaea*), cypress (mainly *Cupressus lusitanica*), *Eucalyptus* sp (many species) and *Tectona grandis* (TFCMP, 2008).



Plate 2: Tree nursery and woodlot owned by Matembwe Tree Growers Association in Njombe region.

Financial support in the establishment and management of the forest plantation is very important to make it more affordable. From the informal discussion it was revealed that most of the respondents in Southern Highlands zone establish and manage their forest plantations using their own source of income while all government forest plantations depend on the government budget and Logging and Miscellaneous Development Account (LMDA).

Large private companies such as the Kilombero Valley Teak Company (KVTC) and the Green Resources Ltd establish and manage their plantation using their own sources, loans and grants (Ngaga, 2011). The development of the forest sector in Tanzania has been dominated by dependence on donor financing, and sectoral self-financing mechanisms have remained undeveloped. Potential financing mechanisms include provision of bank soft loans, private sector investments and carbon finance.

4.3 Expansion potential of the forest plantations

The result of this study indicated that, the total plantable area in both central and large private forest plantation is estimated to be 347 280.7 ha. The total available land for expansion of both central government and large private forest plantations is 187 187.4 ha which is about 54% of the total plantable area under these ownerships (Table 8). From the above information it is justifiable that, the planted area is less than the expansion area hence possible to double the size of the plantation in both private and government ownership within the consideration of normalized yield.

Table 8: Expansion area of the government and large private plantations

Ownership	Plantable		Planted		Expansion	
	area (Ha)	%	area (Ha)	%	Area (Ha)	%
Government forest plantation	228 418	66	105 625	30	122 793	35
Large Private forest plantation	119 102	34	54 708	16	64 394	19
Total	347 520	100	160 333	46	187 187	54

4.3.1 Expansion area for government forest plantations in Tanzania

The study result shows that, all government forest plantations have areas set aside for expansion. The total expansion area of the government forest plantation is 122 793 ha which is 53.9% of the plantable area (Table 8). This means governments through TFS and other stakeholders can double the size of planted area in Tanzania (Appendix.4).

Table 9: Expansion area for government forest plantations

PLANTATION NAME	REGION	EXPANSION	
		Area (Ha)	%
Wino/ Mkongotema	Ruvuma	29 117	23.7
Sao Hill	Iringa	28 429	23.2
North Ruvu	Coastal	19 728	16.1
Buhigwe Forest Plantation	Kigoma	12 000	9.8
Korogwe	Tanga	10 568	8.6
Morogoro Fuelwood	Morogoro	9 000	7.3
Buhindi	Mwanza	5 471	4.5
Mbizi	Rukwa	1 873	1.5
Rubare	Kagera	1 442	1.2
Rondo	Lindi	1 441	1.2
North Kilimanjaro	Kilimanjaro	1 075	0.9
Ukaguru	Morogoro	974	0.8
Kawetire	Mbeya	798	0.6
Longuza	Tanga	267	0.2
Meru/Usa	Arusha	184	0.2
Rubya	Mwanza	127	0.1
Kiwira	Mbeya	112	0.1
West Kilimanjaro	Kilimanjaro	87	0.1
Shume	Tanga	72	0.1
Mtibwa	Morogoro	28	0.02
TOTAL		122 793	100

The largest expansion area is in Wino/Mkongotema followed by Sao Hill Forest (SHFP) plantation which contributes about 23.7% and 23.2% of total expansion area of all government forest plantations in Tanzania respectively (Table 9). The smallest expansion area is in Mtibwa Forest plantation which contributes about 0.02% of the total expansion area of the government forest plantations.

Since the establishment of TFS, planting in the expansion has been increasing each year which resulted in the increase of the planted area from 85 000ha to 105 624.8ha within five (5) years of its implementation. In those few plantations with small expansion area planting is mostly done in the clear felled areas and thus the annual planting target depends on the harvesting speed.

4.3.2 Expansion area for private forest plantations

Results indicate that most of the private forest plantation companies have an area set aside for plantation expansion. Apparently, most expansion areas under private plantations are acquired from adjacent villages and most of this land is still under discussions.

Table 10: Size of expansion area of the forest plantation owned by large private companies

Name of the Company	Plantable area (Ha)	Expansion area	
		(Ha)	%
Mufindi Paper Mills	34 980	25 000	21
Green resources ltd	36 772	18 420	16
New Forest Company ltd	10 500	10 000	8
Kilombero Vally teak Companyu (KVTC)	14 000	9 800	8
Tanganyika wattle company ltd (TANWAT)	15 560	654	1
Matekeleza chang'a and company.	6 520	520	0.4
Total area (Ha)	118 332	64 394	54

The study findings show that, the total expansion area of the large private forest plantations is 54% of the total plantable area under large private companies. This indicates that there is available land for doubling-up the size of industrial private forest plantations in Tanzania. Table 10 indicate that, the largest expansion area is owned by Mufindi paper mills accounting 21% followed by Green Resources ltd with 16% of the total expansion area under private companies in the country. The study revealed further that, Matekelezachang'a and company ltd and Tanganyika wattle company ltd (TANWAT) have least size of the area set aside for expansion of their plantations. New Forest Company and ltd Kilombero Valley teak Company (KVTC) have almost similar expansion area (Table 10). It was however difficult to get the reliable expansion areas of the individual plantations and woodlots because their expansion area can be obtained through buying new land, inheriting or converting cultivated land into forest plantations and woodlots.

4.4. Factors promoting expansion of forest plantations

Tree planting programme in Tanzania has been advocated for decades but implementation of these activities is not promising in most parts of the country. The study discovered that Tree planting activities in Tanzania have been influenced by number of factors as indicated in (Table. 12).

Table 11: Factors promoting expansion of forest plantations in Tanzania

Factors	%
Long term potential investments	17.2
Presences of large wood processing industries	17.2
Good transportation network	15.5
Availability of manpower(labour)	12.1
Growing demand of woody forest products	8.6
Vision and objective of the company/ organization	8.6
Favorable climatic conditions	7.8
Lesson from large forest plantation in the area	6
Indigenous knowledge	5.2
Presences of large wood processing industries	1.7
TOTAL	100

The results shows that, about 17 % of respondents mentioned long term potential investments as their major influence of this investment, 15.5% of respondent was influenced by good transport network while 8.6% were influenced by growing demand of woody forest products and vision and objective of the company/ organization (Table, 12). Also about 1.7% of plantation owners embarked in forest plantation due to presences of large wood processing industries in the nearby area.

This study observed that, people in Tanzania especially in Southern Highlands, Lake and Northern Zones, responded positively to tree planting due to the fact that, they already know the importance of trees due to high contribution highly to their economy of individual households and to the country at large. Also due to favorable climatic conditions and good transportation networks, good investments in wood processing industries which generate demand of wood raw materials for timber, poles and pulping together with the growing demand of wood products for industrials and domestics uses.

According to Ngaga (2011) among the considerable opportunities for expansion of forest plantations in Tanzania include market oriented economy, and growing domestic and international markets for forest products, especially in fast growing economy countries like China. Improvements on competitiveness of Tanzanian forest products can increase the market share in international markets. Some aspects for improvement include: product cost at sawmills, quality, prices, infrastructure, forest products market information and tapping emerging markets e.g. forest certification schemes; In recognition of all these advantages, most of the individuals and large companies have embarked on programmes to establish their own tree plantations and woodlots.

However, investments in industrial plantations are hampered by limited attention to the current operating environment (e.g. long and tedious land acquisition procedures), lack of effective communication between the private sector representatives and the government authorities, as well as lack of data on available

land for investments (i.e. reliable data on most potential areas and opportunities to expand plantation areas in the future) (MFA, 2010).

Other factors include supportive legal and regulatory frameworks, especially the national forest policy (1998) and forest act (2002) to ensure good environment for private sector involvement forestry. Also the country has remained politically stable since independence over 50 years ago which ensure environment for private sector investments.

4.5 Challenges facing expansion of forest plantation in Tanzania

While, in general, the environment in Tanzania is conducive for promotion of plantation forestry and the private sector involvement seems to be gradually growing, there are number of constraints facing involvement in industrial and non industrial forest plantations in Tanzania. Some of the major challenges are indicated in (Table 12).

Table 12: Challenges facing expansion of forest plantation in Tanzania

Challenges	%
Forest fires,	28.4
Availability of manpower(labour)	17.9
Investment and management cost	17.9
Poor seed quality	15.8
Land conflict	10.5
Land acquisition procedures	9.5
TOTAL	100

The study revealed that 28% of the respondent reported wild fires as the major challenges especially in Small scale private forest plantation and woodlots followed by 18% of both availability of manpower and investment and management cost. Forest fire is the major threat, which has contributed to a significant loss of forest plantations and woodlots in Tanzania. Uncontrolled forest fires are a serious concern all over Tanzania caused by several reasons including natural and anthropogenic effects. About 15.8% of the forest plantation owners are facing the problem of poor seed quality while 10.5% and 9.5 % are facing the problem of land conflict and land acquisition problems respectively.

According to the literature, incidence of forest fires in the period 2005-2009, for example, close to 6 000 ha were destroyed by fire, most of it in Sao Hill (2 160 ha) and in Kilombero Valley Teak Company (3 300 ha). During the year 2009/10, information provided by some Plantation Managers showed that a total of c. 3 900 ha were affected by forest fires (Kiangi, 2010; Mussami, 2010).

However strategies need to be in place to ensure that future losses due to forest fires are minimised. Measures are normally undertaken to prevent fire occurrences and/or put off forest fires including cleaning fire breaks before the fire season, purchasing and maintaining fire fighting equipments in a good working condition ready for use in case of fire occurrence. Also keeping standby firefighting crews and vehicle(s) during dry season reduce severe effect of forest fire in most of the government forest plantation. In addition to the above precautionary measures, forest guards are continually employed for patrolling the forest and reporting any fire incidences.

Apparently there are indications that tree planting in individual lands and private forest plantations have caused this problem to significantly decrease especially in Southern Highlands, Lake and Northern Zone. This is because everyone becomes attentive of wild fire especially during dry seasons.

However forests sector in Tanzania are subjected to pressure from other uses by the communities living in or within close proximity. These includes high demand of land for food crops cultivation caused by population growth and harvesting of juvenile wood aggravated by high cost of silvicultural operation and increase in demand of forest product especially timber in the domestic and international market. From this study it was also discovered that procedures for land acquisition is cost full and time consuming therefore small scale tree growers fail to own land officially. However, for optimum land use, it is recommended to plant trees on hilly areas and on exhausted agricultural lands which can no longer support agricultural crops. In areas where there is no land shortage, trees can be planted anywhere (Malimbwi *et al.* 2010).

CHAPTER FIVE

5.0 CONCLUSION AND RECCOMAMANDATIONS

5.1 Conclusion

From this study it can be concluded that, there is significant increase in the area of the forest plantations due to rapid growing of demand for forest products. This increase can be observed much in Southern Highland, Northern and Lake Zone where investment in forest plantation and traditional forest plantation concept is taking place. Therefore financial mechanism is needed to facilitate more establishments of forest plantations in other zones to balance the estimated wood deficit in the country.

Private sector small scale woodlot occupies large area of the forest plantation as compared to government forest plantations. Through practising good management with the intention of reaching normal forest with planned age distribution structure, the area available for forest expansion is big enough to accommodate the doubling of the current size of both private and government forest plantation in the country. Therefore efforts to promote private forest plantations should continue to meet the growing demand for wood materials.

Pinus species are the most planted in both government and private forest plantations and *Pinus patula* being the most important plantation species in Northern and Southern Highland zone. This is due to its growing yield which varies considerable depending on site condition as well as management cost. Also it is preferred most for timber, pulp and paper production, particle board and wood wool manufacturing.

5.2 Recommendations

Basing on the results of this study, it is recommended that;

- (i) Effort to promote private forest plantations should continue since the large part of the forest plantation fall under private sector including large company and individuals. This will ensure better and high productivity from the forest plantation on meeting the growing demand for wood materials.
- (ii) The mobilization of smallholders through tree growers associations should be conducted to increase the area under private plantation forestry especially in the central part of Tanzania. This will create considerable economic and social benefits for local communities and regions, including boosting awareness on the proper utilization of land. This will significantly help to avoid the predicted serious demand-supply deficit.
- (iii) It is recommended that, government through Tanzania Forest Service (TFS) should put forward the best strategies on how they can double the size of the forest plantation to ensure high and better return from commercial forest products.
- (iv) For the regions with available land for expansion of the forest plantations like most region of Southern Highlands Zone and Lake Zone. Governments should provide a favorable investment and operating climate for the private sector to get involved with plantation establishment and management. For regions where land is limiting, out-grower schemes and other woodlots should be supported to assume a much greater role in tree growing.

(v) Together with the existing private forest plantations in Western and Central zone, strategies to find areas for government forest plantation should be implemented and research should be conducted to find the appropriate plantation species for the government plantations in these zones.

(vi) It is also recommended that, more extension services should be provided to private forest plantations owners to ensure timely and proper silvicultural treatment in order to ensure high performance of the plantation.

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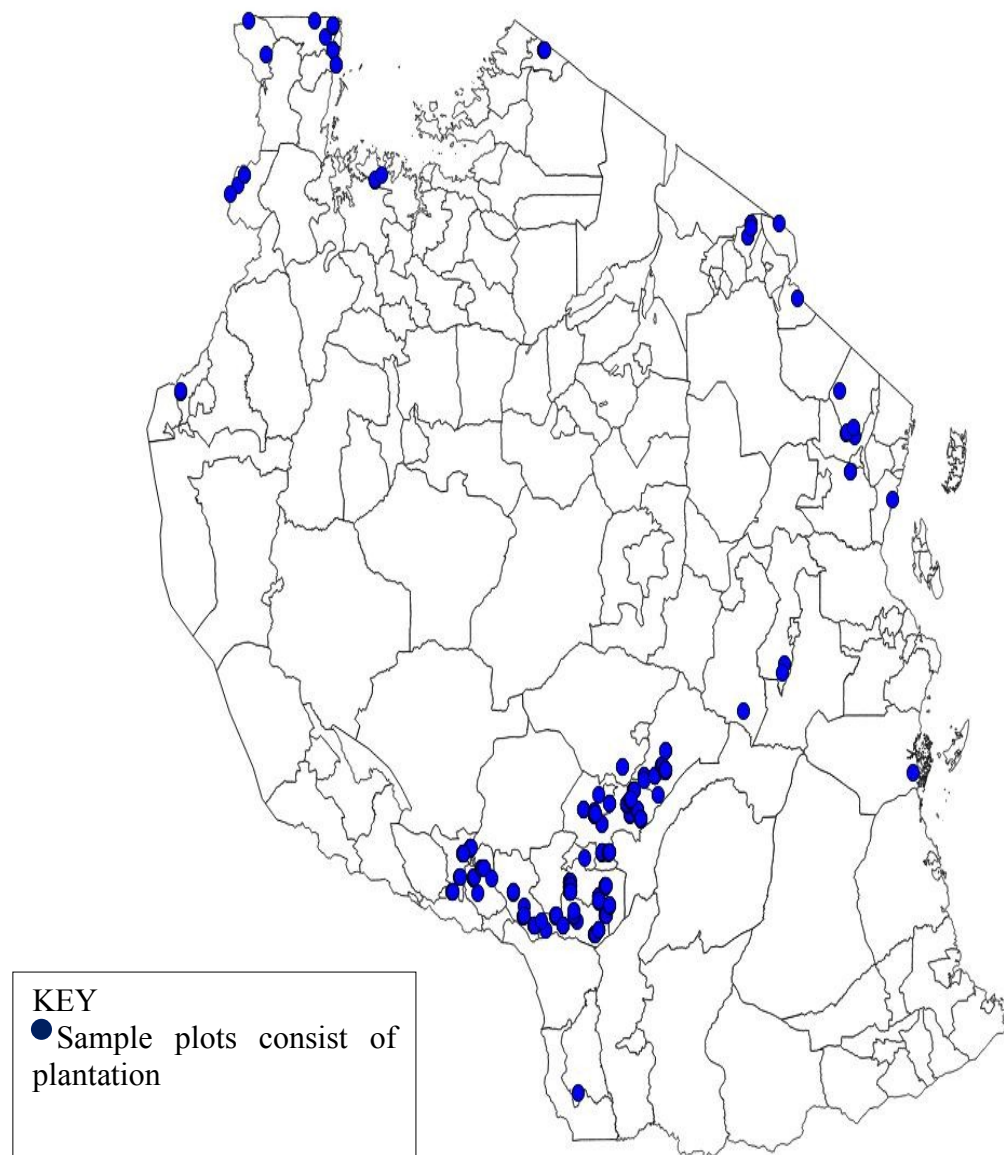
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APPENDIXES

Appendix 1: Distribution of NAFOMA sample plots containing plantation tree species in Tanzania



Source: (NAFORMA,2015)

Appendix 2: Distribution of NAFOMA sample plots containing plantation tree species in Region and district Tanzania

Region code	Region Name	District code	District name	Number of plots
3	Kilimanjaro	5	Hai	3
		6	Moshi Urban	3
4	Tanga	1	Lushoto	5
		6	Handeni	2
5	Morogoro	6	Mvomero	1
11	Iringa	2	Mufindi	70
		7	Kilolo	25
	Njombe	3	Makete	17
		4	Njombe	85
12	Mbeya	2	Mbeya rural	12
		4	Rungwe	10
		5	Ileje	5
		8	Mbeya city	4
18	Kagera	1	Karagwe	2
		2	Bukoba rural	13
		5	Ngara	3
19	Mwanza	5	Sengerema	3
20	Mara	1	Tarime	4

Source: (NAFORMA,2015)

Appendix 3: Checklist for Key Informants**PART 1. Checklist for Managers of Government forest plantations**

Plantation Name

Size of the planted area

Trees species planted per area

Rotation age by species and size of the planted land

Size of the expansion area

Is there any plan for acquiring land for plantation expansion?

Size of the reserved area within the same management

What are the factors affecting plantation expansion

PART 2. Checklist for Managers of large private forest plantations

Plantation Name

Region

Districts

Size of the planted area

Trees species planted per area

Rotation age by species and size of the planted land

Size of the expansion area

Is there any plan for acquiring land for plantation expansion?

Size of the reserved area within the same management

What are the factors affecting plantation expansion

PART 3. Checklist for District forest officials

Region

Districts

Number of private forest plantation in the District

Number of owners of the private forest plantation in the Districts

Actual or average size of each private forest plantation in the district.

Most dominant tree species planted in the District per area.

Average spacing/ stocking

Expansion area

Area of land set aside for plantation expansion

Availability of land for plantation expansion

Procedures for land acquisition in the district.

What are the factors affecting plantation expansion

PART 4. Checklist for WEO/VEO for the selected Wards and villages

Region

Districts

Number of private forest plantation in the Ward/ Village

Number of owners of the private forest plantation in the Ward/ Village

Actual or average size of each private forest plantation in the Ward/ Village.

Most dominant tree species planted in the Ward/ Village.

Average spacing/ stocking

Expansion area

Village land use plan

Area (size) of land set aside for plantation expansion

Availability of land for plantation expansion.

Procedures for land acquisition in the district

What are the factors affecting plantation expansion

PART 5. Checklist for selected small scale Private forest plantations

Region

Districts

Size of your plantation

Total area owned

Mode of acquiring land/Inherited/ Bought/ Village government allocation.....

Total planted area

Trees species have you planted

source of the seeds

Source of seedlings

Spacing

Area set aside for expansion of your plantation.

Plan for buying new land for tree plantation.

Factors affecting expansion of your plantat

Appendix 4: Aare of the central government forest plantations in Tanzania

S/ n	NAME OF PLANTATION	REGIO N	ESTABLISHM ENT YEAR	AREA (Ha)					REMA KS
				TOTAL GAZETTE D	PLANTATBLE	PLANT ED	EXPANSI ON	RESERVE D	
1	Buhindi	Mwanza	1968	21,477	10,597	5,126	5,471	10,880	
2	Buhigwe Forest Plantation	Kigoma		13,000	12,000.00		12,000	1,000	Propose d
3	Kawetire	Mbeya	1937	4,871	3,709	2,911	798	1,163	
4	Kiwira	Mbeya	1960	3028	2,784	2,896	112	20-	
5	Korogwe	Tanga		10,805	10,789	237	10,568	16	
6	Longuza	Tanga	1961	2,749	2,340	2,073	267	409	
7	Mbizi	Rukwa	2014	12,158	3,089	1,216	1,873	9,069	
8	Meru/Usa	Arusha	1953	8,195	6,566	6,382	184	1,629	
9	Morogoro fuelwood	Morogor o		12,000	9,000.00		9,000	3,000	Propose d
10	Mtibwa	Morogor o	1954	3,115	2,369	2,341	28	746	
11	North Kilimanjaro	Kilimanj aro	1951	8,069	7,564	6,489	1,075	505	
12	North Ruvu	Pwani		32,000	20,000	272	19,728	12,000	
13	Rondo	Lindi	1952	14,721	2,979	1,538	1,441	11,742	
14	Rubare	Kagera	1955	6,374	3,450	2,008	1,442	2,924	
15	Rubya	Mwanza	1961	2,149	2,021	1,894	127	128	
16	Sao Hill	Iringa	1965	135,903	86,003	57,574	28,429	49,900	
17	Shume	Tanga	1953	4,509	4,425	4,353	72	84	
18	Ukaguru	Morogor	1957	2,157					

		o			2,157	1,183	974	-	
19	West Kilimanjaro	Kilimanjaro	1956	7,212	4,337	4,250	87	3,295	
20	Wino-Ifinga and Mkongotema	Ruvuma	1923	39,038	32,000	2,883	29,117	7,038	
	Total			343 947	228,179	105,626	122,793	115,528	
	Percentage (%)					46%	54%		

Appendix 5: Area of the private forest plantation in Tanzania by regions

S/N	Region	Area (Ha)	%
1	Njombe	185,224.61	39.16
2	Iringa	150,083.89	31.73
2	Kagera	38,481.72	8.14
3	Morogoro	33,000.00	6.98
3	Kigoma	13,287.65	2.81
4	Mara	9,927.25	2.10
4	Tanga	7,778.09	1.64
5	Kilimanjaro	5,867.61	1.24
5	Manyara	3,717.20	0.79
6	Katavi	3,373.08	0.71
6	Dodoma	3,308.36	0.70
7	Ruvuma	2,991.50	0.63
7	Geita	2,854.31	0.60
8	Mtwara	2,465.49	0.52
8	Rukwa	2,310.85	0.49
9	Tabora	1,376.06	0.29
9	Lindi	1,358.00	0.29
10	Mwanza	1,287.27	0.27
10	Singida	1,124.23	0.24
11	Dar	1,017.33	0.22
11	Simiyu	950.23	0.20
12	Shinyanga	524.37	0.11
12	Mbeya	420.00	0.09
13	Pwani (Coastal)	260.00	0.05
13	Arusha	0	0.00
	TOTAL	472,989.09	100

Figure 6: Distribution of forest plantations in Tanzania

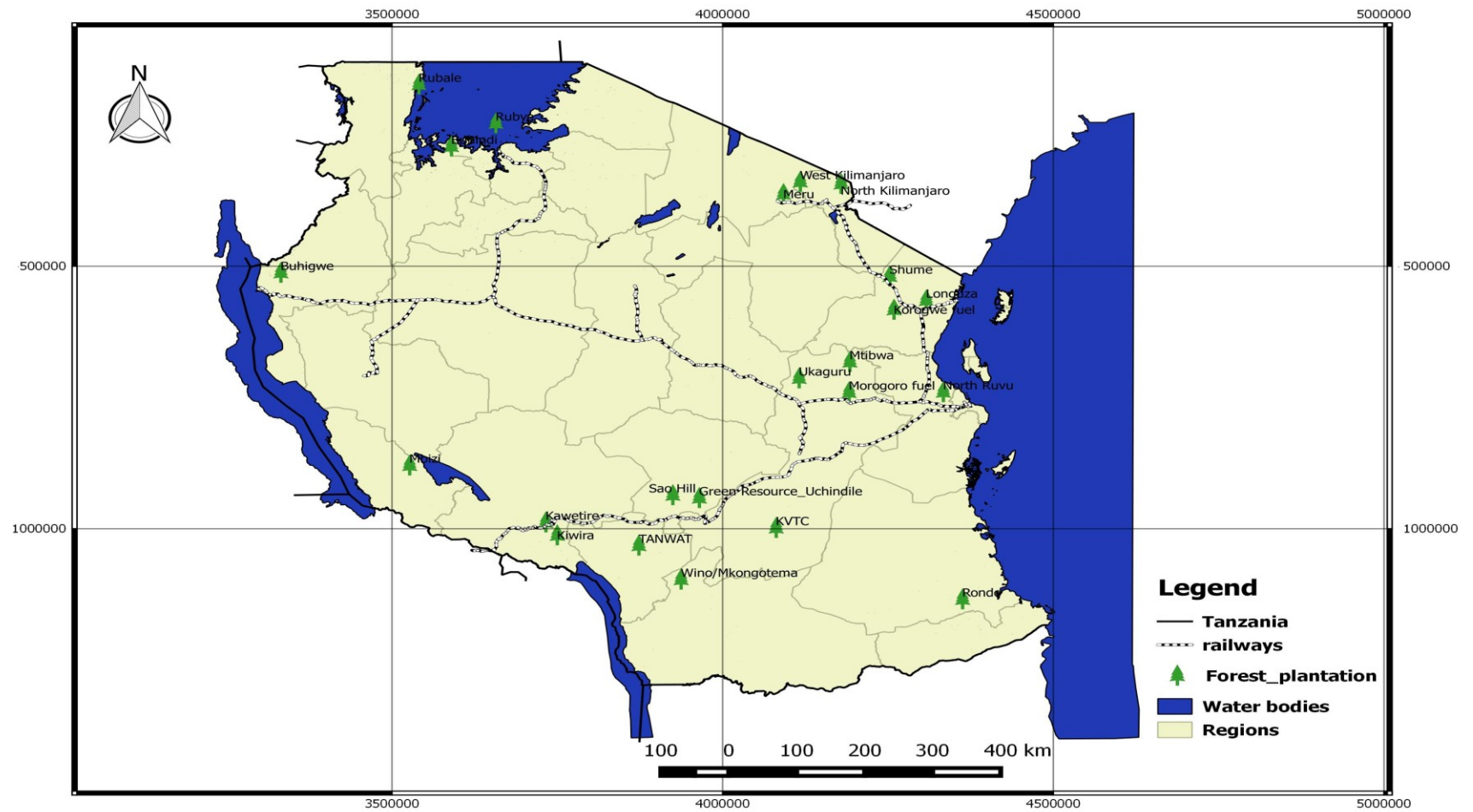


Figure 7: Distribution of the government and private forest plantation by region

S/N	Region	Size of plantation (Ha)		TOTAL
		Gorernment	Private	
1	Arusha	6,381.97		6,381.97
2	Dar	-	1,017.33	1,017.33
3	Dodoma	-	3,308.36	3,308.36
4	Geita	-	2,854.31	2,854.31
5	Iringa	57,573.66	150,083.89	207,657.55
6	Kagera	2,008.30	38,481.72	40,490.02
7	Katavi		3,373.08	3,373.08
8	Kigoma		13,287.65	13,287.65
9	Kilimanjaro	10,739.30	5,867.61	16,606.91
10	Lindi	1,538.20	1,358.00	2,896.20
11	Manyara		3,717.20	3,717.20
12	Mara	-	9,927.25	9,927.25
13	Mbeya	5,806.00	420.00	6,226.00
14	Morogoro	3,523.60	33,000.00	36,523.60
15	Mtwara	-	2,465.49	2,465.49
16	Mwanza	7,020.00	1,287.27	8,307.27
17	Njombe	2,883.00	185,224.61	188,107.61
18	Coastal	272.00	260.00	532.00
19	Rukwa	1,216.00	2,310.85	3,526.85
20	Ruvuma	4,353.00	2,991.50	7,344.50
21	Shinyanga		524.37	524.37
22	Simiyu		950.23	950.23
23	Singida		1,124.23	1,124.23
24	Tabora		1,376.06	1,376.06
25	Tanga	6,425.80	7,778.09	14,203.89
		109,740.83	472,989.09	582,729.92