CONTRIBUTION OF *GMELINA ARBOREA* TREE SPECIES IN COMBATING DEFORESTATION IN NAMTUMBO DISTRICT, TANZANIA

By

Jacob Mbunda

Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Natural Resources Management

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CERTIFICATION

The undersigned certify that he has read and hereby recommends for acceptance by the University of Dodoma, a dissertation entitled: ‘‘**Contribution of *Gmelina arborea* Tree Species in Combating Deforestation in Namtumbo District’’** in partial fulfillment of the requirements for the degree of Master of Science in Natural Resources Management.

…….

Dr. Enock Makupa

(SUPERVISOR)

Date……..……..

DECLARATION

AND

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I Jacob Mbunda, I hereby declare that this research dissertation is a result of my own investigations and findings. The sources done by other people have been acknowledged. Therefore, this work has never previously been submitted in any university for any degree award.

Signature ……..

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DEDICATION

This work is dedicated to my beloved parents, Mr. and Mrs. James Mbunda who in very difficult settings built a strong foundation which has made possible for me to reach this stage today! May the Almighty God provide them with a long and healthier life, AMEN!

ABSTRACT

This study was conducted to assess the contribution of *Gmelina arborea* tree species on combating deforestation in four villages of Rwinga ward, Namtumbo District. The study was conducted in Minazini, Rwinga, Mandepwende and Migelegele villages. The study was guided by three objectives which are; to assess the perception of farmers about planting *Gmelina arborea* tree species in the study area, to assess the extent *Gmelina arborea* tree species has contributed to combat deforestation in the study area and to examine the challenges associated with the plantation of *Gmelina arborea* tree species in the study area. Methods used in data collection were survey, observation, interview, focus group discussion and documentary review. Quantitative data were analyzed by using simple descriptive statistics while Qualitative data were analyzed by using content analysis method.

Findings suggest that there is a positive perception of people toward the plantation of *Gmelina arborea t*ree species in all four villages. Moreover the result indicates that *Gmelina arborea* tree species have great contribution in combating deforestation in the study area.

The main challenges associated with the plantation of *Gmelina arborea* tree species are shortage of capital, insufficient environmental and conservation education and fire incidences. The study recommended that there is a need to provide special environmental program to educate the community and introduce income generation activities in Namtumbo. There is also a need to provide financial support to the community through provision of loans or fund so that they can expand their farms. Furthermore, there is a need to implement rules and regulations guiding forest resource use and conservation in the study area

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LIST OF ACRONYMS

ATTT	Organization of Tanzania Tobacco Traders
DESASD	Department of Economic and Social Affairs Statistical Division
FAO	Food and Agriculture Organization
MNN	Mother Nature Network
NBST	National Bureau of Statistics Tanzania
PEDP	Primary Education Development Program
REDD	Reducing Emission from Deforestation and Degradation
SEDP	Secondary Education Development Program
SPSS	Statistical Package for Social Sciences
TFRI	Tropical Forest Research Institute
TTB	Tanzania Tobacco Board
UNEP	United Nation Environmental Program
URT	United Republic of Tanzania
US	United States
WHO	World Health Organization
WWF	World Wildlife Foundations

CHAPTER ONE

INTRODUCTION

This chapter introduces general overview of the study. It provides the background information of the study in which the broadness of the problem at different levels is explained. It explains the general extent of deforestation and efforts made to minimize the problem in different parts. Further it provides the statement of the problem, objectives of the study, research questions and significance of the study.

1.1 Background Information

Globally, it is estimated that 13 million hectares of forest has been cleared between 2000 and 2010, with net forest loss of 5.2 million hectares per year (FAO 2010). The growth of human population is found to be the major driving force towards deforestation (WWF, 2015). Population growth has increased the demand for agricultural land and forest products (Gaitho, 2014). Expansion of agricultural activities has significantly contributed to the rate of deforestation and land degradation in many parts of the developing world (Giesecke, 2012). This has increases the loss of forest resources and marginalizes arable land for agricultural production (Sharma, 2005). Introduction of *Gmelina arborea* tree species is among the efforts taken by different countries to lower deforestation in the tropical rainforest (Punitha *et al*; 2012). *Gmelina arborea* tree species is the fast growing deciduous tree originated in the South East of Asia (TFRI, 2008).

In Africa, the rate of deforestations has continues in an alarming rate (FAO, 2012b). In the period of 2000 to 2005, 4 million hectors of forest were destructed. *Gmelina arborea* tree species was introduced mainly for giving the famers an alternative

wood for curing tobacco, reforestation programs and income generation (Giesecke, 2012, Wekesa e*t al*; 2013). For example Zambia Leaf Tobacco introduced *Gmelina arborea* tree species for reducing pressure on wood collected for tobacco curing, and for income generation in Zambia (Giesecke, 2012).

In Tanzania, total of 412000 hacters of forest land were cleared in between 1990 to 2005 (Blomley & Iddi, 2009). The major driving forces for deforestation are agriculture, overgrazing, wildfires, charcoal making, logging and fuel wood for cooking and heating (Miles *et al*; 2009). To minimize the pressure of deforestation *Gmelina arborea* tree species was introduced in tobacco growing regions to include Morogoro, Tabora, Rukwa and Ruvuma (Mbuya, 2006).

In Namtumbo, deforestation is mainly caused with the need for fuel wood, commercial logging, charcoal making and agriculture (Nyoni, 2008). For example tobacco cultivation has resulted in the decimation of 33,033 hectares of forest loss for the past three decades due to tobacco production (Nyoni, 2008). Tanzania Tobacco Board introduced *Gmelina arborea* tree species in 1980 to sustain wood fuel used for tobacco curing (TTB, 2006). The aim was to make sure each household in Namtumbo grow this tree species as a way to conserve natural tree species (TTB, 2006). However, since the introduction of this tree species in 1980s years, deforestation is still persisting and contribution of the tree in combating deforestation is not known (Nyoni, 2008). This study was assessing the contribution of *Gmelina arborea* trees species in combating deforestation in Namtumbo district.

1.2 Problem Statement

In Tanzania 61,000 hectares of forest are cleared every year due to tobacco production (Makoye, 2012). The regions which are found to be more affected are Tabora, Shinyanga, Sumbawanga and Ruvuma (ibid). In Namtumbo District, Tobacco cultivation has resulted in the decimation of 33,033 hectares of forest loss for the past three decades (Nyoni, 2008). Tanzania Tobacco Board (TTB) introduced *Gmelina arborea* tree species for tobacco curing since 1980s. Despite the introduction of *Gmelina arborea* tree species, deforestation is still persist and contribution of *Gmelina arborea* tree species in reducing deforestation is not clearly described (Nyoni, 2008). Studies done by Nyoni, 2008; Munish 2010 and TTB, 2006 in Ruvuma especially in Namtumbo district, put little attention on the extent to which *Gmelina arborea* tree species has contributed to minimize deforestation (Mbuya, 2006). It was the purpose of this study to examine the contribution of *Gmelina arborea* tree species on combating deforestation in Namtumbo District so that decision could be made weather to encourage or discourage the plantation of this tree species.

1.3 General Objective of the Study

The overall objective of this study was to examine the contribution of *Gmelina arborea tree species* in combating deforestation in Namtumbo district.

1.3.1 Specific Objectives

i. To assess the perception of farmers about planting *Gmelina arborea* tree species.

ii. To assess the extent *Gmelina arborea* tree species has contributed to combat deforestation in the study area.

iii. To examine the challenges associated with *Gmelina arborea* tree species in Namtumbo District.

1.4 Research Questions

i. What is the perception of farmers about planting *Gmelina arborea* tree species in the study area?

ii. To what extent *Gmelina arborea* tree species has contributed to combat deforestation in the study area?

iii. What are the challenges associated with plantation of *Gmelina arborea* tree species in the study area?

1.5 Significance of the Study

Findings obtained from this study provide an understanding on the extent *Gmelina arborea* tree species has contributed on combating deforestation in Namtumbo. Again it adds to the existing knowledge about *Gmelina arborea.* Moreover this study helps in determining useful plans and policy to combat deforestation and form a base for mobilizing government, donors and other institutional support for conservation programs.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of relevant researches and writings in relation to contribution of *Gmelina arborea* tree species in combating deforestation. The chapter starts to present the definition of key terms followed by conceptual framework of the study. Next it presents the theoretical framework, empirical review and legislative frame work of the united republic of Tanzania. Later the chapter highlights the existing knowledge gap in the literature which needs to be addressed.

2.2 Definition of Key Concepts

2.2.1 Species

Species is a group of individual that actually or potentially can interbreed in nature (Klappenbach, 2015). Species involves a group of organisms that can interbreed and give rise to a fertile offspring and it can be plant or animal (ibid).

2.2.2 Deforestation

Deforestation involves the permanent destruction of indigenous rainforests and woodlands, excluding the removal of trees from plantations or industrial forests (Falla, 2014). According to Cunningham (2006) deforestation is when humans remove or clear large areas of forest lands and related ecosystems for non-forest use. Again Deforestation has been defined as the permanent destruction of forests in order to make the land available for other uses (Bradford, 2015).

2.2.3 *Gmelina arborea*

Gmelina arborea tree species is a fast growing deciduous tree native to South of East Asia (Kijkar 2014). Orwa at el (2009) mentioned different local names applied to mean *Gmelina arborea tree species*, these include; gamari, gumbar, gumhar, gomari, melina and gamar. It is wide broad leave tree with white wood attaining a length of 30m or more within 10 years (TFRI 2008).

2.3 Theoretical Review

2.3.1 Dependency Theory

This study relies on the theory of dependency which was originally proposed by Sandra Ball-Rokeach (Ferraro, 2008). Dependency theory has the notion that resources flow from a periphery of poor and underdeveloped states to a core of wealthy states, enriching the latter at the expense of the former (Ghosh, 2012). Developed regions have established a particular system of economic exchange that imposes certain land use patterns to the less developed regions. This particular economic exchange between the developed and the less developed peripheries takes place on unequal terms resulting in the unsustainable use of natural resources in the less developed areas (ibid). Power, wealth and prosperity are therefore related to the depletion of forest resources in the developing regions and to the sustainable use and possible expansion in prosperous regions (Ghosh, 2012). This theory helps the researcher to reveal the factors which have influenced the acceleration of deforestation in the study area. Tobacco cultivation which is found to be the major driver of deforestation is grown for export purpose to feed the industries in the developed countries while creating a problem in developing countries. By understanding the factors which contribute to deforestation the researcher was able

to foresee what could be the possible causes and solution of deforestation. Again the theory guided the researcher on developing coherent methodology.

2.3.2 Expectancy Theory of Motivation

Atinga (2001) explained that, this theory was introduced by Vroom in 1964. Expectancy theory of motivation states that, an individual's behavior is not formed from objective reality but his or her perception of that reality. The theory tries to establish a relationship between effort, performance and rewards. It strengthening community participation in afforestation, because community members expect certain benefits and support in order to engage or participate in afforestation. Vroom tries in the theory to establish a relationship between effort, performance and rewards. According to Vroom, there are three crucial factors: expectancy, instrumentality and valence that motivate individuals to engage in any activity. Expectancy is the extent of the individual's perception, or belief, that a particular act will produce a particular outcome. Instrumentality is the extent to which the individual perceives that effective performance will lead to desired rewards. Valence, on the other hand, is the strength of the belief that attractive rewards are potentially available. These three factors combine together to create a driving force, which motivates an individual to put in an effort and achieve a level of performance in order to obtain the desired rewards (Atinga, 2001).

The linkage between this theory and afforestation is clearly stated below. People's desire to plant trees (*Gmelina arborea* tree species) is affected by their belief and expectation that their action will produce positive result in terms of growth of the trees and its market (Punitha *et al*; 2012). On the other side if peoples' effort on the

plantation of *Gmelina arborea* tree species will be rewarded, more efforts will be directed on the plantation of this tree species which will help to increase household income. It also reveals the efforts of the community toward forest conservation. Conservation will be archived if rewards from conservation efforts are observed. If the community will find that there is no return from the forest they are likely to destruct the forest. This theory acts as a guide to researcher for organizing the key ideas of the study that shapes the researchers thinking about the study topic.

2.4 Empirical Review

2.4.1 Trend of Deforestation

The global rate of deforestation is massive though there is a down growing of deforestation between 2000 to 2005 years when compared with the previous rates of deforestation (MNN, 2015). Deforestation has affected an estimated 13 million hectares per year between 2000 and 2010 with net forest loss of 5.2 million hectares per year (FAO, 2010). Deforestation is more observed around the tropical rainforest areas with the increase rate of almost 1 per cent per year (UNEP, 2010). If the current rate of deforestation continues, the world's rain forests will vanish within 100 years causing unknown effects on global climate and eliminating the majority of plant and animal species on the planet (ibid). Countries with highest rate of deforestation include Brazil, Indonesia, Thailand, the Democratic Republic of Congo and other parts of Eastern Europe (UNEP, 2010).

Africa continent have the long list of countries with the highest rate of deforestation in the world (Cunningham, 2006). At the end of 1990, Africa had an estimated 528 million hectares, or 30 percent of the world's tropical forests (Agyei, 1998). In

several Sub-Saharan African countries, the rate of deforestation exceeded the global annual average of 0.8 percent (ibid). The rate of deforestation in Africa was 4375000 hectares for the period of 1900 to 2000, and declined to 4040000 hectares for the period of 2000 to 2005 (FAO, 2010). Deforestation has already wiped out roughly 90% of West Africa's original forests (Agyei, 1998).

In Tanzania, about 35,257,000 hacters (39.9%) of Tanzania is forested and most (90%) of the forest area is occupied by woodland (URT, 2012b). However deforestation rates are quite high; for example from 1990 to 2005 an estimated 412,000 hectors of forest land were cleared per annum, equivalent to about 1.1% of the total forest area (Blomley & Iddi, 2009). Namtumbo together with Songea District lost over 33,033 hectares of forest for the past three decades mostly due agriculture specifically tobacco cultivation.

2.4.2 Causes of Deforestation

Human population growth in the world has significantly contributed to the current rates of Deforestation (FAO, 2010). For example global population has grown to 7 billion people by 2011 (Roshetko, 2013) while population is projected to reach 9 billion people by 2046 (ibid). This increasing in human population will place tremendous pressure on planet’s resources such as forest (Gaitho, 2014). The forest are cleared due to the rise of the demand for agricultural land for crop production, animal grazing pasture; forest product, commercial logging and urbanization (FAO, 2012).

Deforestation in sub-Saharan Africa is associated with Poverty (FAO, 2010). In most cases deforestation is influenced by low income of the people at the forest frontier (Kissinger, 2012). More than one third of the African population depends on natural resource like the uses of biomass fuels, mainly firewood for cooking and heating subsistence farming, ranching and agribusinesses (FAO, 2012). Firewood collection and charcoal production are the largest drivers of forest degradation in Africa contributing about 48% of total deforestation (Falla, 2014). Wood meets 80% of all the Democratic Republic of Congo's energy needs and has been the main cause of deforestation (Tulloch, 2014). Demand for meat also has driven the continent into deforestation as ranchers and agribusinesses demand grazing pasture and land to grow feed for livestock (ibid). Another factor is dependence of the people on subsistence farming as their means for survival, has resulted to great deforestation in Sub-Saharan Africa (Cunningham, 2006). People under subsistence farming cut the forests in order to expand their farming land to feed their growing families (FAO, 2011).

In Tanzania agriculture, reliance on wood fuel and charcoal for energy supply has been identified as a key driver behind national rates of deforestation and degradation (Miles, 2009). It is estimated that Tanzania's urban centers consume over one million tons of charcoal every year, and half of it consumed in the country's commercial capital of Dar es Salaam (Philemon, 2012). Logging and lack of land use plans are also the motives toward deforestation in Tanzania (Kiimu, 2012 & Blomley *et al*; 2008).

Namtumbo has not been left aside with the deforestation crisis. Agriculture and dependence on fuel wood for heating and cooking is found to be the major driving factors for deforestation (Nyoni, 2008). For example, Namtumbo together with Songea District (before its separation into two districts) tobacco cultivation alone has resulted in the decimation of 33,033 hectares of forest loss for the past three decades due to tobacco production (Nyoni, 2008). Normally, tobacco is never grown in mixed cropping, each season a new field for tobacco has to be cleared, where about 69% of tobacco farmers clear a new area of woodlands for tobacco cultivation in every growing season (Mangola, 2012). For example; the booming of flue-cured tobacco farming led to vast clearance of the miombo forests for more virgin land and wood to cure the crop in Namtumbo (Nyoni, 2008). Approximately 1 hectare of woodland is required to flue-cure one hectare of planted tobacco (Mangola, 2012).

2.4.3 Different effort taken to address deforestation

Globally there are no general solutions and strategies on arresting deforestation since these vary with region and will change over time and all strategies require cooperation (Walker, 2013). Mass education on deforestation, afforestation and reforestation is being provided as the effort to arrest deforestation in different countries (Falla, 2014). Training and education to stakeholders help people understand how to prevent and reduce adverse environmental effects associated with deforestation and take appropriate action to minimize the problem (Wolosin, 2011). Under the program of afforestation and reforestation, *Gmelina arborea* tree species with other introduced fast growing trees have been used to restore the forest loss and limit the rate of deforestation in different parts of the world (Sharma & Sunderraj, 2005). For example recent awareness followed by stringent law enforcement has

generated consciousness about the use of *Gmelina arborea* tree species in conservation in western India (Sharma & Sunderraj, 2005). Also *Gmelina arborea* tree species is one among the trees suggested for restoration in Myanmar, and its implementation has started at some locations (Falla, 2014). In Indonesia there are a millions of hectares of degraded land in need of rehabilitation by introduced fast *Gmelina arborea* trees species (Roshetko, 2013). Together with other trees, *Gmelina arborea* tree species has been used to convert some of degraded land in Indonesia to more productive use (ibid).

Different organizations such as FAO and REDD are working together in order to combat deforestation in Africa. The techniques of sustainable forestry are widely practiced (Peterson 2015). Depending on forest type, logging may involve harvesting just trees of a particular age and maintaining a forest of similar-aged trees, or it may involve only harvesting mature trees and leaving the rest of the forest intact (Peterson 2015). The use of policies is a reasonable ways to minimize the problem of deforestation, for example the successful reductions of deforestation in Brazil has resulted from variety of policy options which includes policies and programs directly targeted at deforestation (Germany, 2014).

Moreover, the use of *Gmelina arborea* tree species has been considered in Africa for the restoration of degraded land. Example in northeastern Nigeria, degraded land is extensively stocked with *Gmelina arborea* tree species (Gabriel *et al*; 2010). This tree species is also playing a great role on recovering marginal land, and is now an economic important tree along the coastal belt of Kenya (Wekesa *et al*; 2013). In Uganda, *Gmelina arborea* trees species were planted in government plantations such

as in Dokolo District to restore the forest lost due to agriculture activities (KFP, 2011). Plantation of this tree has helped much the recovering of the degraded land and has spread out of the plantations to different directions in Uganda (Gabriel *et al*; 2010).

In Tanzania a variety of demand-side measures have been developed and implemented over the last decade mostly by government, private sector and civil society (URT, 1998 & Kiimu, 2012). Examples include legislation, public procurement policies, voluntary bilateral arrangements, multi-stakeholder roundtables, independent certification, voluntary disclosure, investor activism and consumer campaigns (Kissinger, 2012). In minimizing the pressure of deforestation, agroforestry have been encouraged among the farmers in different parts of Tanzania (Mangola, 2012). Among other trees, *Gmelina arborea* tree species were distributed in all tobacco growing region (Tabora, Ruvuma, Morogoro and Rukwa), to provide the farmers with the alternative wood for drying tobacco (TTB 2006). Beneficiaries of the environmental services of forests are needed to pay for such services and the payment are distributed to the community on the forest frontier (Chomitz *et al* ;2007).

On observing the demand of fuel wood in tobacco production, Tanzania Government in collaboration with Tobacco Companies introduced *Gmelina arborea* tree species for sustaining wood fuel for Tobacco Curing in Namtumbo (TTB, 2006). The aim was to make sure each tobacco farmers in Namtumbo plant this tree species so that wood for curing his or her tobacco is obtained from the grown *Gmelina arborea* tree species (TTB, 2006).

2.4.4 Forest Policy in Tanzania

Tanzania forest policy of 1998 emphasizes the sustainable management and conservation of natural forests (URT, 2012b). The aim of National Forest Policy is to enhance the contribution of the forest sector to the sustainable development of Tanzania (REDDS, 2015). The policy aims to ensure sustainable supply of forest products and services by maintaining sufficient forest area under effective management. It also aimed to maintain Ecosystem stability through conservation of forest biodiversity, water catchments and soil fertility (ibid)**.** The policy was followed up with the enactment of the Forest Act in April, 2002 which was enacted to fulfill various objectives including; promoting, enhancing the contribution of the forest sector to the sustainable development of Tanzania and the conservation and management of natural resources for the benefit of the present and future generations (URT, 2002b). Local communities are empowered under the law to declare their areas as forest reserves, which could be village, group or private forest reserves (REDD, 2015). Section 49 of the forest act provides permits which may be granted for cutting or extract timbers, gather or take away specified forest product, erect building or structure, enter to hunt or fish allows domestic animals to enter and graze in forest reserve (URT, 2002a). Offences and penalties for violations of the act are provided for under Sections 84 to100 (REDD, 2015). For instance, Section 84 provides that any persons who without an existing right, permit or other lawful authority under the act enters into the forest reserve, performs any act which is prohibited is guilty of an offence against this act (URT, 2012a). Anyone who violates the rules and regulations is liable to a fine not less than thirty thousand shillings and not exceeding one million shillings or to imprisonment for a term not exceeding two years or both such fine and imprisonment (REDD, 2015). The act is

important for the protection and regulated use of forests as it provides for a variety of institutional arrangements that could be used to manage forests (URT, 2002a). On the other hand implementation of this policy and acts is weakened by many obstacles such as shortage of fund, limited number of skilled personnel, Lack of committed workers who are committed themselves on corruption. (Kissinger, 2012 & Chiesa, 2009)

2.4.5 Challenges facing the effort made to combat deforestation

Despite the strategies arranged to minimize deforestation in different countries still there is some challenges which brings difficult to reach the intended goal. For instance decisions made as a result of foreign legislation may not be in the best interests of local communities or forests (Walker 2013). For example, they could favor larger industrial scale producers and as a result negatively impact local producer who may be practicing lower impact logging, but are not able to become certified or otherwise prove due diligence in complying with foreign legislation (Walker, 2013). Further, implementation of forest policy of 1998 and the forest act of 2002 in Tanzania becomes difficult as there is insufficient fund for carrying out researches and regular resources assessments (Kiimu, 2012). Hence knowledge on the extent of utilization or degradation of forest resources is limited and outdated; data for forest resources management is inadequate as a result forest resources management is not based on informed decision making (Chiesa, 2009). Again the enforcement of laws and regulations are undermined by some unfaithful and corrupted workers who allow some people to use the forest resources illegally (Kissinger, 2012). Moreover the implementation of legislative is challenged by politics (Kissinger, 2012). Legislation being a political instrument brings a risk that

politics comes into negotiation with the actual enforcement of legislative instruments (Chiesa, 2009). Again strategies to reduce deforestation are done without consideration of the income or benefit of the local communities a feature which does not motivate local communities to participate in conservation (Kissinger, 2012). Plans and strategies to minimize the problem should go hand in hand with improving the welfare of cultivators at the forest frontier (Chakravarty *et al*; 2011). Effective implementation of the plans needs to include stakeholder participation, development of management plans, monitoring and enforcement of the plans (Chakravarty *et al*; 2011). This arena is lagging behind for paucity of funds and investments to encourage the promotion of forestry education which has resulted to lack of knowledge and information to the general community about forests conservation and management (Chomitz *et al*; 2007).

2.5 Knowledge Gap

While Tanzanian forest policy of 1998 and forest act of 2002 emphasize the sustainable management and conservation of natural forests (URT, 2012b), implementation of the policy and its act become difficult as there is no proper involvement of the community, corruptions and insufficient fund for carrying out researches and regular resources assessments (Kiimu, 2012). Knowledge on the extent of utilization or degradation of forest resources is limited and is not updated, while data for forest resources management is inadequate as a result forest resources management is not based on informed decision making (Chiesa, 2009). Studies done by different scholars such as Nyoni, (2008) and Munish (2010), in the literature reviewed above have discussed on the use of *Gmelina arborea* tree species on restoration of degraded land to minimize deforestation, but deforestation still

continues. At the same time forest policies fail to emphasize on afforestation program (Munish 2010). Lacking of feedback on the effort of planting trees such as *Gmelina arborea* tree species has made little to be known on the extent which *Gmelina arborea* tree species has contributed on combating deforestation in Namtumbo district since the tree has been introduced (Nyoni 2008). This study is significance as it brings the feedback about the plantation of the trees on environmental conservation by examining the extent to which *Gmelina arborea* tree species have contributed in combating deforestation in Namtumbo District.

2.6 Conceptual Framework

Conceptual framework is a theoretical structure of assumptions, principles and rules that holds together the ideas comprising a broad concept (Key, 2011). This framework shows the interrelationship among the variables existing in this study. Variables included in this study are independent variables (which are human activities), intermediate variable (which is Government intervention) and dependent variable (which is deforestation).

Human activities (as independent Variable) like expansion of agriculture, grazing, settlement and the need for wood fuel for cooking and heating have great negative impacts on the forest (Nyoni, 2008). These activities develop and expand on the expense of forest. These expansions have accelerated deforestation (which is dependent variable) due to the exploitation and clearing of forest resources for various purposes like the need for fuel wood, agricultural land, grazing land and urbanization (Rahman *et al*; 2012). Environmental policy and regulation on natural resources utilization and land use planning may bring negative impacts on forest due

to weak policy or poor implementation of policy resulted from corruption and lack of commitment on implementation of policy which accelerates the high rate of deforestation (REDDS, 2016). However government interventions (intermediate variable) like conservation education and proper implementation of environmental policies may play a great role to build a positive perception of people towards afforestation and reforestation of different types of trees like *Gmelina arborea* (Palaypayon & Batalon, 2002). Conservation education may increase awareness on the importance of this introduced species, making people plant more trees and help to decrease and combat deforestation resulting into the improvement in forest health, soil fertility and crop production (Kahyarara, *et al;* 2002). Unless conservation measures are maintained upon the improved healthy forest, community will carry unsustainable activities such as agriculture, lumbering and grazing which will result into great deforestation of the improved healthy forest (AgriInfor, 2011). The summary of all this explanation can be seen in the figure 1 below.

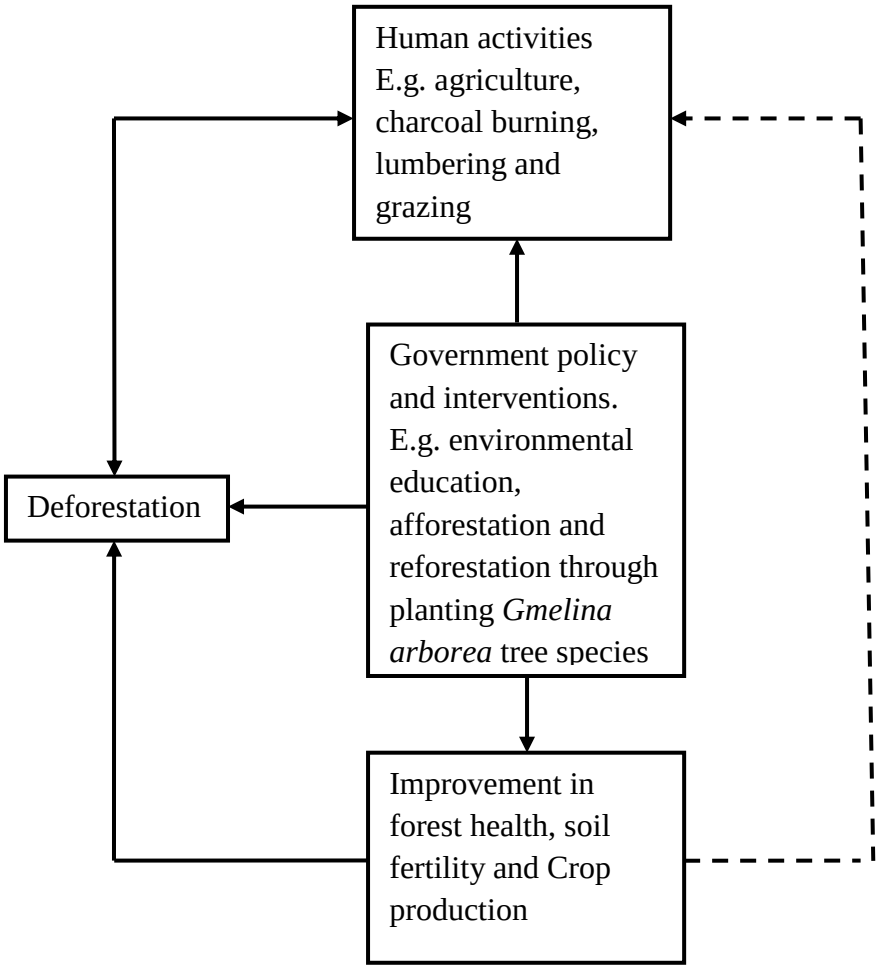

Figure 1: Conceptual framework of the study

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter begins to describe the study area, followed by research design. Further the chapter gives the description of research methodology adopted for the study. Moreover the chapter explains about the methods used in data collection, and finally it explains data processing and analysis.

3.2 Description of the Study Area

3.2.1 Size and Location

Namtumbo District is one of the five districts of Ruvuma Region of Tanzania with the area of 20375 square kilometer (URT, 2012). It is bordered to the north by Morogoro Region, to the east by Tunduru District, to the south by Mozambique and to the west by the Songea Urban District. The study was carried out in all four villages of Rwinga ward which are indicated in small map zoomed from Namtumbo District map (Figure 1).

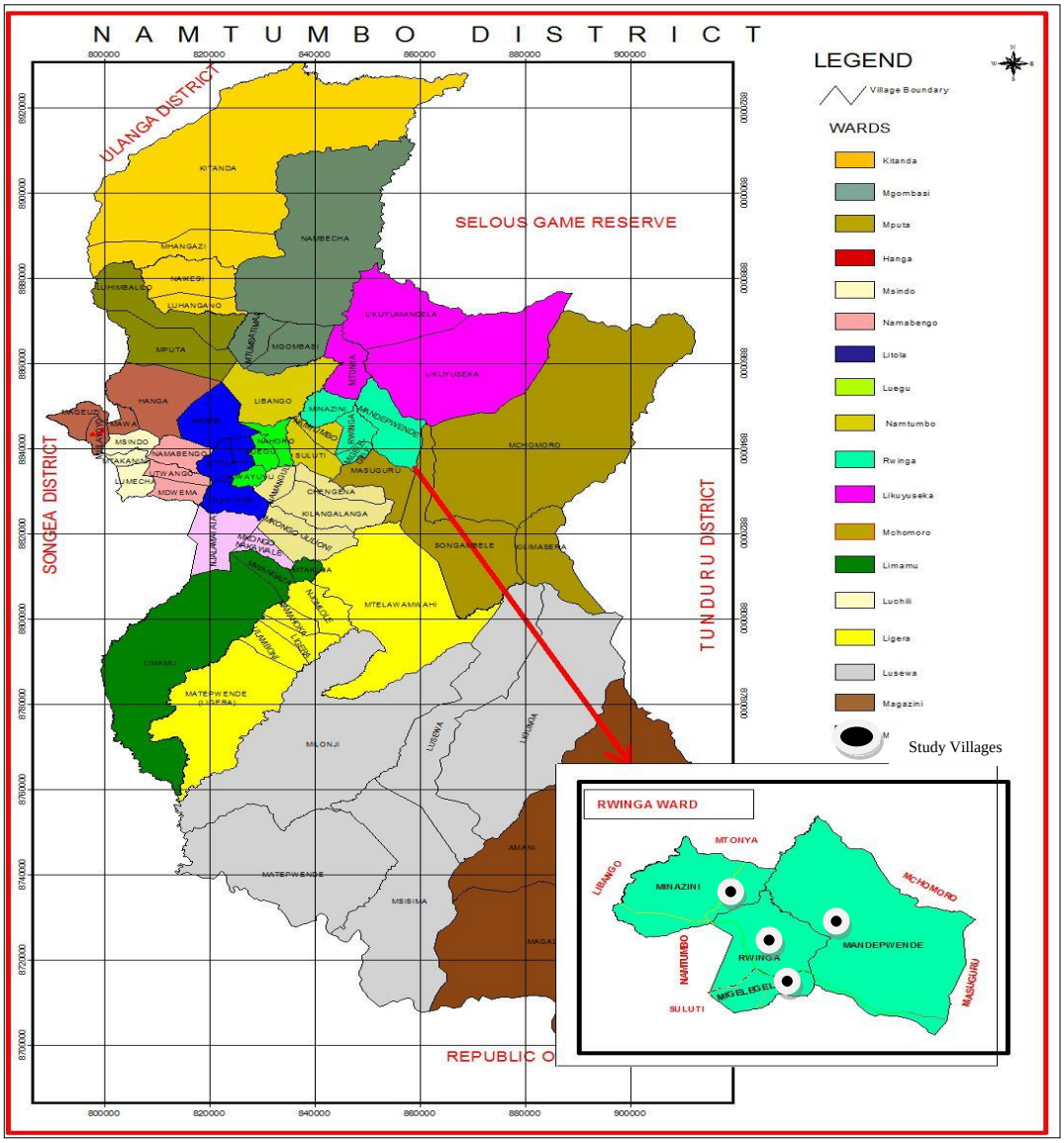

Figure 2: Map of Namtumbo District showing Rwinga Ward Map and Study Villages

Source: Namtumbo District Council (2013)

3.2.2 Population

Namtumbo District has a total population of 201639 people from which 98335 are male and 103304 are female (URT, 2013). Population in this district is mainly Ngoni and Ndendeule tribes dominating the district accounting to 95% of the total population. The remaining portion includes Bena, Yao, Nindi, Matengo and others

(URT, 2012b). The major economic activities of all the tribes in Namtumbo are mainly agriculture specifically shifting cultivation like tobacco cultivation which is a major driver towards deforestation (Nyoni, 2008).

3.2.3 Climate

The predominant climatic feature of the district is one long rain season occurring between November and May (Nyoni, 2008). Annual average rainfall ranges between 800mm and 1200mm (Namtumbo Dc, 2013). Temperature during the day ranges between 20°C to 25°C while during the night temperature range between 15°C to 17°C with altitude being the main factor influencing it (Nyoni, 2008). The combination of both rainfall and temperature plays a great role on influencing the growth of huge forests woodland, bush land, cashew trees, mosaics of grassland and exotic strip tree vegetation in the study area (Mbuligwe and Kaijagwe, 2007).

3.2.4 Altitude and Soil

Based on altitude, the district is divided into intermediate and highland zone. Intermediate zone ranges between 600-1000 meters above sea level while that of highland ranges between 1200-1800 meters above sea level (Nyoni, 2008). The soils of the Namtumbo are dominated by clay loam soils. Nevertheless, patches of sandy soil can be seen some areas of the low altitude such as Lusewa, and Likusanguse (Mbuligwe & Kaijagwe, 2007). The combination of altitude and soils has influenced the growth huge forests woodland, bush land, cashew trees, mosaics of grassland and exotic strip tree vegetation in the study area (Mbuligwe & Kaijagwe, 2007).

3.2.5 Vegetation

Namtumbo District is covered by miombo woodland ecosystems in Selous Game Reserves which involve huge forests woodland, bush land, cashew trees, mosaics of grassland and exotic strip tree vegetation (Mbuligwe & Kaijagwe, 2007). The woodlands (Miombo) in the past years used to cover large area of Namtumbo District (ibid). However, much of the woodlands are currently being depleted through human activities such as cutting firewood, timber lumbering, charcoal making, tobacco curing and bricks making (Nyoni, 2008). The common vegetation in the arable land comprises of exotic strip trees vegetation of *Gmelina arborea*, Misederera (*Cedral toona/odorata*), bamboos and shrubs (Mbuligwe & Kaijagwe, 2007).

3.3 Research Design

Kothari, (2004) defined research design as the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure. This study used descriptive research design, which is a scientific method involving observing and describing the behavior of a subject without influencing it in any way (Shuttleworth, 2008). Descriptive statistics were used in this study as it make use of both quantitative and qualitative data which needed numerical, graphical, tabular methods of data analysis and presentation (Kothari, 2004, Trochim 2006), while qualitative bank on description and content analysis.

3.4 Selection of the Study Area

This study was conducted in Rwinga ward in Namtumbo district. Specifically the study focused on four villages including; Rwinga, Migelegele, Minazini and Mandepwende. Rwinga ward was selected basing on the following criteria; the first criterion is that Rwinga ward has experienced intensive tobacco cultivation which to large extent influences deforestation in the area (Nyoni, 2008). The second criterion is the presence significant number of *Gmelina arborea* tree species which are of widely spread across the ward compares with other wards in the district.

3.5 Sampling Frame

A sampling frame represents the list of individuals to which a sample for study will be drawn and has the property that identifies every single element and include any in the sample with appropriate contact information (Kombo and tromp, 2006). In this study the sampling frame were the list of households, timber makers, carpenters (obtained from the study area), forestry officers from District Executive Director and forestry officers from Tobacco companies.

3.6 Sampling Procedure

Sampling is defined as a selection of subset of elements from a larger group of objects (Lacobucci & Churchill, 2009). This study used simple random sampling to obtain the household in which the respondents of this study were found. Simple random sampling was used because it gives an equal chance to respondents to be involved in the study (Shuttleworth, 2008). Lottery system was used, in which names of the head of household were written on the pieces of paper of equal size. Papers were folded and put into the box then was mixed up. After mixing, papers

were picked from the box (in blind eyes) until hundred pieces of paper (required number of sample size) was found (The details of obtaining sample size is explained in next page). The names of the head of the household written in the selected papers were used as representatives in the study.

Purposive sampling as a non-probability sampling technique was also used to obtain respondents from the population. Under this method not all members of population have an equal chance to be selected in a sample. Kothari (2004) explained that, sample are selected on the basis of known characteristics that seem to represent the population. Under this design key informant from different area of experience were selected regarding on the knowledge and experience on deforestation and *Gmelina arborea* tree species. For example district forest officers, land officers, carpenters and timber makers were purposive selected based on their position.

3.7 Sampling Unit

Sampling unit can be a single element or a collection of elements subject to data analysis in the sample (Rwegoshora, 2006). The sampling unit for this study was the household from Rwinga ward as it is an important source of socio-economic data and indicators to inform and monitor development (Cohen *et al*; 2000). Again within the household information about the growth, distribution and uses of *Gmelina arborea* tree species were captured well. Head of the household (a father or a mother) was selected purposively to be key respondents at the household level because they are the owner of the property at household level. DESASD, (2005) noted that heads of the households have more information of the household compared with other household members.

3.7.1 Sample Size

In this study sample size was estimated by using the formula suggested by Rwegoshora (2006), where household was the unit of analysis.

$$n = \frac{N}{1 + N(e^2)}$$

WHERE, n = required household sample size.

e = Detection error = 10%

N = Total number of household = 4212 (NBST, 2012).

Then the household sample was;

$$n = \frac{4212}{1 + 4212(0.01)} = \frac{4212}{43.12} = 97.68 \approx 98$$

Therefore, the sample size is 98 household, which was approximated to 100 household. Compositions of sample differ from one village to another based on the percentage of population (household) from which the village has contributed to the ward. The same percentage which the village has contributed to total household of the ward (study area) was taken to contribute to the sample of the study. For instance Minazini contribute 30% of total household of the ward (4212) hence it have also contributed 30% of respondents to complete the sample. This was calculated under the following procedures:

1. Minazini = $\frac{1250}{4212}$ x 100 = 29.7 ≈ 30
2. Rwinga = $\frac{1496}{4212}$ x 100 = 35
3. Mandepwende = $\frac{884}{4212}$ x 100 = 20.9 ≈ 21
4. Migelegele = $\frac{582}{4212}$ x 100 = 13.8 ≈ 14

Hence, the sample composition of respondents from total ward household (4212) is indicated in Table 1.

Table 1: Sample Size

Village	Number of respondents in the Ward		
	Total number of household	**Percentage in the Ward**	**Sample Size**
Minazini	1250	30	30
Rwinga	1496	35	35
Mandepwende	884	21	21
Migelegele	582	14	14
Total	**4212**	**100**	**100**

Source: Field Data 2015

3.8 Research Methods

According to Kombo and Tromp (2006), data collection refers to the process of gathering specific information aimed at proving or refuting some facts. Both primary and secondary data were employed in this study.

3.8.1 Primary Data

Grimsley, (2015) defines primary data as the information that is collected specifically from the field using research tools such as experiments, survey questionnaires, interviews and observation for the purpose of research project. Primary data were used in this study as they are specifically adapted to the research needs, they are the first hand experience of the customer recorded and help the respondents in giving their feedback which otherwise would not have been given for on time **(**Ghauri & Gronhaug 2005).

3.8.2 Secondary data

Secondary data are the data collected in the past or other parties which can be found in journals, magazines and books (Grimsley, 2015). Secondary data was used in this study as they are good in saving the time and to make the comparison with the primary data obtained in the study area **(**Ghauri & Gronhaug, 2005).

3.9 Data Collection Methods

3.9.1 Interview

Key, (2011) defined an interview as a direct face to face attempt to obtain reliable and valid measures in form of verbal responses from one or more respondents. It is a conversation in which the roles of the interviewer and the respondent change continually (ibid). Cohen et al (2000) noted that this method entails a set of questions which can be structured, semi-structured or unstructured. It allows subjects to provide their interpretations of the world in which they live and to express how they regard situations from their own point of view (Visser *et al*; 2009). Face to face interview (semi-structured) was used to gather information from key informants. The key informants for this study included the forestry officers, carpenters and timber makers from Rwinga wards. Information which was gathered from this method includes the perception of the people about growing *Gmelina* tree, uses and contribution of the tree on controlling deforestation. Fifteen key informants ware selected on the basis that they have a great depth of insight about *Gmelina arborea* tree species due to their occupation and experience. Interview method was used because can it provide more information and the method is flexible to allow respondents to be free in providing information than other methods (Kothari, 2004).

3.9.2 Survey Method

Survey in research is a specific type of field study that involves the collection of data from a sample of elements drawn from a well-defined population through the use of a questionnaire (Visser *et al*; 2009). The purpose of using this approach is to allow respondents to express their views independently hence maintaining free expression of views (Visser *et al*; 2009). Under this method information which includes the perception of people on planting *Gmelina arborea* trees species, the uses of the tree, challenges and the possible solution on the challenges were gathered at the household level. Both open and closed ended questionnaires were used in collecting data from sampled respondents. Questionnaires covered two aspects which were demographic aspects (age, sex, occupation and education level of the respondents), and questions related to afforestation of *Gmelina arborea* tree species. The researcher used face to face interview in which the researcher or research assistants asked respondents the questions from questionnaires and fill answers accordingly in the questionnaires. Face to face interview was opted to make sure all the questionnaires are filled on time, and help respondents to get clarification about the question which failed to grasp properly (Rwegoshora, 2006). For questionnaires to be effective the following procedures were involved;

First was the *preparation of questionnaires.* Preparation of questionnaires focused on the objectives of the study which included the perception of farmers on planting *Gmelina arborea* tree species, the extent to which *Gmelina arborea* tree species has contributed toward combating deforestation and challenges associated with the plantation of *Gmelina arborea* tree species. The questionnaires were arranged from simple to complex questions to encourage respondents to keep on feeling the answer

about the contribution of *Gmelina arborea* tree species on combating deforestation. Clarity of language was highly considered to enable the understanding of the questions to all respondents.

Second, *recruitment* of research assistant was done basing on the backgrounds and familiarity with the study area to simplify the data collection process. Four research assistants with advanced level of education from four villages were selected basing on their basic knowledge on data collection.

Third is the *training* of the research assistant who was recruited. Training of these research assistants focused on the ways to introduce themselves to respondents, the ways of asking questions, the ways of probing questions and translates the questionnaires from English to Swahili language. This was done as the questionnaires were prepared in English, and in order to make respondents clearly understand the questions, it was then translated into Swahili language which is the main language used by the majority respondents.

The fourth step was the *pre-testing of the questionnaires.* This step aimed at proving weather the questionnaires are clear, specific, interconnected and answerable so that respondents can manage to provide the answer to this study. It was also used to test questionnaire wording, sequencing, lay out and to estimate the time to be taken by the respondents to respond. The sample of ten respondents from four villages was taken for pre-testing. To make sure there is no bias on obtaining respondents for pre-testing, lottery system was used. The names of hundred respondents from four villages were written on the slips of paper and mixed in a container. One piece of

paper was picked up from the container at a time until ten required sample were found.

The last step was *administration of the questionnaires.* In this step face to face questionnaire survey was administered to ten selected household. The researcher or research assistants asked respondents the questions from questionnaires and fill answers accordingly in the questionnaires until all ten respondents which were sampled for pre testing were surveyed.

3.9.3 Observation

Observation is a way of gathering data by watching behavior, events, or noting physical characteristics in their natural setting (Kothari, 2004). This method is preferred because it gives the researcher an opportunity to sort the information directly from the field. The researcher prepared observation schedule or observation guide to observe different issues which indicated whether the tree is helpful or not in combating deforestation. Example, presence of *Gmelina arborea* wood in lumber stores or the presence of furniture made from *Gmelina arborea tree* in furniture shops was an indicator of the economic contribution of the tree apart from minimizing deforestation in the study area, while observation of timber from native trees in lumber shops indicated that natural forest is still harvested at higher rate hence *Gmelina arborea* tree species is less helpful in controlling deforestation. Observation also was done in the forest whereby the presence of tree stumps in the forest were an indicator that deforestation is still continue while the absence of tree stump in the forest indicated that the rate of deforestation has been controlled. Further the use of *Gmelina arborea* tree species as a source of wood fuel in tobacco

curing, bricks making, cooking and heating was an indicator that the tree have a contribution in combating deforestation and improving the household income while the minimal use of the tree as wood fuel indicate the minimal contribution of the tree in combating deforestation in the study area.

3.9.4 Focus Group Discussion

Focus Group Discussion is a qualitative method used purposely to obtain in-depth information on the concepts, perception and ideas of group members about a specific topic (Cohen *et al*; 2000). The rational of using this was to obtain in-depth information of the framers understanding about the contribution of *Gmelina arborea* tree on combating deforestation in the study area. It also enabled the illiterate respondents to participate in giving the information about the contribution of *Gmelina arborea* in combating deforestation in the study area (Kothari 2004). The researcher formed four groups, one from each study village and each group consists of five heads of household who was randomly selected. Lottery system was used to select five heads of the household to be included in Focused Group Discussion in each village. Names of the head of household were written on the pieces of paper of equal size. Papers were folded and put into the box then was mixed up. After mixing, papers were picked from the box (in blind eyes) until five pieces of paper from each village was found. The names of the house hold appeared in the picked pieces of paper was nominated as the participant in focused Group Discussion. Swahili language was used during the discussion as the language is familiar to all the participants. During the session, the researcher and participants started by introducing each other and later the researcher introduced the topics for discussion which was the extent to which *Gmelina arborea* tree species has contributed in

combating deforestation and the challenges which are associated with the plantation of *Gmelina arborea* tree species in the study area. The researcher together with his assistant was noting all the responses that were given out during the discussion which took about an hour.

3.9.5 Documentary Review

Documentary review involves the collection of secondary data. According to Key (2011), secondary data are that which has previously been collected and is utilized by a person other than the one who collected the data. Secondary data were collected from various documents such as journals and official reports available by visiting both published and unpublished documents from the office of Namtumbo District Executive Director, and District Forestry Office. Some of the document reviewed include different reports prepared in different occasions example report on the trend of deforestation presented in world environmental day, June 2014, report on the fire incidences presented in the annual District council, and Journal of poverty and conservation.

3.10 Data Processing and Analysis

Kombo and Tromp (2006) define data analysis as the process of examining what has been collected in a survey or experiment and making deductions and inferences. The collected quantitative data was organized and coded. Coding and editing of the collected data was done by using Statistical Package for Social Sciences (SPSS) version 16.0 and analyzed by using simple descriptive statistics. Data were computed into frequencies, cross tabulations and figures and presented into tables, graphs and plates. The SPSS program is found to be appropriate since it has the

features that can accommodate the categorical variables (Viseer, 2009). Qualitative data which were obtained through observation and interviews were analyzed by using content analysis method. Content analysis is a research tool used to determine the presence of certain words or concepts within texts or sets of texts (Meyer, 2015). The researcher quantified and analyzed the presence, meanings and relationships of words and concepts then make inferences about the messages within the texts and the audience during data collection.

3.11 Validity and Reliability

3.11.1 Validity

According to Kothari, (2004) validity refers to the ability of a test to measure what is intended to measure and provide generalized research findings. To assure validity of this study different technique were used to include the cross-checking of the data with the existing literature, regarding the experts' suggestion and opinions and relying on the guidance of the supervisor. On top of that careful formulation of question and pre-testing were conducted before the actual field research to ensure their accuracy.

3.11.2 Reliability

Reliability is the ability of research instrument to provide the same results when applied at different time in the same study area (Cohen, L. *et al*; 2000). In order to increase reliability of this research an array of method such as interview, questionnaires and focus group discussion were used in order to make a triangulation of the information which was gathered. Moreover, before the actual study, pre-testing was conducted to make sure the clarity and accuracy of the questionnaires.

Multi-methodological approach was used to view the study from diverse points as surveyors place instruments on any three hilltops to get an overlapping data set about the valley or plain below (Olsen, 2004).

3.12 Research Ethics

After the official permission from the university a researcher went field for data collection. In the field the purpose of the research was clearly explained to the research participants. The researcher instructed the participant that their participation was voluntary and that they can withdraw from participation at any time. Moreover, participants' identities were kept anonymous. Participation of the respondents was acknowledged and the culture of people around the study area was observed to make sure the researcher could not impose anything that might interfere the culture of the people and hence affect data collection in the study area.

CHAPTER FOUR

FINDINGS AND DISCUSSION

4.1 Introduction

This chapter presents the research findings and discussion. The chapter is organized into four sub sections. Section one presents the demographic characteristics of respondents. Section two present the perception of people about planting *Gmelina arborea* tree species. Section three present the assessment of the extent *Gmelina arborea* tree species has contributed to combat deforestation in the study area, section four examines the challenges associated with *Gmelina arborea* tree species and proposed measures of overcoming the challenges associated with planting of *Gmelina arborea* tree species in the study area.

4.2 Demographic Characteristics of Respondents

The study was conducted in a way that both men and women of different ages, education backgrounds and occupations were considered in the study. These were done to ensure quality of information received from the participants.

4.2.1 Sex of Respondents

The finding indicates that 74% of respondents were males and the rest 26% were female (Table 2). The dominance of male respondents to represent the household in the study area may imply the persistence of patriarchy community where men are found to be heads of household. Nyoni (2008) posted that many household in Namtumbo District belongs to patriarch system in which men are the head of household owning the household property and dominating the major decision making processes of the household**.** Regarding the influence of sex on environmental

degradation and tree plantations, males in the study area have a greater influence on the degradation of environmental resources such as forest compared with female counterparts. This notion supports Fisher and Shively (2000) who noted that there is a positive relation between adult male labor and forest degrading occupations due to energetic ability to fall the trees.

Table 2: Distribution of respondents according to sex

Gender	Percentage %
Male	74
Female	26
Total	**100**

Source: Field Data 2015

4.2.2 Education Level

Education is an important socio-economic variable influencing the choice of economic activities to support the livelihood (Gwiarda, 2011). Findings indicate that 73% and 18% of respondents have received primary and secondary education respectively (Figure, 3). The implementation of Universal Primary Education of 1970s all over the country and the introduction of Primary education development programs (PEDP) and Secondary education development programs (SEDP) may explain why the proportions of individuals with primary and secondary education in the study areas are high compared with Diploma and non-formal. This data implies that the result provided by respondents is of good quality as majority of them have at least primary education which put them on the position to make good analysis and argument.

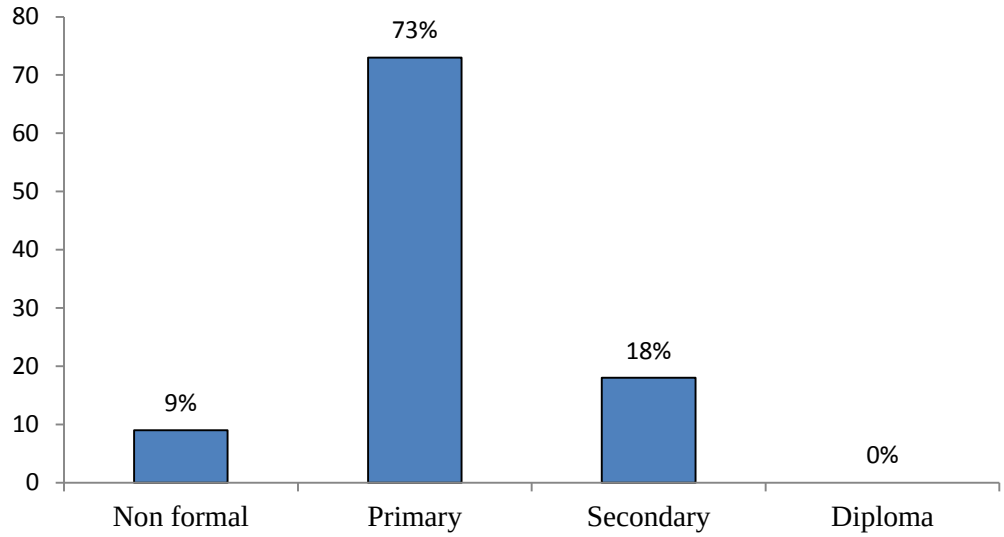

Figure 3: Education of respondents

Source: Field Data 2015

4.2.3 Age of Respondents

Results show that most of respondents in the study area aged between 28years to 48years (Table 3). This data implies that majority of respondents in the study area are energetic and economically active to carry out difficult and productive work such as planting *Gmelina arborea* tree species in large scale compared with elders above 57years. Elders' participation in plantation of *Gmelina arborea* is minimal due to the fact that many of them have given up to deal with long term projects due to lack of energy and fear of dying. This demonstrated well during group discussion as indicated in the following statement when one discussant commented about that;

> *"Always elders tend to ignore the plantation of Gmelina arborea tree species complaining that the plantations consume much energy which may not assure them with the return before their death".*

This argument supports Kubota & Temu (2006) who argues that generally elder participation in conservation program is minimal compared to the youth.

Table 3: Age of respondents

Age Group	Percentage (%)
18-27	11
28-37	22
38-47	36
48-57	19
57+	12
Total	**100**

Source: Field Data 2015.

4.2.4 Occupation of Respondents

Finding regarding the occupation of respondent shows that majority (88%) of the respondents were peasants specifically in crop production and livestock keeping (Figure 4). These findings imply that majority of people in the study area have low income (common characteristic of peasants) the factor that may expose them into deforestation through engaging into unsustainable use of forest resources. Such activities include shifting cultivation, charcoal burning and the use of fuel wood in tobacco curing in order to support their survival.

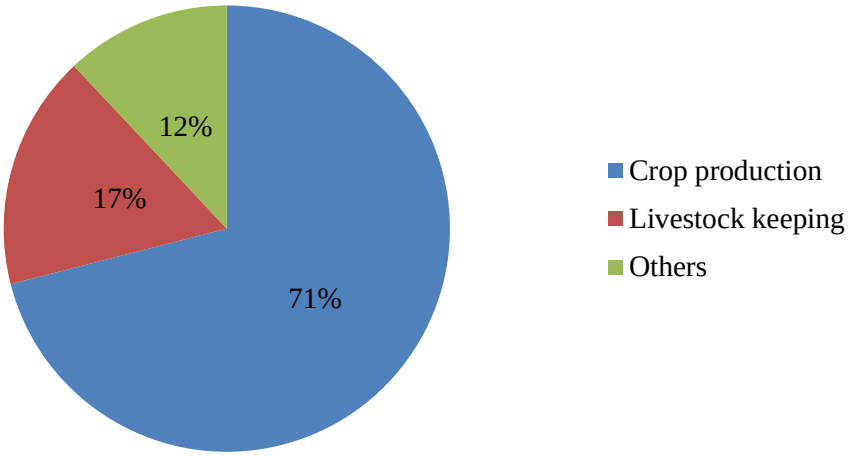

Figure 4: Occupation of respondents

Source: Field Data 2015

These finding supports Amorhan (2008) who suggested that poverty is a major motive towards deforestation since majority of poverty rely completely in forest resources for their daily earnings whereas land degraders are forced to migrate exploring new forest frontiers while increasing deforestation.

4.2.5 Respondents Duration of Resident in the Study Area

Finding from the study shows that duration of residents range from 1year to more than 11years. About 65% of respondents in Rwinga ward have stayed in their villages for more than 11years (Figure 5). This data have an implication that majority of respondents have a permanent resident since they have stayed in their villages for more than 11years hence, respondents are able to provide accuracy information due to long experience of staying in the village. Thus they were able to provide forest changes experienced since the introduction of the tree species and their livelihood in general.

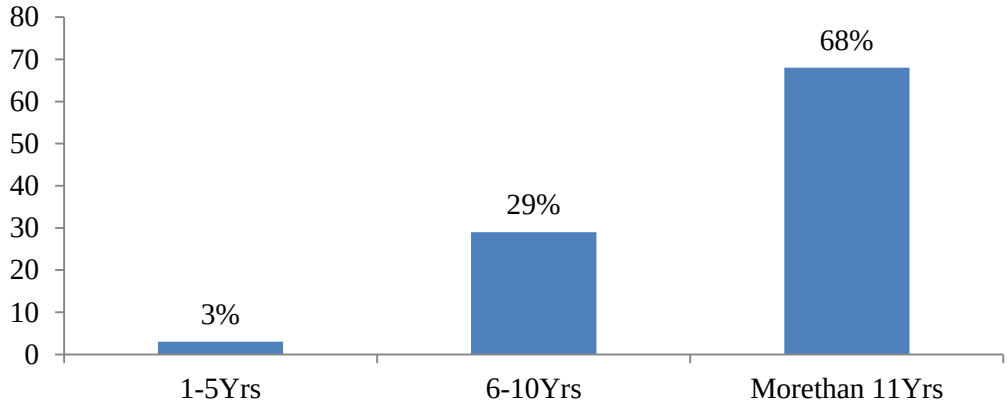

Figure 5: Duration of residential of respondents

Source: Field Data 2015

Again this community has great opportunity to involve themselves in dealing with long term project plans of environment programs such as plantation of *Gmelina arborea* trees species as they are permanently living in their villages.

4.3 Perception of Farmers on Planting *Gmelina arborea* Tree Species

Findings showed that majority of respondents (93% n=100) have positive perception on the introduction and plantation of *Gmelina arborea* tree species (Figure 6). This finding implies that majority of people in the study area are aware with the importance of *Gmelina arborea* tree species as an activities that also conserve the environment. Higher percentage on positive perception toward planting *Gmelina arborea* tree species may be attributed by the experience farmers have got on the advantages of *Gmelina arborea* tree in environment conservation and improvement of the household income.

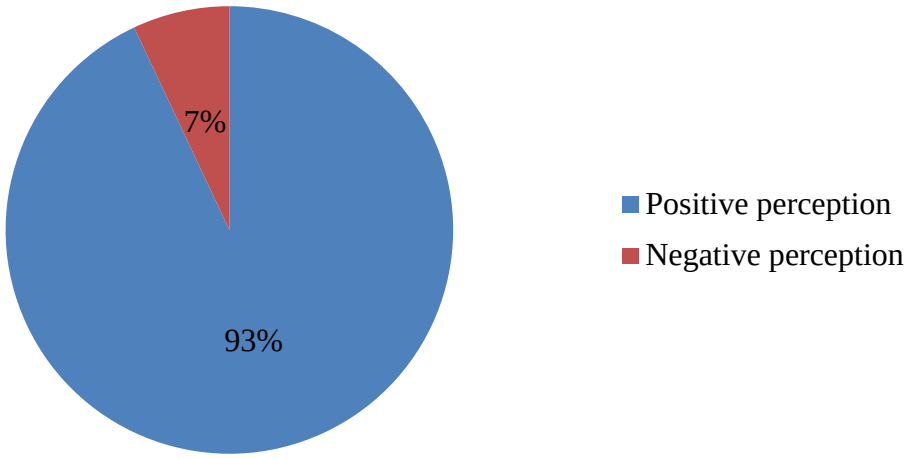

Figure 6: Perception of farmers on planting *Gmelina arborea* tree species

Source: Field Data 2015

Also positive perception about planting *Gmelina arborea* trees species were revealed during group discussion with villagers in the study area as noted by one farmer in the following statement;

> *"Within 20 years after the introduction of this tree in our village, many farmers ignored the plantation of these trees since their use was found to be only for tobacco curing. During those days the market of tobacco continues to drop each season then we found the tree had no more significance. Nowadays we have observed the tree provides a significant return that is why we have been encouraged to expand our farm".*

Moreover it has been observed by the researcher that there are many farmers who have decided to join *Gmelina arborea* tree plantation as large number of new plantation of this species has been established in the study area. This has anticipate conservation implication as more tree plantation will minimize rate of deforestation and add more income to rural communities in the study area. During the interview with key informants at District office one of the district forest officer commented that, many farmers continue to expand their tree plantation due to its durability and market demand in Namtumbo. This view supports Florido, & Cornejo (2002), who argued that, wood made from *Gmelina arborea* tree, is good in making furniture, constructions, plywood, black doors, general carpentry and packages. It is also used in carriages, carvings, musical instruments, ornamental works and for making quality toys and picture frames.

4.4 Contribution of *Gmelina arborea* Tree Species in Combating Deforestation

4.4.1 Plantation of *Gmelina arborea* Tree Species.

Data about the number of farmers who has planted *Gmelina arborea* tree species revealed that, 92% of respondents have planted *Gmelina arborea* trees species (Figure 7). This finding has an implication that majority of respondents are aware

with the important of tree plantation in forest conservation and livelihood improvement. The positive response towards planting of *Gmelina arborea* tree species probably was attributed by the great impetus provided by Government and tobacco traders during the days of its introduction in 1980s.

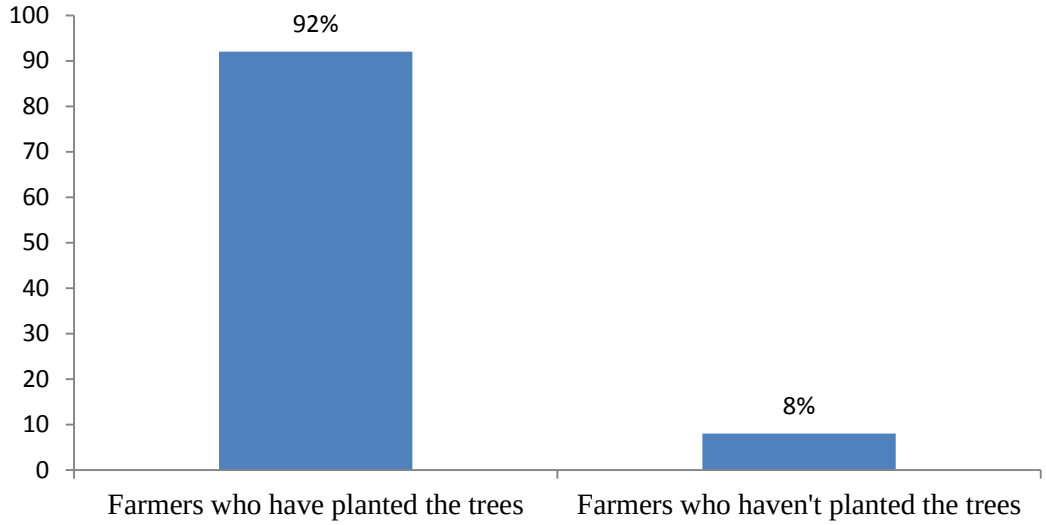

Figure 7: Farmers who have planted *Gmelina arborea* tree species

Source: Field Data 2015

This can be explained well by the following statement from the interview with key informant who reflects the extent communities were encouraged and motivated to plant the tree species;

> *"I managed to plant these trees during those days because tobacco companies encouraged us and distributed free seedling to the farmers and directed us to plant these tree around our field land"*

According to one of the forestry officer from the Association of Tanzania Tobacco Traders, noted that most of the trees which are harvested today is the result of the effort made by tobacco companies in collaboration with Tanzania Tobacco Board during those days by providing the seedling and education on how to manage the trees and the need of planting those trees. From the time of introduction of the tree farmers have continued to plant the trees and expand their farms.

4.4.2 Used as Alternative Tree for Timber Making

Overall respondents (89% n=100) show that *Gmelina arborea* tree species is used for timber making (Figure 8). This finding implies that majority of timber and furniture makers have shifted from the use of native trees to *Gmelina arborea* tree species in timber and furniture making. Alteration on the use of *Gmelina arborea* tree species for timber and furniture making implies further that there is number of native trees which remain conserved in the forest as their demand is covered by *Gmelina arborea* tree species, this has played a big role in limiting the rate of deforestation in the study area (Roshetko, 2013). Discussion with most of timber makers reveals that most of them have put restriction for not making timbers using the native trees like *Pterocarpus spp* (mtumbati) and *lafcadiello Schmid* (mpuga) instead they use timbers made from *Gmelina arborea* tree species which are durable as native trees. The rest 11% are still use the native trees especially *lafcadiello Schmid* and *Pterocarpus spp*.

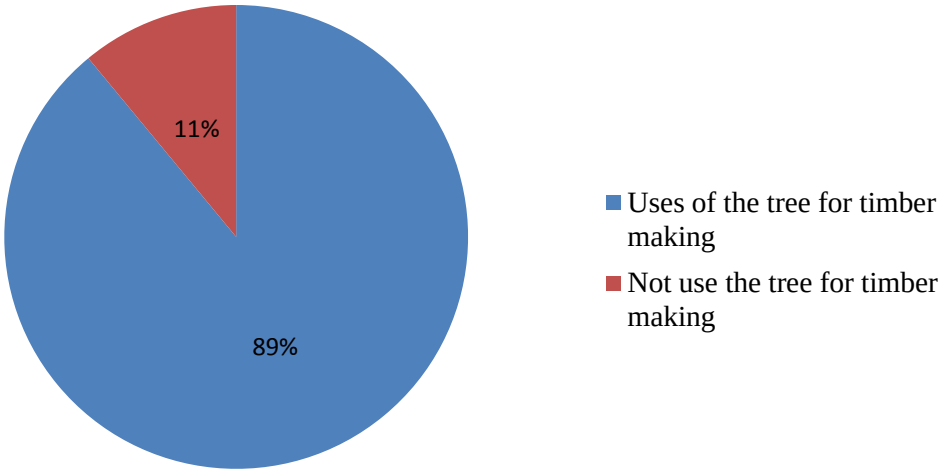

Figure 8: The use *Gmelina arborea* tree species in timber making

Source: Field Data 2015

Information from Observation also supports that most of the timbers in timber shops and furniture in furniture shops are made from *Gmelina arborea* tree species

(Plate1). During the interview, one of the forestry officer from district office noted that, the rate of deforestation has been minimized through the plantation and uses of *Gmelina arborea* tree species in timber and furniture making.

Plate 1: Timbers made from *Gmelina arborea* tree species in Namtumbo

Plate 2: Furniture made from *Gmelina arborea* tree species timber in Namtumbo

Forestry officer argued further that the reasons which made the carpenters adopt the use of *Gmelina arborea tree species* is durability of its wood which is equivalent to most of the timbers made from native trees. This result supports (Swamy *et al*; 2008 &Wekesa, 2013) who argued that *Gmelina arborea* tree species have remarkable growth rate and provide a very durable wood. During the Focused group discussion, majority of discussants reveals that, other reasons that have convinced timber makers and carpenters to shift from native trees to *Gmelina arborea* tree species are higher

cost of transport, lumbering permit and bureaucratic processes in getting lumbering permit from district forestry office. During the interview with carpenters, most of the interviewee admitted that *Gmelina arborea* tree species is the best introduced tree species which has the durability to replace most of the native forest trees, as explained in the following statement from group participants in Mandepwende village;

> *"This tree takes short rotation and its timbers have no doubt on durability. Wood from Gmelina arborea tree cannot be affected by any weather condition, and its joinery works can be done with regardless of the dryness of the timber while providing the same results."*

Interview with timber shop keepers in Rwinga ward reveals that each shop supplies an average of 40m^3 of timber made from *Gmelina arborea* tree species each month. As there are 12 timber shops, an average of 480m^3 of timber made from *Gmelina arborea* tree species is supplied in Rwinga ward in each month. Further it reveals that there is an average of more than 4800m^3 of timber from *Gmelina arborea* tree species which are supplied each year from the timber shops to different parts of the study area. It is true that *Gmelina arborea* trees species have helps to conserve more than 4800m^3 of biomass from native trees which could be used on the absence of this tree.

4.4.3 Used as Woodfuel for Bricks Baking

Finding reveals that more than 64% of respondents use *Gmelina arborea* tree species in woodfuel specifically in bricks baking (Figure 10). This finding has an implication that some of the native trees which were supposed to serve bricks baking in the study area have continued to exist in the forest as its role has been played by *Gmelina arborea* tree species. Existing health native forest in large extent is attributed by

increasing plantation of *Gmelina arborea* tree species which lower the rate of deforestation of the native trees. Result provided during focused group discussion with some residents, reveals that the use of *Gmelina arborea* tree species in bricks baking aims at limiting the transport cost and bureaucratic processes needed by individuals to fetch woodfuel from the native forest. If one decide to bake his/her bricks by using the native trees, he or she should have to incur the cost of wood cutting and transportation permit and the transport cost of not less than 100,000 Tsh per trip of wood depending on the distance from which native forest are found. In this cost majority of people find is better to prune the braches or cut down *Gmelina arborea* tree species which they have planted around their locality and use it to bake their bricks.

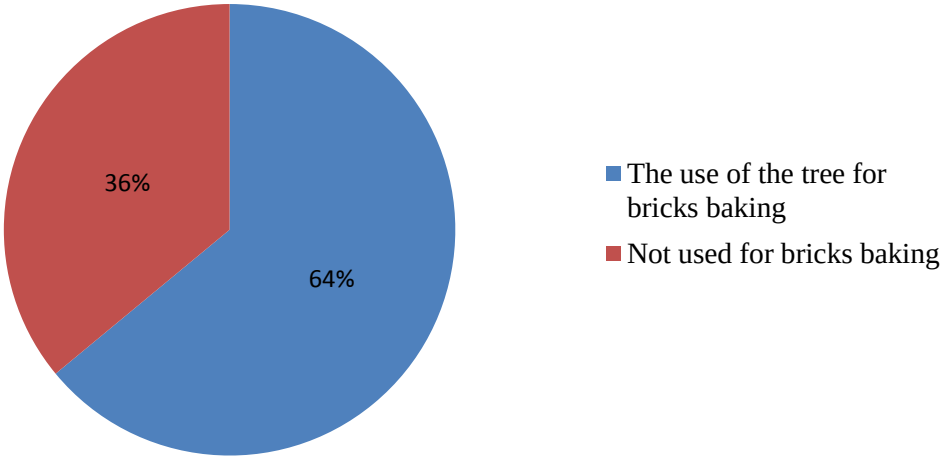

Figure 9: The use of *Gmelina arborea* tree species in bricks baking

Source: Field Data 2015

Gmelina arborea has served tons of native trees from being cut down for bricks making since probing reveals that 12000 bricks need more than 8 tons of firewood. Regarding on the amount of woodfuel served from the native trees, discussion with village leaders noted that an average of 40 kilns of bricks is baked by using *Gmelina*

arborea tree species each year in each village which gives the total of 160 kilns in Rwinga ward. The discussion shows further that each kiln of bricks constitute the average of 12000 bricks which is baked with the average of 8 tons of woodfuel. This view is somehow correlates with the Study done by Hines & Eckman (2008), which shows that bricks making is among the factor which contributes to deforestation of native trees whereas brick burning of 50000 bricks requires about 20 tons of firewood (Kissinger, 2012). Basing on the above data, more than 1280 tons of woodfuel from *Gmelina arborea* is used each year to bake the bricks in Rwinga ward. In other world it is concluded that approximately more than 1280 tons of wood fuel from native forest is being saved each year in Rwinga ward.

4.4.4 Used as Alternative Tree for Curing Tobacco

Some (24%) of respondents who grow tobacco mentioned *Gmelina arborea* tree is among the tree which they use to cure tobacco (Table 4). This finding has an implication that there is the number of biomass of native trees which are conserved in the forest due to the use of *Gmelina arborea* tree species in tobacco curing. Some farmers who grow tobacco identified that before the introduction of *Gmelina arborea* tree species, native trees (like *Brachystidia spp*, *Erythrina abyssinica*, *Syzygium cordatum* and *Paurosa spp*) were cut and used as a source of fuel to cure tobacco. Nowadays farmers are using *Gmelina arborea* tree to cure tobacco. During the focus group discussion with farmers, one discussant said that;

> *"During those days farmers used the native trees which take long time to grow but these days majority of farmers who grows tobacco use Gmelina arborea tree species to cure tobacco because they provide good result compared with the native trees and they found close to their farms. This have made the native trees continue to exist"*

Table 4: *Gmelina arborea* used as woodfuel for tobacco curing

The use of *Gmelina arborea* tree in tobacco curing	Percentage (%)
Yes	24
No	76
Total	**100**

Source: Field Data 2015

This has an implication that biomass from *Gmelina arborea* tree used for curing tobacco, significantly have replaced the woodfuel which could be taken from the native trees. This has resulted to the conservation of large number of native trees. Interview during the household survey with tobacco farmers reveals that an average of 1.5 hectares of tobacco farm is cultivated by individual farmer each year, and each hectare of tobacco farm consumes an average of 10 tons of woodfuel (Mangola 2008). This data supports Nyoni (2008) and Makoye (2012) who argued that one hectare of flue cured tobacco consumes more than 10 tons of woodfuel from nursery practices to the day when tobacco is taken to the market. According to one of agricultural officer from Association of Tanzania Tobacco Traders (ATTT) there are 95 hectares of tobacco farms in the study area in 2014/15 season of agriculture. Basing on the ratio of 1 hectare of tobacco farm per 10 tons of woodfuel to cure tobacco, there is 950 tons of woodfuel from *Gmelina arborea* tree species used to cure tobacco in 2014/15 agricultural season. In other words there is more than 950 tons of biomass from native trees which are conserved each year due the use of *Gmelina arborea* tree species in tobacco farming. This implies that the extent of *Gmelina arborea* tree species have contributed much on limiting the rate of deforestation in Rwinga ward, and play a great role in conserving native forest trees species in the study area. Finding from this study are going contrary with the report

provided by district forestry office during the world environment day this year which reveals that, there is minimal improvement in forest conservation as the rate of deforestation has been a little bit minimized by 3% for the current ten years. This report finds that there is great improvement in forest health which has contributed with the use of plantation trees such as *Gmelina arborea* in different uses like timber and furniture making.

4.5. Challenges Associated with the Plantation of *Gmelina arborea* Tree Species

Further, respondents were asked to identify challenges associated with the plantation of *Gmelina arborea* tree species in a study area. Majority of respondents acknowledged that there are some challenges in the plantation of *Gmelina arborea* tree species (Figure11).

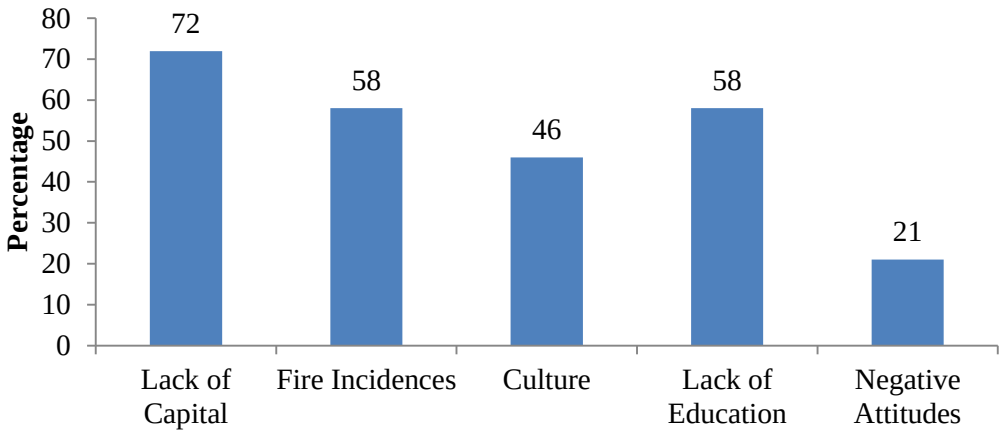

Figure 10: Challenges associated with the plantation of *Gmelina arborea* tree species

Source: Field Data 2015

4.5.1 Lack of Capital

About 72% of respondents identified shortage of capital to be a challenge towards the plantation of *Gmelina arborea* tree species. Probably this is attributed by the state of poverty in rural area due to the fact that most of respondent are peasants.

This variation might be attributed by the concept of dependency theory in which resources flow from a periphery to a core of wealthy, while enriching the core at the expense of the periphery (Ghosh, 2012). Deforestation which is persisting in Rwinga ward is a result of tobacco cultivation. It is observed that tobacco cultivation have a great influence on the state of poverty which exist in the study area. Tobacco production continues to exist on the expense of peasants in Rwinga Ward while the industrial developed countries continue to flourish due to exportation of tobacco from the study area (Bradford, 2015). During the focused group discussion with farmers, one farmer reported that;

> *"Our poverty has been caused by tobacco cultivation. We used to invest a lot of energy throughout the year to serve tobacco farms but we came back with little or nothing after selling tobacco at "Chama cha Msingi." Tangible things which can be observed after the plantation season were bare land resulted from clearance of the forest for tobacco cultivation.*

This view supports Kangalawe & Noe (2012) who argued that *with tobacco cultivation* many tobacco farmers, rather than growing rich from the crop, often find themselves in debt to tobacco companies. The use of child labor in the tobacco fields is common practice in Namtumbo which lead to missing out on vital educational opportunities that could help lift them out of poverty. Shortage of capital bring the hindrance for the household to implement the plantation of *Gmelina arborea* tree species by failing to meet expenses (like cost of seeds and preparation of nursery) of propagation and management of plantation of this species. This has led the community into having limited field of the plantations. N'nko (2010) argued that fewer capital and technology available to farmers hinder the growth and development of agroforestry industry to the extent that brings poor return.

4.5.2 Lack of Education

About 58% of respondents identified that lack of education is a challenge toward plantation of *Gmelina arborea* tree species. Culture and negative attitude provided by the farmer is found to be part of shortage of education. This challenge may be influenced by lack of village meeting, seminars and workshops on how to prepare nurseries and to plant this introduced species (Amorhan 2008). It is also contributed with the lack of exposure on how the tree contributes to income generation and environment conservation. This view supports KFP (2011), who explained that education on the management of tree plantation have great influence on assuring high production in tree plantation. During the interview, with key informants such as district forest officers and ATTT forestry officer, one officer admitted that most of farmers have not exposed themselves in timber industry. For a long time they believe that plantation of trees is possible in cold region such as Njombe, Makambako, Iringa and Mbeya. In addition to that, respondents admitted that these trees take a long time to mature, a period which they are not sure whether they will be alive or not, hence planting tree for them is probability, better to plant a short term crops.

4.5.3 Fire Incidence

Generally 58% of respondents identified that fire is found to be a challenge to the plantation of *Gmelina arborea* tree species in the study area. This implies that some people don't know the impact of fire in the environment especially in tree plantation. One of the agricultural officer from ATTT addressed that, most of the native people in Namtumbo have the notion that fire is not a problem at all, hence setting fire and leaving it spreading in the forest doesn't disturb their minds. He added that native people in Namtumbo set fire during the dry season after harvesting, for farm preparation and small animal hunting as indicated in the statement below;

> *"Some people may compete on fire setting, that there is some individual who believes their hands are gifted in fire setting, when they set fire no grass will remain on its color."*

The above interview implies that environmental education is not enough provided to people in Namtumbo. Sharma & Sunderraj (2005) noted that, Fire kills and suppresses young *Gmelina arborea* tree species making it difficult to grow.

Another challenge which was mentioned by the respondents during group discussion is the tendency of the tree to consume a lot of water from the ground. During the focus group discussion the view of many farmers blamed the tree on its water consumption as one farmer commented that;

> *"Gmelina arborea tree species consume much water to the extent that no more plant will grow under the trees"*

When forestry officers asked about the consumption of water by the tree on study, they explain that there is no data which explain the consumption of water by *Gmelina arborea* though majority of farmers in the study area complaining that the tree consume a lot of water from the ground.

Gmelina arborea tree species is also blamed with the tendency of suppressing other crops which had been grown on beneath of the tree. During focus group discussion some farmers complained that if the tree had been grown to the extent that they made canopy, no plant could grow around the tree on study. Interview with forestry officer provide controversial answer where others accept that the tree suppress other crops while others argued that suppression of the plant beneath the canopy tree is common to all the canopy trees. This implies that there is no enough study which has been conducted to examine the existence of other plant species beneath *Gmelina arborea* tree species.

CHAPTER FIVE

CONCLUSIONS AND RECOMENDATIONS

5.1 Introduction

This chapter presents the summary of the major findings of the study that was conducted in Rwinga ward of Namtumbo district. This chapter starts to present summary of the key findings, followed by main conclusions of the study. The next part provides recommendations of the study basing on the key issue arouse in this study. The last part of the chapter present suggestions for areas for future research directions in this discipline.

5.2 Summary

The study focus on examine the contribution of *Gmelina arborea* tree species in combating deforestation in Rwinga ward. Specifically the study investigate the perception of farmers on planting *Gmelina arborea* tree species and the extent which *Gmelina arborea* tree species has contributed to combat deforestation in the study area. It also examines the challenges associated with the plantation of *Gmelina arborea* tree species in the study area.

The finding reveals that *Gmelina arborea* tree species is a well known exotic tree in Namtumbo District. Most of the farmers have positive perception about planting *Gmelina arborea* tree species. Their positive perception is associated to short period of tree growth, durability of its wood and market demand of the wood produced by the tree.

It has been found that *Gmelina arborea* tree species has contributed much in limiting the rate of deforestation in Namtumbo District. This is found through the use of *Gmelina arborea* trees species which has significantly replaced the use of native trees in different cases hence contribute to conservation of the native forest trees. Major uses of *Gmelina arborea* tree which help in conservation of native trees include lumbering, carpentry works, bricks baking and tobacco curing.

Finding also reveals that some farmers in the study area use *Gmelina arborea* tree species for bricks baking. Before the introduction of *Gmelina arborea* tree species most of the woodfuel for bricks baking were taken from the native forest. Moreover *Gmelina arborea* tree species has found to be among the trees used in tobacco curing by some tobacco farmers in the study area. Farmers who prefer the use of this tree mentioned the accessibility of the tree close to their tobacco field and its ability to cure tobacco is among the factors which encourage them to use this tree.

Further the study revealed some challenges which affect the plantation of *Gmelina arborea* tree plantation. Capital was found to be the leading challenge mentioned by 72% of respondents followed by lack of education which was mentioned by 58% of respondents and fire incidences mentioned by 58% of respondents. Other challenges are culture mentioned by 46% of respondents and negative attitude of some farmers towards planting *Gmelina arborea* tree species which was mentioned by 21% of respondents.

5.3 Conclusion

Findings revealed that *Gmelina arborea* tree species is a well known introduced tree species in Namtumbo district. Majority of peasants in Namtumbo have planted *Gmelina arborea* tree species. Even though most of farmers have planted it at small scale, plantations are found to continue to expand as days goes on. Majority of farmers have a positive perception towards planting this tree as it provides number of benefits including timber making, furniture making, and woodfuel for bricks and tobacco curing, features that motivate many people in the study area to plant the tree. Furthermore findings revealed that, *Gmelina arborea* tree species has played a great role on combating deforestation in Namtumbo District whereby the tree has replaced use of native trees. The study revealed that most of the carpentry works and fuel wood specifically in bricks baking and tobacco curing are done by using *Gmelina arborea* tree species. This implies that timber and furniture makers have shifted from the use of native trees to *Gmelina arborea* tree species which has positive implication to forest conservation.

Study found that, plantation of *Gmelina arborea* tree species in Namtumbo is challenged with number of challenges. Education on how to manage the plantation of *Gmelina arborea* and on the importance of the tree on income generation and environmental conservation has limit the production of the trees to the wider community members hence limits its contribution on income generation and environmental conservation. Most of farmers lack agroforestry education; they don’t know how to propagate the trees and how to manage them so that they can provide the boles for reasonable timbers. This have limits the production of the tree and in

other way have discouraged some farmers to put more effort on the plantation of the trees on study.

In addition to that, capital is found to be a big problem which limits the expansion of the size of the farm. Most of the farmers in Namtumbo have small farms such as 1hactare or less as they have no fund to expand their farms. Shortage of capital is contributed with the mode of production in the study area as most of the people are producing for subsistence earning. This problem has made the slow expansion of the plantation of this tree species.

Findings reveal that fire incidence is dominance incident in Namtumbo especially during the dry seasons from August to December of each year. This affects the seedling of *Gmelina arborea* tree species making it difficult to reach the maturity stage. This has been much attributed by the bad activities such as use of fire in the preparation of farms, hunting of small animals and ignorance of some of people in the study area. Fire incidence has limits the growth of many seedlings and discouraged majority of farmers to expand their farms in the study area. Furthermore the tree is blamed with the tendency of higher water consumption from the ground feature which drives the land into draught. Again some farmers have no habit of planting *Gmelina arborea* tree as they perceive that the tree suppress the crops which are grown around the tree, a feature which is associated with the canopy trees.

Not only that but also culture and negative attitudes towards the plantation of *Gmelina arborea* tree species also has found to be big challenge toward the plantation of this introduced tree.

5.4 Limitation of the Study

The process of collecting information was not easy, the researcher faces many problems but the following were the major constraint;

Both economic and time resources constraints made it challenging to gather all the material needed on time. To overcome the problem of time limit the researcher trained more research assistants so that he managed to collect the needed data on time. Moreover the researcher had to find other sources of fund to add to the budget which was found to be insufficient.

It was difficult to meet the appointment with the heads of the household as majority of them were out of there resident when the researcher visited the household. Most of the household visited were free to provide the information on the presence of father of the house. On the absence of the farther of the house information were not provided as they believe no one can act as a head of the household instead of father. This demanded the researcher to revisit some household for more than two, these things caused the researcher to spend more time and money.

There was insufficient cooperation on the side of participants. Some claimed to be paid during the interview hence turn up was very poor. However, through awareness building by providing education on the important of the study, some agreed to talk something better to my research while others refused completely, hence, I had to use a lot of time to find others who were ready to be interviewed without being paid.

5.5 Recommendations

Despite the positive responses of farmers towards planting *Gmelina arborea* tree species there are some effort needed in order to increase the production of the tree. Basing on this view, the researcher therefore makes the following recommendations:

First, the government and other stakeholders should provide agroforestry and environmental education, and encourage farmers to join agroforestry industry through the use of *Gmelina arborea* tree species. Education can be provided through the use of village meetings, workshops and seminars. Few Villagers may be nominated to get the seminar elsewhere and later they can share with others the knowledge they have acquired from the workshop or seminar. Education provided will help the farmer to get the insight of the tree in terms of propagation and management which will lead into high production. If the farmer will be on the position to harvest higher production, they will be motivated to expand their farms to increase the production.

Moreover, since capital is found to be the problem to most of the farmers, government and other stakeholders should organize farmers in small groups and provide them with loans or fund which will help them to expand their farms and increase the production of this tree species. Increase in production of the tree will lead to more conservation of the native forest trees in the study area and elsewhere.

Government should prepare the external markets for the tree product to capture international and local market. External market could be archived through the advertisements of the wood produced by this tree species in different areas such as media and meeting. If the production will increase while the market remain the same, the price of the products will fall, which in turn will discourage the farmers to

continue with the plantation of the trees as clearly explained by the expectancy theory of motivation.

Since fire incidence is found to be the problem toward the plantation of *Gmelina arborea* trees species, roles and regulation should be made and implemented to make sure the tendency of forest burning is strictly prohibited. This can be done through the formulation of bylaws which will be used to punish those who caught to set wild fire within the District. Roles and regulation will assure and motivate farmers to keep on planting the tree.

5.6 Suggestions for Further Studies

- ✓ Since some farmers are complaining that *Gmelina arborea* tree species consumes much water while forest officers haven't any data on the consumption of water by the tree then, future study should examine the amount of water consumed by *Gmelina arborea* tree species from the ground. Knowledge on the amount of water consumed by this tree will enable the decision whether to encourage or discourage the plantation of *Gmelina arborea* tree species in the study area.
- ✓ Again as the tree is blamed that it suppress other plants, there is a need to conduct a study to investigate the compatibility of *Gmelina arborea* tree species with other plants in the study area so that we can be on the position to judge whether there is problem with other species and how to manage the problem.

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APPENDICES

Appendix 1: Survey Questionnaires for the Household

The under listed questions have been set to provide the researcher with the answer towards the study on the contribution of *Gmelina arborea* tree species in combating deforestation in Namtumbo District. To make the study successful, please I beg for your cooperation. Please answer the questions according to you knowledge. All the responses will be confidential and will be used for academic purposes only.

A: Demographic information of respondents

Date……..……

1. Village……..……

2. Sex a) Male……. b) Female…….

3. Age a) 18-27……... b) 28-37…… c) 48-57……. d) 58^{+}…….

4. Education level. a) Primary…….. b) Secondary…..… c) Diploma….. d) $Degree^{+}$……

5. Main economic activity. a) Peasant……. b) Carpenter….. c) Trader…… d) Timber maker…. e) Others……...

B: The perception of farmers on planting *Gmelina arborea* tree species on environment

6. How long have you been in this village? a) 1-5yrs….. b) 6-10yrs…… c) 10+……...

7. Do you know *Gmelina arborea* tree species? a) Yes…….. b) No…….

8. Why *Gmelina arborea* tree species was introduced in this village?

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9. **What is your view about planting *Gmelina arborea* tree species?**

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C: The extent *Gmelina arborea* tree species has contributed to combat deforestation in the study area

10. Have you plant any *Gmelina arborea* tree species? a) Yes…… b) No……...

11. If Yes, How many hectares of *Gmelina arborea* have you grown?

a) Less than 1ha…….. b) 1ha……. c) 2ha…….. d) 3ha and above……

12. Why you have decided to plant *Gmelina arborea* tree species?

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13. Does the tree species have any contribution in improving your household income/livelihood?

Yes…… No……

14. If yes what benefits are accruing from planting *Gmelina arborea* tree species?

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15. Is there any impacts resulted from *Gmelina arborea* tree? a) Yes……. b) No……..

16. If Yes, What are the positive impacts of *Gmelina arborea* tree in the forests or environment?

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17. If Yes, What are the negative impacts of *Gmelina arborea* tree in the environment? **.....**

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D: Challenges associated with *Gmelina arborea* tree species in Namtumbo.

18. Are there any challenges on planting Gmelina arborea tree species? a) Yes….. b) No……

19. If Yes, **What are the challenges which face the growth of *Gmelina arborea* tree species?**

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20. What do you think would be the solution towards the above challenges?

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Appendix 2: Interview Guide for the Key Informant

Dear Sir/Madam, I'm a student from the University of Dodoma, I'm conducting the research on the contribution of *Gmelina arborea* tree species in combating deforestation in Namtumbo District. The under listed questions have been set to provide the researcher with the answer towards the study. To make the study successful, please I beg for your cooperation. Please answer the questions according to you knowledge. All the responses will be confidential and will be used for academic purposes only.

Date of Interview…… Na…….

Name of Organization……..…..……..

Section……..

Title/Position……..…….……

B: The perception of people on planting *Gmelina arborea* tree species on environment

1. Do you know *Gmelina arborea* tree species? a) Yes……b) No……
2. If yes, for how long this tree has been grown in Namtumbo?

   a) Less than 10yrs……b) 11-20yrs…… c) 21-30yrs……. d) 31^{+}……

3. Why *Gmelina arborea* tree species was introduced?

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3. What is your view about planting *Gmelina arborea* tree species?

C: The extent *Gmelina arborea* tree species has contributed to combat deforestation in the study area

5. Is there any farmer in Namtumbo who own more than 1 hectare of this tree species?

a) Yes…….. b) No……..

7. Why some farmers have decided to plant *Gmelina arborea* tree species?

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8. Does the tree species have any contribution in improving the household income/livelihood?

Yes…… No……

9. If yes what benefits the farmers are accruing from planting *Gmelina arborea* tree species?

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10. Is there any impacts resulted from *Gmelina arborea* tree? a) Yes….. b) No…….

11. If Yes, What are the positive impacts of *Gmelina arborea* tree in the forests or environment?

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12. If Yes in Qn10, What are the negative impacts of *Gmelina arborea* tree in the environment?

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D: Challenges associated with *Gmelina arborea* tree species in Namtumbo.

13. Are there any challenges on planting Gmelina arborea tree species? a) Yes..…. b) No……

14. If Yes, **What are the challenges which face the planting of *Gmelina arborea* tree species?**

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15. What do you think would be the solution towards the above challenges?

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Appendix 3: Observation Schedule

The extent which *Gmelina arborea* tree species has contributed in combating deforestation

Issue to be observed	**Observation results**
Distributions of *Gmelina arborea* trees in the study area	
Size of *Gmelina arborea* trees in the study area	
Percentage of timbers made by *Gmelina arborea* in the timber shops	
Percentage of the furniture made from *Gmelina arborea* in the furniture shops.	
Distribution of *Gmelina arborea* in the study area	
Patches of tree stems within the forest	
Species of Firewood and charcoal used in the household	

C: Impacts of *Gmelina arborea* on the environment

Issue to be observed	**Observation results**
Leaf load dropped by *Gmelina arborea* tree species.	
Other species which depend on *Gmelina arborea* tree species.	
Distribution and growth of other plant species around/beneath *Gmelina arborea* tree species.	