THE DYNAMICS OF LAND USE CHANGE, A CASE STUDY OF MEATU AND IRAMBA DISTRICTS OF TANZANIA

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN RURAL DEVELOPMENT OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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ABSTRACT

The study was carried out in Iramba and Meatu Districts of Tanzania to examine the drivers of land use change. Household questionnaires, focus group discussions and key informant interviews were used to collect data. Data were analyzed descriptively, inferentially and content-wise with socially referenced interpretation to give a general theme for the findings. In tracing the historical trend of land use changes, the key informants a mentioned 1983-1985 and 1988, 1993, 1996, 1998, 2002 and 2007 as periods which had severe droughts resulting into food insecurity, human and animal populations encroachment into unused land, land resources degradation and decreased number of livestock. Extension into unused land and increase of area under crop cultivation were the main proximate causes of land use changes. Moreover, the determining factors for farm size are adequate land and affordable price of agricultural inputs (seeds, pesticides and fertilizer) with Chi-Square value of 85.443 which was significant at 0.00 % ($p \leq 0.05$) and presence of labour with a Chi-Square value of 137.820 which was highly significant at 0.00% ($p \leq 0.05$). Other determining factors were climate change and variability (rainfall specifically). Effects of land use change were reported on area under cultivation with average of 86.9% of the respondents reporting that formal grazing land were put under crop cultivation. There were also land use change effects on environment and forest production including increased soil erosion and reduced forest size.

DECLARATION

I, LOTI GHOZ BIYAGILA, declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work done within the period of registration and that it has neither been submitted nor being concurrently submitted for a degree award in any other institution.

_____ _____

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The above declarations is confirmed

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DEDICATION

With love and enthusiasm, this work is dedicated to my parents Levina Kazige Lugendo and Fabian Ghoz Biyagila.

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LIST OF ABBREVIATIONS

APO	Asian Productivity Organization
DSI	Development Studies Institute
EPINAV	Enhancing Pro-poor Innovation in Natural Resources and Agricultural Value Chains
ERP	Economic Recovery Program
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
HADO	Hifadhi Mazingila ya Dodoma
HASHI	Hifadhi Mazingila ya Shinyanga
IFAD	International Fund for Agricultural Development
ISC	Investing on Children and their Society
LVEMP	Lake Victoria Environmental Project
NEMC	National Environmental Council
NGOs	Non Governmental Organization
SAP	Structural Adjustment Program
SNAIL	Sokoine National Agriculture Library
SPSS	Statistical Package for Social Sciences
SUA	Sokoine University of Agriculture
UN	United Nations
URT	United Republic of Tanzania
WB	World Bank
WVT	World Vision Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Land use change is a process which involves alteration and modification of the land. In some cases land use change includes incomplete alteration of land use types to others and retaining their status like rain fed to irrigation agriculture or natural vegetation to planted vegetation (Masarra, 2012). Some changes are associated with alterations of forestry by crop cultivation or livestock grazing, replacement of crop cultivation area by human settlements with associated human demand on the environment.

Likewise, land use change necessitates system change through changes in cropping system involving mono-cropping to intercropping or vice versa. Land use change can occur as extensification and intensification in which one or more land use proliferates at the expense of others (Kangalawe *et al*., 2007). Agricultural extensification can be at the expense of grazing land, forestry and settlement. Agricultural intensification happens as the endless use of same land without resting and may include practices that conserve and replenish the land. Most human-allied sustenance activities depend on land since land is the fundamental factor of production that supports living organisms and ensures their continued existence.

Agricultural expansion has shifted between regions over time followed by general development of civilizations, economies, and increasing populations. It is estimated that one fifth of the world population lives on 5.2 billion hectares of the world's dry

land which is equivalent one-third of the land area of the globes area. In addition about 40 percent of the population inhabits degraded lands (UN and IFAD, 2000).

Human alterations of the landscape and their deleterious consequences of the land since the dawn of civilization have been noted for a long time. Greek philosophers like Plato, Aristotle, and Roman Emperors such as Hadrian have already reported about the deterioration of natural vegetation and the erosion of fertile land (Kees *et al.,* 2012).

Notwithstanding, land use dynamics encompass processes driven by human actions but also produce changes that impact on humans (Agarwal *et al.,* 2002). These dynamics alter the availability of different biophysical resources including soil, vegetation, water and animal feeds. Consequently, land use changes lead to a decreased or increased availability of different products, services for human, livestock, agricultural production and may damage the natural resources base as well.

Globally, half of the ice-free land surface has been modified by human activities over the last 10 000 years, and estimates reveal undisturbed/wilderness areas representing 46% of the earth's land surface. Forests covered about 50% of the earth's land area eight thousands (8000) years ago, as opposed to 30% today (Lambin *et al.,* 2003). Agriculture in the form of both crop cultivation and livestock keeping has expanded into forests and savannas in all parts of the world to meet the demand for food and fiber.

With regard to land-use practices in Sub-Saharan African dry lands, rain fed agriculture dominates the region and supports various rural livelihoods (Godfray *et al.,* 2010). It is characterized by low crop yields, which results from scarce and unreliable rainfall amounts that combine with extensive agriculture and results in the overexploitation of forests, woodlands and rangelands. As such, poverty and hunger are predominant, as more than 50 % of Africa's poorest people are concentrated on "low potential" lands that are prone to degradation (Masarra, 2012).

In Tanzania, there has been reported land use changes of which most is rapid depletion of forests associated with increase in population, extensification of agricultural activities and increased demand for forest products (Misana *et al.,* 2012). A principal aspect behind extensification of agricultural land has been the current fast population growth and resultant pressure on land. Moreover, Kikula (1996), reported that, in 18th century Kondoa Irangi hills of central Tanzania were wooded, when the Irangi settled in Irangi hills of Kondoa District, valley bottoms were used for pastures. But with time, the pasture valley bottoms and fertile wooded hills were put under agriculture. Some of the wooded areas were turned into grazing areas.

Similarly, in central Tanzania, land-use has been constantly changing over the last few decades, with an intervention of trying to rehabilitate the worst degraded areas since1970s when all livestock were driven out. Since the early 1990s free-grazing livestock have progressively, but illegitimately been brought back. The return of

livestock has improved the accessibility of manure and is likely to reverse the trends of ongoing land use. Moreover, a proof is also presented to demonstrate that farmers have been quick to grasp whatever chances they had to make use of new land-use opportunities, today the size of cultivated area has increased considerably compared to the early 1970s when intensive conservation efforts begun (Kangalawe *et al.,* 2007).

About 90% of Iramba and Meatu Districts residents depend on crop cultivation and livestock keeping as the main source of their livelihood and it is estimated that on average each household has access to about 3.2 hectares of land in Meatu (URT, 2010). Despite the semi-arid conditions, agriculture has continued to dominate the livelihoods and economic performance of central Tanzania of which Iramba and Meatu are inclusive.

Farmers in Iramba District are predominantly small scale, subsistence farmers with a portion going towards cash crop production (Kari and Susan, 2010). Sunflower is grown by nearly 90% of farmers, followed by maize, sorghum and groundnuts. Practically in central Tanzania, no permanent crops are grown and it has the largest area of pasture to support the high population of cattle in the region. However little is known on the drivers of land use changes in Iramba and Meatu Districts hence necessitating further research to know the drivers of land use change for agricultural practices indicated by intensification, extensification and diversification in agricultural practices is necessary.

1.2 Statement of the Problem

Meatu and Iramba Districts of Tanzania main land depend on land use for their economic and social survival. These Districts have very limited potential for irrigation agriculture except for those individuals who own land adjacent to Simiyu River in Meatu and Ndulumo River in Iramba. Crop cultivation is highly dictated by the occurrence of rainfall resulting in rain-fed agriculture that allows producing only one crop per year in most cases.

However, land use change has been prevailing in these areas since they have been habited by human population, recent study by Majule and Lucumay (2009) on Impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas which relates to land use changes indicates proper timing of agricultural operation, crop diversification, use of different crop varieties and changing of planting dates exist. Also, Kangalawe (2009), studied land use changes and their implications on rural livelihoods in the degraded environments of central Tanzania focusing on implications of land use changes to rural livelihoods but did not identify the real cause of land use changes and how this has been evolving overtime.

Furthermore, some of the contributing factors and processes are likely to be area specific and to evolve over time as well. Hence, some of the outputs and resulting influences may not be applicable in other areas including Iramba and Meatu. On top of all these, land use change prevails in the study area but there are no clear factors known to cause the phenomena.

While these studies provide interesting and relevant insights, questions remain, is climate change the only driver of land use changes? This instigates a need for knowing the drivers of land use change in order to fill the knowledge gap which exists. Therefore, based on these facts, this study aimed to identify drivers of land use changes in Iramba and Meatu Districts.

1.3 Justification for the Study

Land has remained the lead sector in a cluster of several sectors, the Government of Tanzania has changed names several times from: "lands and surveys" before independence; to "lands, forestry and wildlife" up to 1963; to "lands, settlement and water" up to 1968; to "lands, housing and urban development" up to 1984; to "lands, natural resources and tourism" up to 1986; to "lands, water, housing and Urban Development" in 1987; to "lands, natural resources and Tourism" up to 1990; to "lands, housing and urban development" up to 1995; to "lands and human settlement development" up to 2005; and to "lands, housing and human settlement development" to date.

All changes retained land as the basic sector showing, albeit in principle, the central role of land in natural resource management and generally, socio-economic development of the country as viewed by policy makers throughout the last half a century (Furaha, 2009). The clustering also names some of the economic sectors, besides agriculture that are closely linked with land to include: natural resources - forestry, wildlife, water; the built environment – human settlements (including housing and urban development); and tourism.

A number of studies have been conducted in central Tanzania which represents a large part of semi-arid areas, but there is significant variation in the level of analysis performed and purpose and output of the studies. Since land provides wide range of uses, agriculture is identified as a lead sector that routinely depends on it as it accounts for 24.5% of GDP and about 60% of export earnings and source of livelihoods to 80% of the population (URT, 2010). It is hoped that this study will provide information for decision makers and development practitioners about the magnitude and dimensions of long term land use changes and their cause in the study areas and surrounding. Understanding such changes is critical for formulating effective development policies and management strategies.

Findings from the study therefore are expected to be useful to Districts that are prone to continued land use changes due to social, political, economic, demographic and technological factors. Moreover, results from the study are vital for academicians, development practitioners, research institutions and individuals dealing with land use, agricultural development, population issues and poverty alleviation as the basis for new innovations in the activities they embark on. Therefore, based on the information generated, issues that need immediate action have been identified and prioritized. In addition, the study gives an overview of the various ranges of local knowledge and practices within the study areas from which future intervention can be designed.

1.4 Objectives for the Study

1.4.1 General objective

The overall objective of the study was to examine drivers of land use changes in Iramba and Meatu Districts.

1.4.2 Specific objectives

The following were specific objectives of the study

i) To trace and establish the historical trend of land use changes in the study area.

ii) To identify factors responsible for land use changes in the study area.

iii) To determine the association of land use changes on agricultural activities in the study area.

1.5 Research Questions

i) How has land use been changing over time?

ii) What factors are responsible for land use changes in the study area?

iii) What are the initiatives related of land use changes in the study area?

1.6 Research Hypothesis

H_0: Land use changes do not have significant association with agricultural activities

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Definition of Key Terms

2.1.1 Land

Land is the attribute of the earth's land surface captured in the distribution of vegetation, water, desert and ice and the immediate subsurface, including biota, soil, topography, surface and groundwater. It also includes those structures created solely by human activities and settlement (Chrysoulakis *et al.,* 2004). Land is an essential natural resource, both for the survival and prosperity of humanity and for the maintenance of all the terrestrial ecosystems. Although it is a fixed, scarce, tangible and immovable resource, it is a degradable and transferable entity that is only sustainable when it is properly used by humans (Massara, 2012).

Land is a natural resource which has different characteristics in any part of the world. The most important and special characteristic of the land is that it cannot be extended through easy and simple processes. Most households, especially in third world countries, depend on land and other natural resources for satisfying needs and achieving their long-term livelihood goals. In traditional societies, the concept of land extends beyond the purpose of production. It also holds important social and spiritual values (Massara, 2012).

2.1.2 Land use

Land use refers to the purpose or intent for which a piece of land is being used. Land use is the intended employment and management strategy placed on the land cover by human agents, or land managers to exploit the land cover and reflects human activities such as industrial zones, residential zones, agricultural fields, grazing, logging, and mining among many others (Chrysoulakis *et al*., 2004). Cultivation, grazing, ranching and urbanization, are all examples of land use activities. Generally, the management of land, including tilling, fertilization, and irrigation, is also characterized as land use activities.

2.1.3 Land use change

Land use change is defined to be any physical, biological or chemical change attributable to management, which may include conversion of grazing to cropping, change in fertilizer use, drainage improvements, installation and use of irrigation, plantations, building farm dams, pollution and land degradation, vegetation removal, changed fire regime, spread of weeds and exotic species, and conversion to non-agricultural uses (Lambin and Geist, 2007).

Land use change is also a quantitative change in the real extent (increases or decreases) of the given type of land use or land cover. According to Lambin and Geist (2007), two types of change are land cover conversion which involves a change from one cover type to another and land cover modification which involves alterations of structure or function without a wholesale change from one type to another; it could involve changes in productivity or biomass. Same literature states that land use (both deliberately and inadvertently)

alters land cover by converting the land cover, changing it to a qualitatively different state, modifying it, quantitatively changing its condition without full conversion and maintaining it in its condition against natural agents of change.

2.1.4 Agricultural intensification

Agricultural intensification refers to a substitution of inputs of capital, labour and skills for land so as to gain more production from a given area, use it more frequently and hence make possible a greater concentration of production (Francesco, 1999). Intensity is usually measured in terms of output per unit of land or as a surrogate, input variables against constant land (Kangalawe *et al.,* 2007). From various assumptions on land use changes, agricultural intensification has been pointed out as one of the drivers contributing to changes in way land is managed and exploited to meet demands.

Agricultural intensification is an increase in average inputs of labour or capital on a smallholding, either cultivated land alone, or on cultivated and grazing land, for the purpose of increasing the value of output per hectare (Kangalawe *et al.,* 2007). Agricultural intensification may occur as a result of an increase in the gross output in fixed proportions due to inputs expanding proportionately without technological changes, shift towards more valuable outputs and technical progress that raises land productivity. In practice the intensification process may occur as a combination of these, but the relative feasibility of the three components is likely to vary greatly in different areas.

For agricultural intensification to occur there should be an increased demand for output. Increased demand may be through population growth, in-migration or increased market demand in a country or region, or demand for higher value added output such as fruit and vegetables when income per head grows. Agricultural intensification requires labour or capital to enable the increased inputs necessary to raise the value of output per hectare (Grace, 1998).

Agricultural intensification itself is usually conceived of as a positive process; something that agricultural systems should be encouraged towards. However, there may be negative effects of intensification - both in terms of the quantity of livelihoods, and the quality of those livelihoods. Evidence of the increased use of natural or artificial fertilizer, improved seeds, animal traction, mechanization, mixed farming; or series/relay-cropping and changes to the landscape such as irrigation, or soil conservation measures would suggest that intensification occurs. Furthermore, intensive animal production has helped address the fast-growing demand for meat associated with increasing global wealth (Godfray *et al*., 2010).

Additionally, Nicole (2011) demonstrated that excessive nitrogen fertilization depletes soil organic matter, which decreases soil productivity and synthetic Nitrogen efficiency. The introduction of a limited number of high-yielding varieties increased food production but has resulted in the loss of countless traditional varieties available for natural selection and breeding, thereby increasing crop vulnerability to stresses.

2.1.5 Agricultural extensification

Agricultural extensification is the process of introducing production into land areas that were previously unused or used for less intensive purposes. In practice, to meet the demands for food imposed by an increasing population, extensification often involves exploiting marginal lands with resultant degradation and desertification. These terms define the limits of a continuum of land use change resulting from outcomes driven by technology or policy options (Evaristo *et al.,* 2013).

Extensification of farming is the opposite of intensification. It is the process of decreasing the use of capital and inputs (e.g. fertilizers, pesticides, machinery) relative to land area. There is a little difference between the concepts of intensification and extensification. In theory, intensive systems are not only those with a higher output from the same amount of land by means of more input of labour or other resources, but also those with a consistent agricultural production from a smaller plot of arable land (i.e. a relative increase per unit of land) with a constant input of labour. In summary, it can be said that extensification of agricultural activities includes increasing amount of land, equal input of labour and/or other resources, equal amount of land, decreasing input of labour and/or other resources while intensification of agricultural activities includes equal amount of land, increasing input of resources and/or labour and decreasing amount of land, equal input of resources and/or labour

2.1.6 Agricultural diversification

Agricultural diversification is a process accompanying economic growth, characterized by a gradual movement out of subsistence food crops to a diversified market oriented production system, triggered by improved rural infrastructure, rapid technological change in agricultural production, particularly food staple production and diversification in food demand patterns (Francesco, 1999). It is linked to increasing commercialization, marketing and agro food based industrial activities that affect the overall rural economy and to the structural transformation of the economy where the agricultural share of GDP contracts.

Diversification originates from the word "diverge", which means to move or extend in a different direction from a common point. In this sense diversification is the opposite of concentration, therefore, most of the techniques of measuring diversification actually measures concentration in the system (APO, 2004). In economics, diversification refers to a situation in which decrease in the dominance of an activity, alternately increase in the share of many activities in a system is depicted.

Diversification of agriculture means developing a larger number crop or enterprise-mix in favor of high-value and more remunerative enterprises. Diversification is reckoned as an important strategy to overcome the challenges faced by many developing countries. It may be of different forms as supplementing farm incomes with non-farm incomes; increasing the number of crops grown and types of livestock reared; and use of resources in diverse farm enterprises (APO, 2004). The

food basket is diversifying in favor of livestock, fruits and vegetables. In response to these demands, the crop-mix is changing in favour of more commercial crops and from low- to high-elasticity commodities (APO, 2004). To meet these challenges, the production strategy should be to encourage diversification of the production system without sacrificing the basic obligation of ensuring food security.

2.2 Empirical Studies on Land Use Changes in Tanzania

The call for research on historical trend of land use is that by understanding the past, it could be possible to build projections for the future. As the aim of the study, among the land use changes occurring, the most considerable historical change in land use has been the expansion of agricultural lands. Since the start of plant domestication the progression of cropland was relatively slow (Kahsay, 2004). There are studies which have been carried out on land use changes like Majule and Mary (2009); Kangalawe (2012); and Misana *et al.* (2012), in which the expansion of crop land at the expenses of natural vegetation, including forests and shrub lands have been reported.

Land use types identified in central Tanzania by Kangalawe (2009), are cultivated areas, fallow lands, sparse to dense tree cover, open grassland, wooded grassland, severely eroded areas, and sand rivers with fresh sand accumulations, Lake Haubi in Kondoa and its surrounding swamps. The sparse woodland to dense tree cover is defined as areas with more than 40 % canopy cover; wooded grassland having 10 – 40% canopy cover; open grassland having less than 10 % canopy cover and the class called ‘severely eroded areas’ represented areas with bare soil and ⁄ or a

network of gullies (Kangalawe, 2009). Similar literature reveals that a large part of the population in central Tanzania depends on agriculture for its livelihoods. A wide range of crops are grown in the area, and a comprehensive list can be found in Kangalawe (2013). Livestock-keeping has for many generations been an important part of the land use of the study area, with livestock grazing on uncultivated steep slopes and between fields during the rainy season and in the seasonally wet depressions during the dry season. As mentioned above, a major shift in the land-use pattern was the evacuation of grazing livestock from the Irangi Hills in 1979 as one of the soil-conservation measures implemented by Dodoma Region Soil Conservation Project (HADO) to allow for natural vegetation recovery (Kangalawe 2009).

Ngailo *et al.* (2009) who studied land use change in Arumeru Tanzania, pointed out that population change, periodic change of weather and shrinkage of land resources are the main causes of land use change in Arumeru but did not clearly show their relation to agricultural practices. The driving forces of land use change are multifaceted, so there is a need for use of conceptual frameworks and analytical methods that are both comprehensive enough to capture the dynamics of society–environment interactions at different scales, and flexible enough to accommodate the temporal dynamics of these processes (Peter *et al.,* 2010).

It is essential that drivers of land use change processes be studied in reference to the complexity of the human-environment systems within the study area. As such, without dismissing the utility of spatially referenced data to specific research

questions, this study used an approach that provides "socially referenced" interpretations of various kinds of data that assist in characterizing the drivers of land use change for agricultural practices. Such socially referenced interpretations concerned the local interpretation of land use change for agricultural practices via cultural, political and economic relationships that are found in Iramba and Meatu Districts.

Majule *et al.* (2006), on ecological gradients as a framework for analysis of land use changes in East Africa came up with the discussion of ecological gradient to assist understanding the complex interaction between societal and ecological processes underlying land use changes in East Africa. Detailed case on the slopes of Mt. Kilimanjaro show land use change is responsive to the dynamics of both local and external driving forces. The study has shown that distinct ecological conditions at the extremities of gradients are associated with specific land use which may be different within livelihood systems such as for wet and dry seasons grazing.

Lyimo (2008), conducted a study on land use change and livelihood diversification in Usangu Plains, Tanzania. Results show that Usangu plains have experienced changes in land use towards agricultural land use intensification due to high population growth, market demand for rice and impact of liberalization policy. In the study, high population growth rate is mainly due to increased migration of people seeking diverse livelihood opportunities including farm employments and rice production. This has partly contributed to both expansion of agricultural land frontier and agricultural intensification to meet the demand of increasing

population. Similarly, it has been argued that high population growth is a stimulus for agricultural intensification through development and adoption of new technologies (Boserup, 1965).

Additionally, Lyimo (2008), reported that the role of market has been facilitated by policy changes and improvement of infrastructure where roads and railways link the Usangu plains with other market centers. Biophysical factors including presence of river networks, flat terrain, soil types and access to irrigation in the study area have partly provided suitable environment for land use intensification (rice production). Therefore, a clear link for land use change for agricultural practices provides an interest on how similar conditions of Usangu plains might be similar drivers of land use change in Iramba and Meatu Districts.

2.3 Empirical Evidence on the Causes of Land-use Change

Identifying the causes of land-use change requires an understanding of how people make land-use decisions and how various factors interact in specific contexts to influence decision making on land use. Therefore, the following have been identified as the types of causes of land use change.

Underlying causes

These are fundamental forces that underpin the more proximate causes of land use change formed by a complex of social, political, economic, demographic, technological, cultural, and biophysical variables that constitute initial conditions in the human-environment relations and are structural or systemic in nature.

Proximate causes

These operate at the local level (individual farms, households or communities). By contrast, underlying causes may originate from the regional, districts, country or even global levels, with complex interplays between levels of organization. Underlying causes are often exogenous to the local communities managing land and are thus uncontrollable by these communities.

2.3.1 General insights on causes of land-use change

2.3.1.1 Multiple causes

Land use change is always caused by interacting factors originating from different levels of organization of the coupled human-environment systems. Driving forces of land-use change vary in time and space, according to specific human-environment conditions, can be slow variables, with long turnover times, which determine the boundaries of sustainability and collectively govern the land use trajectory (such as the spread of salinity in irrigation schemes or declining infant mortality), or fast variables, with short turnover times such as food aid or climatic variability associated with "*El Niño oscillation"* (Lambin *et al*., 2001). Changes are generally driven by a combination of factors that work gradually and factors that happen intermittently.

2.3.1.2 Natural climate variability

Natural environmental change and variability interact with human causes of land use change. Highly variable ecosystem conditions driven by climatic variations amplify the pressures arising from high demand on land resources, especially under

dry to sub-humid climatic conditions. Natural and socioeconomic changes may operate as synchronous but independent events. When drier conditions prevail, livestock management practices are ill adapted and cause land degradation. This overstocking happened several times in Australia and, in the 1970s, in the African Sahel (Puigdef *et al*., 1998). Land-use change, such as cropland expansion in dry lands, may also increase the vulnerability of human environment systems to climatic fluctuations and thereby trigger land degradation.

2.3.1.3 Economic and technological factors

Economic factors and policies define a range of variables that have a direct impact on the land uses for example, input and output prices, taxes, subsidies, production and transportation costs, capital flows and investments, credit access, trade and technology (Carr *et al.,* 2003). The unequal distribution of wealth between households, countries, and regions determines geographic differences in economic opportunities and constraints. It affects, for example, who is able to develop, use and profit from new technologies that increase efficiency in land use and management.

Agricultural technology as much as providing secure land tenure and giving farmers better access to credit and markets can potentially encourage more deforestation rather than relieving pressure on the forests (Lambin, 2003).

2.3.1.4 Demographic factors

At longer timescales, both increases and decreases of a given population have a large impact on land use. Demographic change does not only imply the shift from high to low rates of fertility and mortality (as suggested by the demographic transition), but it is also associated with the development of households and features of their life cycle (Carr *et al.,* 2003).

As an example of the latter phenomenon, the splintering of family herds in the West African Sudan-Sahel zone over the past 25 years due to increases in nuclear households and the transfer of livestock wealth from herding families to merchants, agriculturalists, and government officials led to increased investment in crop production, reduced labour availability among pastoral households, lowered energy and skills applied to livestock husbandry, and reduced livestock mobility, which increased the risk of land degradation (Lambin *et al.,* 2003).

2.3.1.5 Institutional factors

It is also important to understand institutions (political, legal, economic, and traditional) and their interactions with individual decision making, access to land, labour, capital, technology and information is prearranged by local and national policies (Lambin, 2003). Therefore, policies are important to ensure that local users are able to influence resource-management as many land-use changes are due to ill-defined policies and weak institutional enforcement. Consolidation of landholdings

and the shift from communal, traditional systems to formal, state authorized regimes is a trend observed throughout the developing world (Lambin and Geist, 2007). With increasingly interconnected market forces and the rise of international environmental conventions, the impact of institutional drivers moves from the local to the global level.

2.3.1.6 Social and cultural factors

Numerous cultural factors also influence decision making on land use. Land managers/users have various motivations, collective memories and personal histories. Their attitudes, values, beliefs, and individual perceptions influence land-use decisions for instance through their perception and attitude toward risk (Lambin *et al.,* 2003). Understanding the controlling models of various factors may thus explain the management of resources, adaptive strategies, compliance or resistance to policies or social learning and therefore social resilience in the face of land use change.

2.4 Theoretical Framework of the Study

The theoretical part of this study is based on classical population theory. Many of the concepts incorporated in this study have been adopted from concepts obtained in the theory. Thomas Malthus developed one of the first comprehensive theories of population – land use relationships, Malthus is known to have posited that population growth would lead to famine and eventual population crash since human population grows geometrically while food production increases only arithmetically (Malthus, 1873, cited by Kangalawe, 2012). However, Malthus also stated that,

since the most productive land tends to be used first, as rural population increases, the average quality of new agricultural land brought into production declines.

Classical economists later added to Malthus theory by noting that increased application of labour lead to a fall in output, a theory today known as the law of diminishing returns (Kangalawe, 2012). In response to technological advances, Boserup (1965), presented the notion that population growth should encourage technological change to increase food outputs per unit of land

According to Boserup, as available land becomes scarce relative to labour, farmers will adopt labour intensive land management strategies. She theorized that rural societies under pressure from population growth adopt increasingly intensive land use by shortening crop fallows over time until ultimately; annual cropping (the elimination of fallow) and multiple cropping (more than one crop per year on the same land) are implemented. Other forms of intensification include fertilizers, herbicides and pesticides application will be adopted during later stages in intensification particularly when annual cropping and multcropping are the norm (Kangalawe *et al.,* 2007).

According to Boserup, these responses may be multiphase that is why they may occur stepwise or simultaneously. Migration and lastly fertility reduction are hypothesized to occur after land use adaptation and off farm employment opportunities have been exhausted (Carr *et al.,* 2003). Given our understanding of

theoretical linkage between population growth and agricultural land use in developing world may be applicable for comparison between land use change in Meatu and Iramba Districts central Tanzania.

Land use change is attributed to population growth which is commonly blamed for widespread environmental degradation (Malmberg, 2007). This ascribes to the neo-Malthusian theory that once carrying capacity of the land resources has been surpassed degradation occurs There are however situations where environmental quality has been reported to improve with population growth (Peter *et al*., 2010).

In line with Boserup's (1965) theory of technological innovations with population increase, population growth alone is deficient to explain land use change in nearly all situations rather, it interacts with other underlying factors such as politics and cultural norms and economic condition prevailing in a given geographical location (Peter *et al.,* 2010). Thus depending on the prevailing socio-economic factors and household resource circumstances, farming systems may undergo intensification hence resulting into land use changes for agricultural practices (Malmberg, 2007).

Boserup (1965) focusing on the same issue of population deviates from Malthusian assumption of constant technology by emphasizing the role of high population growth in stimulating land use for agricultural intensification through the development and adoption of new technologies. Under this perspective, agricultural

change is driven primarily by the changing consumption need of the local population due to population growth. Boserup argues that demographic pressure acts as catalyst in compelling farmers to adopt intensification of agriculture. Similarly it has been noted that when land becomes scarce due to in migration, natural population growth or attraction of people to market canters, the desire to increase farm output per unit area and higher population density, compel farmers to intensify (Lyimo, 2008). Therefore based on this theoretical hypothesis which relates land use change for agricultural activities, similar assumptions hold and are important for this study in central Tanzania in Iramba and Meatu Districts.

2.5 Conceptual Framework of the Study

The conceptual framework (Figure. 1) comprises of variables resulting to land use changes indicated by intensification, extensification and diversification of agricultural practices. These variables are the demographic characteristics of the respondents, social cultural factors, environmental changes, economic opportunities, improved infrastructure and institutional initiatives as independent variables. Furthermore effects of land use change to agricultural activities as effects to nature of land owned for crop cultivation and animal grazing, soil fertility maintenance techniques, areas under cultivation and environment and forest production in the study area.

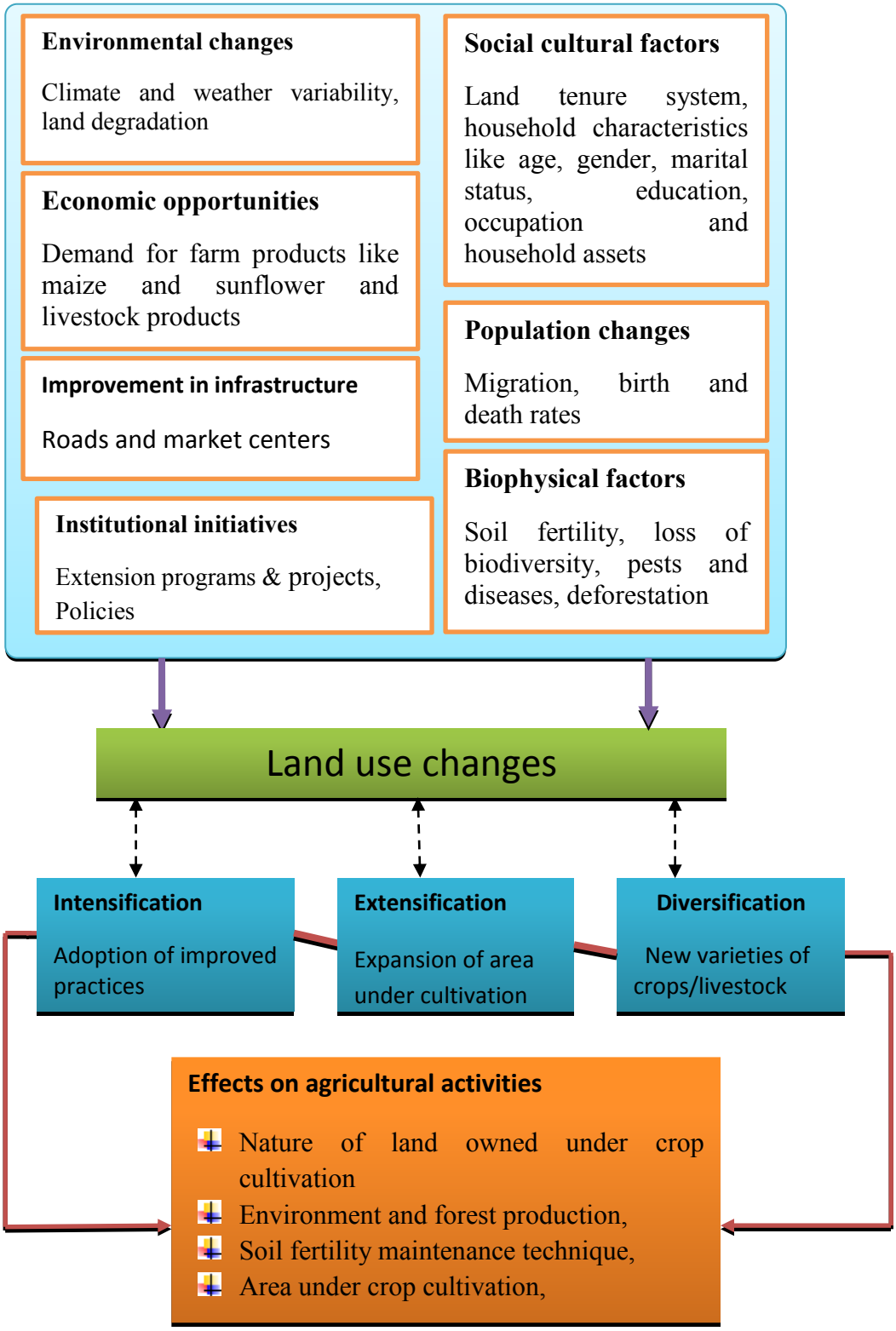

Figure 1: Conceptual framework for the study

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Description of the Study Area

The study was carried out in two districts of Iramba in Singida Region and Meatu in Simiyu Region both in central Tanzania.

3.1.1 Iramba District

Iramba District is found in Singida Region central part of Tanzania mainland. The District has an area of 7900 Km^2 with 17 wards, its administrative headquarters known as Kiomboi is located 100 km north west of Singida town, with a population of 236 282 people where males are 116 997 and females are 119 285 with average household size of 5.4 people (URT, 2013). The District is bordered to the northwest by Shinyanga Region, to the northeast by Manyara Region, to the south by Singida Rural and Singida Urban Districts and to the west by Tabora Region.

The climate of Iramba District is semi-arid with seven to nine months of dry season, lasting from late March to late November (URT, 2009). The mean annual rainfall ranges between 600 mm and 800 mm and the rainfall is erratic and unreliable in terms of both amount and timing. Soils in this District are mainly sandy and loamy of low fertility and seasonally waterlogged or flooded clays. Major soils types are; Ferralic Cambisols, Chromic Cambisols, Gleyic Solonetz, Eutric Vertisols, Haplic Phaeozem, UmbricNitisols, Utric Planosols, Lithic

LeptosolsLuvic Phaeozem and Chromic Luvisols. Major crops grown are: maize, millet, sunflower, sorghum, rice, tobacco, cotton and groundnuts (URT, 2009).

3.1.2 Meatu District

Meatu District is found in Simiyu Region formerly it was part of Shinyanga Region. The District has 25 wards and a population of 299 619 people with 143 569 males and 156 050 females (URT, 2013).

Soils in this District are mainly sandy and loamy of low fertility and seasonally waterlogged or flooded clays. Major soils types are; Ferralic Cambisols, Chromic Cambisols, Gleyic Solonetz, Eutric Vertisols, Haplic Phaeozem, Umbric Nitisols, Utric Planosols, Lithic Leptosols, Luvic Phaeozem and Chromic Luvisols (De Paw, 1984). Major crops grown are: maize, millet, rice, sorghum, sunflower, cotton and groundnuts. The climate of District is semi-arid with prolonged dry season, lasting from late March to late November (URT, 2009).

3.2 Land-use Types in the Study Area

Iramba and Meatu populations have access to various livelihood options, including a mixture of sedentary, semi-sedentary and nomadic groups. Nomads represent a little over one quarter of the population. Mwashata village has good-quality tree cover, and many of the trees have commercial value. Trees are harvested from the forest hills, and the local market demands have recently increased. Many village clusters also include displaced persons and/or immigrants, primarily from northern and western of Tanzania, having moved due to previous droughts experienced in

search of areas for cultivation and grazing. However, currently inhabitants also include people from most parts of Tanzania but many of them are from Shinyanga, Mwanza, Manyara and Dodoma Regions. Agriculture is the principal source of livelihood to these people through the sale crop and some livestock products like milk, ghee, cooking oil.

The sedentary population practices agriculture and livestock keeping as shown in plate 1. Cereals mainly millet, sorghum and maize constitute the bulk of rain fed cultivation. The remains of crops after harvest are later used as feeds for livestock.

Plate 1: Livestock grazing on farms as a land-use type in the study

3.2 Research Design

Since this was a survey research, a cross-sectional research design was applied. The cross-sectional research design allows data to be collected at a single point in one time and used in descriptive analysis and for determination of relationships among variables. The design was favourable because of various reasons especially the nature of the study objectives, which needed data to be collected at a single point in one time by using a structured questionnaire.

3.3 Sampling Procedure

3.3.1 Study population, sampling frame and study units

Sampling is the process by which inference is made to the whole by examining a part. The study covered two districts, the study population was the crop cultivators and livestock keepers and heads of these households were the study units.

3.3.2 Sample size and selection of respondents

The sample size was 122 respondents from the two districts whereas each of the selected villages contributed 25 % of respondents. Purposive sampling was used to select four villages from two Districts of Iramba in Singida Region and Meatu in Simiyu Region of which two villages from Meatu District namely Mwashata and Mwamanimba and two villages from Iramba namely Kidalu and Tyegelo were selected. Villages were purposively selected on the basis of being in the EPINAV Project.

From two sampled villages, sampling frame was all crop producers and livestock keepers. The list of heads of household who are crop producers and livestock

keepers was prepared with the help of village executive officers and hamlet chairpersons from each sampled village. Simple random sampling was used to get respondent from the village, from a prepared list of respondents where 30 respondents were selected from each village,

Simple random sampling is a method of selection of a sample comprising of N number of sampling units out of the population having N number of sampling units such that every sampling unit has an equal chance of being chosen. The procedures used were;

i) Identifying the N units in the population with the numbers 1 to 30 from four villages, ii) Choosing any random number arbitrarily in the random number table and start reading numbers, iii) Choosing the sampling unit whose serial number corresponds to the random number drawn from the table of random numbers and iv) If any random number was repeated, then it was ignored and more numbers were drawn. With this therefore an approximate of 30 respondents came from each village and a total of 122 respondents were selected from four villages in two Districts of Iramba and Meatu.

In case the sample size was not achieved, snowball sampling technique was employed to get additional respondents. This sample size was convenient to obtain the information relevant for the study. A minimum of 30 or 100 case samples is appropriate in accommodating a range of varying sub-populations (Bailey, 1994).

3.4 Data Collection Methods

Qualitative and quantitative methods were used in the study. The qualitative method dealt with multiple realities perceived in the study. In the qualitative research, a focus was on verbal narratives through discussion and observations rather than numbers. Qualitative research usually takes place in naturally occurring situations, as contrasted with quantitative research, in which behaviours and settings are controlled and manipulated (McMillan, 2000, cited by Zafirovski, 2005).

Qualitative research seeks to discover the meaning that participants attach to their behavior and how they interpret situations (Woods, 2006). Qualitative findings grow out of three kinds of data collection: (1) in-depth, open-ended interviews; (2) direct observations; and (3) written documents. At the simplest level, a questionnaire or interview that asks both fixed- choice (closed) questions and open-ended questions is an example of how quantitative measurement and qualitative inquiry are often combined (Masarra, 2012). For the qualitative part of the study data were collected through Focus Group Discussions (FGD), key informants and field observation and narratives from indigenous of the study area had to add supplementary information's needed for qualitative data.

3.4.1 Questionnaire

Primary data were collected using a questionnaire designed to obtain information about the social characteristics of respondents, factors responsible for land use changes and the effects of land-use change on agricultural activities. The

questionnaire was built on the author's literature review and discussions with experienced researchers. Moreover, before the actual data collection, a pretest with 15 rural persons was carried out in Mvomero District for further improvement of the questionnaire. A structured questionnaire with open and close-ended questions was used to collect quantitative data. The survey dealt with livestock keepers and crop producers within the village.

3.4.2 Key informants interview

To obtain information about historical changes in the study area, 16 interviews were held for the whole study with four interviews from each sampled village. Interviews were held with Extension Officers, Village Executive Officers, Hamlet Leaders and Religious Leaders. The information focused on land use change (cultural practices, historical trends and reasons for land use changes). It was found to be useful because in the confined society narration is the only means for documenting such information from generation to generation, and this knowledge may disappear with the death of the knowledgeable elderly persons. Furthermore, key informants were used to give information on various past and present strategies in place for land use change with local government officials, Non-Government officials and extension officers.

3.4.3 Focus group discussions

Focus Group Discussions (FGDs) were used to collect information on the historical trend of land use changes in the study area for objective (i) and objective (ii) on the causes of land use change. In addition, checklists of items for FGDs with

indigenous of Iramba District, residing in Iramba for more than 20 years, traditional leaders, retired employees, famous old people and local government officials were used. Ntongani *et al*. (2009), recommends this technique in explaining how social facts relate to each other in a social system and the way they relate to the natural physical environment. A total of four FGD were conducted in the study area. During the FGDs, the discussants were free to explain what they knew on the historical trend of land use. FGDs in Mwashata had a total of 12 respondents, in Mwamanimba FGD had a total of 10 respondents, in Kidaru FGD had 8 respondents and in Tyegelo the respondents were 7.

3.5 Data Collection Exercise

3.5.1 Primary data

Primary data collection was done through structured and semi-structured interviews with the respondents (crop cultivators and livestock keepers) for objective ii) to identify factors responsible for land use changes in the study area, objective iii) to determine the effects of land use changes on agricultural activities in the study area. Checklists of items for discussion designed for key informants and FGD for objective i) to trace the historical trend of land use change in the study area and supplementary information that were obtained from the structured questionnaire.

3.5.2 Secondary data

These were collected through reviewing various publications and reports, statistics from regional and national offices. Moreover, literature from Sokoine University of Agriculture (SNAL) and the internet were reviewed.

3.6 Data Analysis

The data which were collected were sorted, coded and also summarized before analysis. The analysis was done using the Statistical Package for Social Sciences (SPSS) computer software Version 16.0 and excel in accordance with the objectives of the study ii) To identify factors responsible for land use changes in the study area and objective and iii) To determine the effects of land use changes on agricultural activities in the study area.

3.6.1 Descriptive statistics

Descriptive statistics included means, frequencies, percentages and cross tabulations on individual variables to describe factors behind land use changes in the study area.

3.6.2 Inferential statistics

Ntongani *et al.* (2009) reported that the inferential statistics provide an idea of whether the patterns explained in the sample population are likely to apply to the population from which the samples were taken. Chi-square test was used to test the research hypothesis for objective (ii) in order to gauge associations on causes of land use change and agricultural activities. The equation for chi-square was as shown below.

$$\chi^2 = \sum \frac{(Ov - Ev)^2}{Ev} \quad \text{..... (i)}$$

Where: χ^2= Chi-square

Ov = Observed value, Ev = Expected value

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Socio-demographic Characteristics of Respondents

The summarized socio-demographic characteristics of respondents that were involved in the study include household headship according to sex, age of the respondents and marital status of the respondent, economic activity of the respondent, level of education of the household head, household size and household member support with farm labour. These attributes provide important household social, demographic and economic characteristics which are the basis of production and reproduction.

Table 1: Demographic characteristics of the respondents (n=122)

Variables	Frequency	Percentage
Sex of household head		
Male	100	82.0
Female	22	18.0
Age of respondents		
<30	13	10.7
31-45	35	28.1
46-60	55	45.5
>60	19	15.7
Marital status		
Single	1	0.8
Married	107	87.7
Divorced/separated	3	2.5
Widowed	11	9.0
Economic activity		
Crop cultivation per only	79	64.8
Livestock keeping per only	6	4.9
Livestock keeping and crop production	33	27.0
Employed by the government	3	2.5
Retired government worker	1	0.8

4.1.1 Household headship according to sex

The results in Table 1 show that 82% of the surveyed households were male headed and 16% were female headed. The situation is typical of most countries in sub Saharan Africa (Manyong *et al.,* 2008). According to URT (2006), household is

defined as a single person or group of persons who live together. Usually these are husband, wife and children. Other relatives, boarders and servants are included as members of the household if they were present in the household on the census night.

A considerable difference in numbers between male headed households and female headed households in the study area was due to the reasons that the focus of the study was to heads of the households. At time when females were the heads of households they were either single, widows or separated. This implies that the reported land use change has the significant relationship to the sex of the household head since larger percentage of the households use land for their survival through crop cultivation, livestock keeping and sale of forest products like firewood and charcoal.

4.1.2 Age of the respondents

Age is the most fundamental characteristic of a population. Age structure of the population is a reflection of population dynamics in the past. Age affects the future growth of population and its structure change in the future (URT, 2006). The results in Table 1 reveal that, the majority of surveyed household respondents (45.5 %) were the age group ranging from 46-60 years old, while (28.1 %) were in the age group of 31- 45 years old. The rest of the population (10.7 %) was < 30 year old, and 15.7 % were aged above 60. This shows that all respondents were above 18 years old and capable to respond to questions.

4.1.3 Marital Status of the respondents

In the study, respondents were asked if they are married, single, divorced or were widow/widower. This would indicate how marital status can cause land use changes. Table 1 show that 87.7 % of the respondents were married, 2.5 % of the respondents were divorced, 9 % of the respondents were widowed and only 0.8 % of the respondents were single. This implies that majority of the respondents who are married have larger families compared to the ones who were single and widows which compels them to cultivate large areas in need for food to feed the larger families, necessitates encroaching to unused land because of family members land to cultivate so as to earn a living. Therefore the present land use change in the study area has a significant relationship to marital status of the respondents with married respondents showing that they have contributed to the situation of land use change.

4.1.4 Economic activities of the respondents

Table 1 shows economic activities done by the respondents which were divided into five categories namely crop cultivation only, livestock keeping only, livestock keeping and crop production, employed by the government and retired government worker. Results show that 64.8% of the respondents were dealing with crop cultivation only, 27 % of the respondents were dealing with livestock and crop cultivation altogether, 4.9 % of the respondents were dealing with livestock keeping only and 2.5 % of the respondents were employed by the government and 0.8% of the respondents were retired government workers.

From the sampled population, it was expected that most of respondents would be crop cultivators and livestock keepers. This implies that the majority of Iramba and Meatu district depends on land for their livelihood activities which is also a cause of land use changes. This gives a clear evidence that apart from other causes of land use changes crop cultivation and livestock keeping play a leading role in the study area because crop cultivators have expanded to unused land in search for area to cultivate which has affected livestock keepers resulting into migrating to other areas which there are fewer crop cultivators but with enough space to graze.

The study conforms to Robert *et al*. (2009), who found that education level of the populations affects the rate of technological adoptions mopane worm farming technology in Zimbabwe. Moreover, results conforms to Musamba *et al*. (2011), who found differences of economic activities of respondents which were fishing, crop production, small scale business, formal employment, tourism activities and livestock keepers in Musoma Municipality when studying the impact of socio-economic activities around Lake Victoria to land use changes.

The diversity of economic activities in the study area indicates the need for more land to accommodate various land uses and the need for space to dispose wastes generated from these economic activities something which was not the case with Meatu and Iramba Districts. The need for more land is the same to that of Iramba and Meatu Districts where crop producers have small area useful for crop cultivation and livestock keepers have no area to graze their cattle resulting into higher expenses of hiring land for crop cultivation and migration of livestock

keepers to regions that are thought to have enough area to cultivate crops, to graze cattle in Mbeya, Rukwa and Tabora.

4.1.5 Level of education of the respondents

In Table 1, levels of education of the respondents was primary school 70 % followed by those who did not go to school (18 %), secondary school education were 9.8% and only few with 1.6% only with college level of education. Levels of education attained were primary school, secondary school, college and did not go to school. This is a typical situation of most rural area of Tanzania where people of lower level of education are found in rural areas practising agriculture while the educated ones are working in professional and salaried employments in urban areas. Higher average percentage 70.0% of respondents with primary education and 18.8 % of the respondents who did not go to school imply that there are few people with environmental and agricultural knowledge to enable them know how to practise their agriculture while making sure that the environment is also safe for future use, hence resulting into deforestation, cultivation of larger area with the expectations of high returns without considering other factors like rainfall, fertility and periods of farm predations.

This has subsequently acted as disincentive to rural people of which its effects are the deforestation, lack of and low participation of rural people on conservation programs, over exploitation of land resources, land encroachment and conversion of grazing land into other land uses and general poor land use practices. It can be established that, land use change is the consequence of making land use values

unknown due to a marginal level of education attained by people of Meatu and Iramba Districts. Similar findings were found by Musamba *et al*. (2011), who found that the level of education to be significant on the prediction of impacts on Lake Victoria (p=0.00) and negatively correlated with the level of impact on Lake Victoria. Musamba *et al*. (2011), portray that marginal decrease in education level has impacted the Lake Victoria negatively by a multiplicative factor of 0.71. Therefore education level of sampled population implied that the present land use change and its effects have been due to the levels of education attained.

The information from FGD revealed Mwashata, Mwamanimba, Kidaru and Tyegelo are located in areas where there were limited education facilities hence leading to most people having a primary level of education. The results correspond to that of Hardley *et al*. (2009), who reported that education is important parameter regarding to human capital for reducing inequality and poverty and laying the foundation for sustained economic growth, effective institutions and sound governance.

4.1.6 Household size and household members support with farm labour

Household size in this study was established by considering all groups of persons who usually eat and share some common living arrangements. Table 2 show that 51.6 % of the households had an average of 6-10 people, 24.6 % of the households had an average of 1-5 household's members, and 14.8 % of households had an average of 11-15 people and few households had an average of 5.7 % with 16-20 household members and 3.3% with 20-25 household's members.

Table 2: Household size and household member support with farm labour (n= 122)

Variable	Frequency	Percentage
Household size		
1 – 5	30	24.6
6 – 10	63	51.6
11 – 15	18	14.8
Above 15	11	9.0
Household members support farm labour		
1 – 2	19	15.6
3 – 5	74	60.6
6 – 8	29	23.8

An indication of having more than 6 household members which was found to be more than half of the sampled respondents can be translated to increased populations, increased human settlements as observed in the study area during this survey, this observation is also supported by Ndibalema (2010), cited by Kwaslema (2013), who reported loss of habitats for birds to agriculture expansions. Noe (2003), observed the shrinkage of size of Kitendeni wildlife corridor in Kilimanjaro National Park to about 5 km^2in 2001 from 21 km^2in 1952 and the main reasons were cropland expansions and human settlements and land use changes, generally the same threats operate in Kidaru, Tyegelo, Mwashata and Mwamanimba Villages.

From the interviewed households results in Table 2 show that 73 (59.8 %) households had 3-5 people who support farm labour, 29 (23.8%) households with 6-8 people support farm labour and only 20 (16.4%) household had 1-2 household members who support farm labour of which the household head was inclusive. It

was seen from the sampled households that most households had members who can support them in farm labour and those who did not have house members supporting them in farm labour were found living with people too young to work in farming activities.

4.2 Historical Trend of Land use Change in the Study Area

Key informants were interviewed on the Historical trend of land use change and later FGDs were held with other respondents who were not the key informants to trace the historical trend of land use changes in the study area. The objective the two exercise was to get a historical trend of land use change accompanied with traditional factors considered to have influenced the present land use in terms of size, types of crops grown and ownership of land in the study area and behaviour of indigenous residents of the study area to the influence of land use change for agricultural practices and time lines explanations on the scenario of land use change in Mwashata, Mwamanimba, Kidaru and Tyegelo villages. Furthermore, key informants were asked whether there are various land use projects in the study area. All these aimed at getting to know the historical trend of land use change and the root causes. Information given was in form of narratives, estimated quantity and others were observed directly by the researcher from the field.

Historical trends show changes from one year to the next and, therefore, provide a good means of tracking longer-term changes. This method can stimulate a valuable discussion about the speed and extent of positive and negative changes, why a situation is as it is and why different groups or individuals hold the views they do.

The purpose of this method is to obtain a historical understanding of sequential changes that have occurred, relating to particular points of interest. However, it only provides general insights and details need to be validated. When asked about the historical trend of land use changes in Mwashata village FGD participants categorized land use changes in the following phases

4.2.1 From 1970s to 1990s

Respondents reported that the village had small area of coverage with fewer numbers of people; also livestock keepers were few with large herds. Cotton production by this time was the main activity of the people as it was championed by *Kilimo Cha Kufa na Kupona* during villagilization period under President J. K Nyerere, few people could afford the use of animal power in farming activities. Land tenure system was flexible as every individual who needed land could at least get a plot to cultivate. Despite small farm sizes, a lot was harvested from the farm, FGD participants clarified that;

> *"If one decides to use a certain piece of land has to notify others on the use of place by inviting them to share a drink and food, this is how we were doing"*

Soil erosion caused by the moving livestock; grazing areas were enough for livestock keepers as one could own up to 200 cattle and get a place to graze them, FGD participants from Mwashata village clarified that;

> *"By those days I was still young in the age 20's and I was living with my parents in Mwakasumbi village where we had a lot of cattle and by this*

time pasture wasn't a problem, only wild animals were a threat to our cattle. One could graze in any place that was free except in reserved areas."

It was reported that, agricultural production was high as one could get 15 to 20 bags of maize per acre without using pesticides or fertilizer and weeding was only once.

A similar scenario was in Iramba District as FGD participants reported that, by that time millet was a staple crop and there was plenty of it, the population was also small compared to present and owners of cattle were there though not many and the rain season was once a year from November to April, land for agricultural activities was enough and by during that time river Ndulumo was not there it just came in recent because of the heavy rains in the northern part of Tanzania which carry water to into valleys and slopes of Iramba. By this period food crisis was less compared to the current time. FGD respondents from Tyegelo village confirmed that;

"By 1970 crop cultivation was a must activity, though the village had very few people, the primary school here (Kidaru primary school) served people of Tyegelo, Kidaru, Ndulumo and other neighboring villages"

4.2.2 From 1990s to 2000s

In Meatu District FGD participants reported that cases of food insecurity were there and it was the time when the government brought food aid to the people, the problem was in the whole region because of drought which affected most food crops. By this time rainfall was a problem which resulted in crop failure, death of

livestock because of lack of pasture. Most livestock keepers had to migrate to areas which were thought to have rainfall and pasture. From then, the number of livestock in Mwashata and Mwamanimba started declining since the land for livestock keeping had decreased. This happened because of the increasing number of people to needed to use the land under crop cultivation. It was reported that, within a period of about five to ten years people who engaged themselves in crop cultivation increased because some had to start mixed farming rather than depending on a single activity thereafter changing from pastoral land use to mixed farming, this resulted to diversification of the land use.

A different scenario was reported in Iramba District as this period experienced a lot of pastoralist's immigrants from the west and north of Iramba. By this time food insecurity among the Iramba people was common and it is also the same period when the government food aid was brought to the people. The population doubled, land degradations came as people had to clear forest for large farms, for building materials, soil erosion on hilltops was common since the increased number of livestock with tremendous changes in land uses being noticed but notably being expansion of farmland, shifting cultivation, lowland farming and putting former grazing areas into cultivation started.

Worse still, land became scarce and issues of land renting started with one NKWA (traditional name for 15m wide and 100m length farm size) for 2 000 Tsh. Before 1990s land was a free asset and access to and use of land for crop cultivation was of communal style.

Because of the changes farmers have to travel long distances in search of additional land. While they sometimes manage to purchase these distant parcels, increasingly others rent. While close to some households, these formerly communal lands are often many kilometers away. As they travel long distances, farmers, pressured by a growing population, also move onto marginal lands traditionally thought to be unproductive or too fragile for seasonal cropping.

Increasing cultivation of marginal lands and their subsequent degradation is a phenomenon common to densely-populated countries around the globe (Gregersen *et al*., 1992). Sometime, farmers leave these marginal lands in forest, pasture, or under long-fallow cultivation. Increasingly, farmers now use most of land to produce annual food crops specifically maize, sunflower, sorghum and paddy for both food and income needs.

4.2.3 From 2000s to date

During this period, there are high demands for food due to growth in population while environmental degradation is wide spread. There are various agricultural and environmental development projects being implemented, in Meatu District Investing on Children and their Society (ISC) which is a Non-Government Organization has projects on value chains development and agribusiness with the aim of enhancing production for sale, modern farming practices, use of pesticides, use of chemical fertilizer, forming farmer groups, loans on agricultural inputs. Implementation of the project has resulted in improved access and use of fertilizers, pesticides and good varieties of seeds on loans basis which is repaid during the harvesting period.

Also, Hifadhi Mazingira ya Shinyanga (HASH) which aimed at reforestation and environmental protection has managed to plant drought tolerant trees in most parts of the district of which Mwashata and Mwamanimba are have greatly benefitted.

Moreover, EPINAV which is being implemented by Sokoine University of Agriculture on climate change and Lake Victoria Environmental Management Project (LVEMP) aim at protecting and conserving Simiyu River. These projects have been implemented to rescue the situation of land degradation, food insecurity, climate change which are typical land use change indicators.

In Mwashata hiring land is expensive compared to Mwamanimba as one acre is rented for 30 000/= Tsh per growing season but in Mwamanimba one acre is rented at 20 000/= Tsh per growing season. One of the respondents explained that;

> *"In years past if you had no enough area to cultivate, you could ask from a neighbor and would give you where to cultivate at no cost, but these days where everyone needs to cultivate for different purposes like food and sale, you have to hire land at a cost of which even the farm remains after harvest are yours as you can bring your cattle to graze in that farm for some days"*

Grazing areas in Mwashata, Kidaru and Tyegelo are few and this has resulted into reduced number of cattle. But in Mwamanimba grazing areas are hired and a contracts on how grazing will be made is agreed. A respondent in FGD reported that;

> *"If I have a plot of land that has grasses which cattle can feed already this is wealth..... because if you cannot move your cattle to other areas that have pastures like in Tabora and Singida therefore one should be able to pay for the place to graze, one gives money and you are given a place where your cattle can graze for at least one to two weeks"*

It was reported that, the village government of Mwamanimba has a place used for renting to people who need to graze their livestock during rainy season; the project is profitable to the village government as it has a lot of customers. This shows scarcity of land for grazing which has resulted to lot of people migrating to other areas.

By tracing the historical trend of land use change in the study areas, personal cross-checking on the use of land were also made and happened to interview one of the village respondents from Tyegelo, the conversations were based on how land is being used by specifying the location of uses, field type uses and the reasons for such uses. A respondent responded as shown Table 3.

Table 3: Land uses for Mr. Shango who is a retired teacher (Tyegelo village)

Location	Field Type	Rationale
In close proximity to home	Livestock houses (cattle, goats, sheep, chicken, pigs)	Well-located for milking in morning and evening. Allows monitoring of livestock for regular chores such as spraying and cleanliness
Middle distance away from home	Maize, beans, sorghum	Easy to transport the harvest, residues are used by calves as feeds after harvesting, making sure the land is utilized
Away from home	Millet, paddy, maize and sorghum, sweet potatoes and livestock grazing area	Crops don't need a lot of inputs, but provide good cover for hillsides prone to erosion. Sweet potatoes in particular attract a lot of mice so it is preferred that these are not grown close home
Boundaries	Planted trees	Tree crops in particular are used to mark out boundaries.

The key informants reported that the dynamics of land use changes were evident even prior to this period. They narrated that the natural resource situation during the 1970s was better than the latest decades despite drought conditions in the 1950's and 1960's. During these decades, the human population was lower, and agricultural land was properly used by local people. Consequently, there was a long fallow period ranging from 5-10 years and agricultural productivity was generally

high. Therefore, the rate of land degradation in form of soil erosion, deforestation was low and soils were more fertile in comparison to present. The key informants also mentioned that during those decades there was an effective mechanism for conflict management between farmers and herders regarding issues of land use. Since when the effects of droughts were experienced in the early eighties, agricultural productivity decreased, local people cleared forests and food deficiencies occurred, human and animal populations increased due to human and animal migration from neighboring regions of Mwanza, Manyara and other neighboring regions.

It was narrated that food aid was introduced to the area by government from 2000 in Mwashata, Mwamanimba villages of Meatu Districts. Similar situation was in Kidaru village as people have been receiving food aid from the government and World Vision for more than 10 years because of increased frequency of hunger, crop failure due to shortage of rainfall.

The key informants also mentioned that the years 1983-1985 were periods of severe droughts as well as 1988, 1993, 1996, 1998, 2002 and 2007, which were also severe. As due to recurring droughts, and food insecurity, human and animal populations began to concentrate in areas which were not used, and this led to land resource degradation in recent decades. Key informants narrated that the degradation of land led to lower crop productivity, lack of edible grazing species and a delayed regeneration period, and this resulted in decreased soil fertility. However, as a result of land degradation, land-use patterns changed in terms of

over cultivation without a fallow period, overgrazing and overcutting of trees for fuel and charcoal for market purposes, agricultural expansion and building materials.

Meanwhile, key informants identified that number of cattle which were kept by people in the villages has decreased tremendously and most of the livestock keepers have shifted to other regions with sufficient pasture for their cattle. In addition, few household use hand hoes in their farming activities, as many use drought animals of which two out of five households have a pair oxen for farming purpose. Also in responding to soil infertility, key informants identified that some people have opted for the use of improved crop varieties specifically for maize where PANNAR, SEEDCO are used. There has also been shift from cotton production to millet, maize, sorghum and sometimes sunflower because these crops are used as food and at same time are used for commercial purpose an advantage which cotton lacks.

4.3 Drivers of Land use Changes

Causes of land use change are categorized into immediate and underlying causes of land use changes. Immediate causes are those which directly cause land use changes while the root causes are those which drive the process of change. The immediate cause includes changes in livelihood strategies, expansion of agriculture and settlements, encroachment and availability of markets for agricultural products in the study area. The root causes include changes in resource management responsibilities, demographic factors, and government policies, economic, environmental and institutional factors.

4.3.1 Immediate/proximate causes of land use changes

4.3.1.1 Changes in people's livelihood strategies

Iramba and Meatu residents depended on crop production and livestock keeping for long period, a type of land use that co-existed with other activities. Millet, maize and sorghum were the common food while cattle keeping provided milk. With the decline of livestock production resulting from long periods of drought, limited pasture and outbreak of cattle diseases in the 1980s people of Meatu and Iramba Districts were forced to diversify their livelihood strategies. The immediate solutions were to adapt from in-migrants, migrate to other areas area which resulted into reduced number of livestock and more concentration with crop production. Similar situation was found to be the reason for land use changes in Kilimanjaro (Noe, 2003). This led to land use change from livestock grazing to crop production.

4.3.1.2 Extension into unused land

Previous findings have shown that there has been encroachment into unused land for grazing, crop cultivation, and wood and non-wood products like poles for house building, timber and fodder. In Table 4 about two third (63.9 %) of respondents reported prevalence of drought for long periods of time as the factor which made people to go for unused land, 32% reported need for food as the driver for encroachment and only 3.3% of the respondents did not know the reason. According to respondents the major reasons given for encroachment was the prevalence of drought for long period of time and food scarcity in Mwashata, Mwamanimba, Kidaru and Tyegelo villages respectively.

Table 4: Reason for encroachment into unused land (n=122)

Variable	Frequency	Percentage
Food insecurity	39	32.0
Prevalence of drought for long period of time	78	63.9
Don't know	4	3.7

A study by Madulu (1996), cited by Majule and Mary (2009) reveals that the climatic conditions of most of the semi-arid areas of Tanzania are characterized by short and unreliable rains, which restrict the suitability of the land. Therefore, majority were able to tell that prolonged dry conditions have been a problem forcing them to use land which was unused for crop cultivation, animal grazing and other human related activities. Also more frequently, farmers reported experiencing long dry spells and drought, leading to low yields or total crop failure.

4.3.1.3 Increase of area under crop cultivation

It has been observed in the previous sections that agriculture has been expanding at the expense of other land uses. As shown in Table 5, 61.5 % of the respondents reported to have increased area under crop cultivation. Due to expansion, cultivation was extended to mountain, areas which were used for grazing and even to the Maswa Game Reserve area. There has also been expansion of agriculture into river beds in the study area as it was reported that there are people who cultivate across the beds of Simiyu River in Mwashata, Meatu District also similar situation is happening in Tyegelo village in Iramba District where cultivation of river of Ndulumo River beds happens. This explains the reasons for reduced size of Maswa

Game Reserve and reduced area for animal grazing in Mwamanimba and Mwashata villages.

The responses show the size of land they have been using for cultivation for the last 20 years. In the study area 54.1 % of respondents reported that their farm size in the past 20 years ranged 0-5 acres of which 27.9 % reported to have used 6-10acreas, 11.5 % respondents used 11-20 acres, only 2.5 % respondents reported to have been using 21-40 acres of farm land and finally 3.3% respondents reported to have used 41-70 acres of farm land in the past 20 years. In comparison to the current use of land for farming activities similar question was asked to the respondents as to what size of farm do they use for agricultural activities in acres non-irrigated crop land and 49.2% respondents reported to be using 6-10 acres of land which is an increase in comparison to the past 20 years. Other responded as shown on Table 5.

Table 5: Increase of area under crop cultivation (n=122)

Approximate Size of crop land (acres)	**10 years ago**		**Currently**	
	F	**%**	**F**	**%**
1-5	66	54.1	10	8.2
6-10	34	27.9	60	49.2
11-20	14	11.5	34	27.9
21-40	3	2.5	16	13.1
41-70	4	3.3	2	1.6

4.3.1.4 Reasons for increase in areas under crop cultivation

In the study area the reasons for increase in area under crop cultivation were pointed out as follows:

Increased use of draught power in farming activities; respondents were asked on what type of power do they use in farming activities, Table 6 shows that almost all (96.6 %) of the respondents reported use of drought power in farming activities, followed by use of human labour at an average of 88.6 % of the respondents. With these findings majority uses draught animals followed by human labour and very few uses tractors and power tillers. The study conforms to Nazaire *et al.* (2013) who proposed use of draught power as the strategy of improving agriculture in Tanzania and found increased areas under agriculture. This has been one of the great reasons as to why people have to increase their farm size because there is reduced use of hand hoes and an increase in use of draught animals.

Table 6: Types of power used in farming activities (n=122)

Type of power	Not used		Moderately used		Mostly used	
	F	%	F	%	F	%
Use of human labour	0	0	41	33.6	81	66.4
Use of tractor	72	59	40	32.8	10	8.2
Use of drought power	0	0	13	10.7	109	89.3
Use of power tillers	94	77	28	23.0	0	0

Family sizes have increased, need for more food and income: A number of respondents reported that expansion of area under cultivation has been due to increase in family size and need for more food and income as shown in Table 7 with an average of 47% of the respondents reported that increase in number of household members, need for food and income was the reason for expansion of area under cultivation in the study area. The study relate to Musamba *et al.* (2004), who reported population increase to have resulted into agricultural intensification in Maasai Mara in Kenya hence affecting the natural ecosystem on which wildlife depends for their survival. This has been the case with natural forest found in Iramba and Meatu. The analysis here focuses only on the respondents who reported need for more food, income and increase in household size as their reason for expansion of their areas under cultivation in Mwashata, Kidaru, Tyegelo and Mwamanimba villages.

It is generally accepted that the relationship between per capita incomes and caloric availability is positive. The relationship is further characterized by a calorie–income elasticity that is inelastic, meaning that a 1 % increase in income (measured at the mean) is associated with a less than 1 % increase in calories, causality issues aside (Karl and James, 2010). The same is true for Iramba and Meatu Districts where increase in household size necessitates increased areas under cultivation to address the need for more food to feed the household members.

Table 7: Reasons for increase in areas under crop cultivation (n=122)

Reason	Frequency	Percentage
Family size increase, need for food and income	58	47.5
Small areas produce little, rain shortage and areas are settled	43	35.2
Decline of soil fertility, good prices of agricultural produce hence a motivator	38	31.1

This has resulted into number of people to use large areas of land for cultivation with expectation of getting higher yields. Also respondents reported that cultivating large area reduces the risks of loss after harvesting because one can cultivate a small area and when rainfall does not fall they can lose everything, therefore cultivation of large areas is used to avoid loss which might occur. As shown in Table 7, all most half 47.5 % of respondents reported an increase in the area under crop cultivation, 35.2 % reported that small area under cultivation produces little returns; it was their perception which drove them to use large areas of land for crop cultivation. In this regard, there are a number of other reasons which make people perceive that way which include lack of training on proper farming system while majority of the respondents had primary level education and others did not go to school, this has a relationship to the way they perceive the natural world.

In the study, almost all farmers use more than one plot for crop production with the aim of avoiding crop failure risks resulting from rainfall variability and drought. It was found that staggered planting is very common where crops are planted before rain onset (dry land) on uncultivated land. Others plant immediately after rain, and

other plots are planted a few days after the first rains. It is similar Majule and Mary (2009), that farmers plant their seeds on uncultivated land due to fear of rainfall and drought conditions in central Tanzania Tilling the land starts in fields which were planted prior to cultivation on the third week after the onset of rains which according to key informant enables to destroy early geminating weeds and reduces weeding costs.

These are done purposely to distribute risk by ensuring that rain is utilized to the maximum by the crop planted in dry field. Moreover, study results fit with Majule and Lucumay (2009), on impacts of climate change, variability and adaptation strategies on agriculture in semi-arid areas who found proper timing of agricultural operation, crop diversification, use of different crop varieties and changing of planting dates existing as a strategy against rainfall unpredictability. Kangalawe (2009) found land use changes because of changing rural livelihoods on which rainfall determines agricultural performance for most of households who use it as their base for survival. It was reported that land is scarce in the village therefore people have to struggle to get land for crop cultivation by renting which is also expensive, because people assume that cultivating large area reduces possibility of incurring higher costs of renting, draught animals and weeding in the next growing season.

Respondents reported decline of soil fertility hence cultivating large area of land so as to obtain the amount of yield that will sustain their survival, hence households owning large areas of land under crop cultivation the study conforms to Ward

(2013), who found such an increase of land used for crop cultivating in south Africa and reports that the phenomena are common to typical farmer's society where their entire livelihood depends on agriculture which results to competitions for farming areas during agriculture seasons.

Table 8: Changes of area cultivated for past 20 years (n=122)

State of crop land	Frequency	Percent
Increase	75	61.5
Decrease	22	18.0
No changes	25	20.5

Apart from an increase in area under crop cultivation, some of the respondents reported decrease of area under crop cultivation where by 18 % as shown in 8. The reason for the decrease was expenses of hiring land during the farming season and scarcity of the land; most of these people are living in areas where there are alternatives in earning a living other than agriculture and most of them came from Dugusilu hamlet in Kidaru village, Amani hamlet in Tyegelo village and Mwabayanda hamlet in Mwamanimba village, in these areas there are small business on which residents are engaged. Respondents reported to have decreased their land use for crop cultivation because they started doing other activities after crop production has proven failure while they have invested a lot. They reported practices business, buy food and livestock keeping. Table 8 show 20.5 % of the respondents reported that there are no changes in farm size used for crop cultivation.

4.4 Determining Factors for Household Decisions on the Farm Size for Farming Activities in any Season

During the study, respondents reported to have decreased areas under crop cultivation and some did not witness changes in size, in this regard number of reasons was given by respondents as follows

Table 9: Factors which determine decision on farm size

Variable / factor	**Not at all F& (%)**	**Moderate important F& (%)**	**Very important F& (%)**	**Chi square value**	**Asymp. Sig**
Favorable climate	19 (15.5)	43 (35.2)	60 (49.1)	62.082	.040
Family size	11 (9.0)	48 (39.3)	79 (41.0)	2.623	.049
Presence of labour	4 (3.3)	32 (26.2)	86 (70.5)	85.443	.000
Adequate land	7 (20.5)	51 (41.0)	64 (38.5)	43.885	.000
Affordable price inputs	2 (1.6)	19 (15.6)	101(82.8)	137.820	.000
Adequate storage facilities	60 (49.2)	43 (35.2)	19 (15.6)	20.869	.000
Reliable capital	27 (22.1)	49 (40.2)	46 (37.7)	7.00	.030
Adequate extension services	15 (12.3)	22 (18.0)	85 (69.7)	73.098	.000
Infestation and outbreaks of diseases	31 (25.4)	38 (31.1)	53 (43.4)	6.213	.045
Stronger producers organization	70 (57.3)	31 (25.4)	19 (15.5)	2.279	.070
Price fluctuation of agricultural produce	50 (41.0)	49 (40.2)	23 (18.9)	11.525	.003
Distance to the farm	21 (17.2)	47 (38.5)	54 (44.3)	14.869	.001

*Significance level at 95%

4.4.1 Adequate land and affordable price of agricultural inputs (seeds, pesticides and fertilizer)

Farm size for crop cultivation is a good determinant of quantity of produce if other factors remain constant, agriculture being a source of food for the fast-growing population, raw materials for agro industries, foreign exchange for the country, and employment for the majority of the rural population (URT, 1997). Findings as shown in Table 9 shows 82.8 % of the respondent reporting affordable price of seeds, fertilizer and pesticides as a determining factor for the size of land used for crop cultivation with a chi-Square value of 137.8 which was highly significant at 0.00 % ($p \leq 0.05$). Despite these problems, crop cultivation is still the main economic undertakings of the people in Mwashata, Mwamanimba, Kidaru and Tyegelo villages. On the other side, land scarcity, increasing aridity, lack of agricultural tools and inputs, high prices of inputs, loss of soil fertility and unpredictable weather as well as crumbling productive infrastructures feature prominently. Productive infrastructure includes lack of pesticides for cotton which is the commercial crop.

4.4.2 Climate change and variability (rainfall specifically)

Tanzania possesses a complex landscape, formed by the western and eastern branches of the East African Rift Valley, resulting in substantial spatial variability in climate. The country's climate varies from tropical at the coast to temperate in the highlands. As shown in Table 9 about half (49.1%) of the respondents reported climate (rainfall) as a determining factor for decision making for the farm size with a chi-square value of 62.082 which was significant at 0.04% ($p \leq 0.05$). The

perception given to climate change by farmers was on rainfall and prolonged period of dry season. The study conforms Majule and Lucumay (2009) who reported that a shortening of the rainy season and more frequent dry spells exists in central Tanzania.

Respondents indicated changes in rainfall seasons and pattern, temperature increases in some areas than they were before and prevalence of extreme events such as floods and drought. "*Some areas can have the whole year without rains, and when the rains come it is not at the usual time as expected*" (FGD participant). Farmers use these scenarios to decide on the size of farm land. Similarly the study conforms to Mbilinyi and Ole (2013), who reported that climate change has been an obstacle to small scale farmers in Muheza Tanzania where droughts and dry spells are more frequent, rain is inconsistent, and torrential downpours are heavier and higher temperatures increase the evaporation of soil moisture.

4.4.3 Infestation, outbreaks of diseases and adequate storage facilities

As it is shown in Table 9, 43.4% of the respondents reported infestation and outbreaks of diseases as a very important factor and 31.1% reported to be moderately important factor determining factor for farm size in any growing season and a chi-square value of 6.89 which was significant at 0.049 % ($p \leq 0.05$). In Iramba District, weevils, birds, stalk borers, large grain borers, and vermin such as rodents, monkeys and wild pigs were reported to be prevalent though not in all seasons.

In Meatu District the crop pests reported were cotton strainers, cut-worms and armyworms. Also rodents, armyworms, bollworms, stalk borers, larger grain borers and leaf hoppers were reported to be a factor for guiding their decision of farm size. It should be noted, however, that though these pests were mentioned by some farmers, it does not necessarily imply that these pests were completely absent from the area in the past. The study conforms to Kangalawe and Lyimo (2013), who reported that there is an increase of crop pest in Shinyanga Rural District and Manyoni District both of central Tanzania which has resulted in decreased maize and cotton production in recent years.

Also, some reported adequate extension services as determining factor with 69.7% reporting that is was a very important factor and 18% of the respondents reporting that a moderate factor with a chi-square value of 73.093 which was highly significant at 0.00% ($p \leq 0.05$). It was reported so because most of the farmers who were interviewed cultivated cash crops mostly sunflower therefore extension officers are very important to farmers view hence used as a guiding factor for farm size.

4.4.4 Price of agricultural produce and distance to the farm

As shown in Table 9, distance from the farm to market and the price of agricultural produce have significant positive effect on the decision on farm size of respondents in Iramba and Meatu where 18.9% reported price of agricultural produce a very important factor and 40.2% as their moderate determining factor with a Chi-Square value of 11.525 which was significant at 0.03 ($p \leq 0.05$). While it is true that most cash crops earn better prices in markets far away from the production area

(probably the urban markets) where demand is higher compared to the market within the vicinity of the farms, with distance to the farm as a determining factor, 44.3% of the respondents reported being a very important factor and 38.5% reported it being a moderately important factor.

Furthermore, a Chi-Square value of 15 which is significant at 0.01% ($p \leq 0.05$) signifies how distance from the farm to market is an important factor in determining the decision on the size of farm. These findings are consistent and in line with the finding of Mwangi *et al*. (2013) that the value of farm produces significantly determine the diversification decision among farmers and enable them to grow various crops which may require extensive areas of coverage. Moreover, Barrett (2008), argues that well-integrated markets that transmit excess supply to distant locations encourage household market participation.

On the other hand the study conforms to Evaristo *et al.* (2013), who found most of the agricultural land concentrated along road networks whereby people tend to expand their farms by acquiring adjacent unoccupied land. This implies that land for agricultural uses decrease with increased distance from road networks while forests on the other hand increase with increased distance from road networks. Similar results were found by Evaristo *et al.* (2013). Forests in most cases are adjacent to grassland which helps minimizing forest clearance for agricultural use.

4.4.5 Reliable capital and stronger producer organizations

In Table 9, reliable capital to farmers imply access and use of required technology, use of labour, farm inputs, enough land and the whole ability of the farmers to invest in crop cultivation at a required time. In Meatu District land use for crop cultivation is dominated by cotton, maize, sorghum, millet. Farmers reported the need for enough capital for cotton cultivation with a consideration of the crop being so expensive to manage, an average of 37.7% of the respondents reported reliable capital to be a very important factor which determines their farm size with a chi-square value of 7.00 which is significant (P=0.05).

Similar response was attached to the level of difficult of farm management practices reported that farmers avoid cotton production because of the management costs involved as 66.4% reported that easiness to manage is a very important factor to decide what farm size to cultivate and plant with a chi-square value of 62.08 highly significant (p = 0.05). At the same time, producers organisation as a non-determining factor for land use farm size for crop cultivation with only 15.5 % of the respondents reporting as a very important factor and 57.3 % reporting it as a non-determining factor with chi-square value of 2.279 insignificant (p = 0.05) showing a non-significant association of strong producer organisation and decision on farm size.

The above finding is contrary to Ndalahwa (1998), who found the Sukuma to have a local history of well-organized neighbourhood group collaboration in work and organized at village or sub-village levels which constitute an important labour

source. Abrahams argues that, agricultural cooperation between neighbors takes place mainly through (*malika*) a vernacular to mean a team for working, the medium of local cultivation and threshing which do the work for individual members of the team in turn. This finding of study is contrary to Mwaseba *et al.* (2009), who found empowerment among farmers groups perceived as the process of acquiring new knowledge, acquiring resources, participating in decision making and of being able to hold development organizations accountable and increase in self-confidence. This is a different scenario of Iramba and Meatu of where findings show producers organization have no role as the guiding factor to the size of farm used for crop cultivation. Therefore, the role of farmer's organizations is more likely to occur where there is a long-term collaboration between farmers themselves, and where the relationship is built on the basis of equality, partnership, and mutual respect.

4.5 Underlying Causes of Land use Change

Root causes of land use changes may be grouped into such major categories as demographic, economic, institutional (policies, politics), and social cultural factors. These factors, either independently or in complex combination, may have altered and or changed resource use pattern that may have culminated into changes in land use in the study area.

4.5.1 Demographic changes

Demographic change, through birth, death and migration form the basis for explaining land use change and resultant effect on agricultural practices. Mwashata,

Mwamanimba, Kidaru and Tyegelo villages were inhabited way back in 1920's before the official registration of the villages. At that time, human population was very low and pastoralists had many cattle since pasture was present.

Population density of Meatu in 1957 was 2 people / km^2 and changes occurred where in 1967 it was 14 people / km^2, in 1978 it was 22 people / km^2 and in 1988 it was 27 people / km^2 (URT, 2007). Also demographic statistics of 1988, 2002 and 2012 as shown in Table 10, show a tremendous increase of population in Iramba and Meatu Districts over the period. Moreover the population of Iramba District as in Table 10 currently is 236 282 people where males are 116 997 and females are 119 285 and the population of Meatu District is 299 619 people with 143 569 males and 156 050 females (URT, 2013). This show a change in population over a period of time which has an implication on land use change with its associated effects on agricultural activities in the study area.

The increase in population went hand in hand with the need for more areas for cultivation and settlement as a result crop cultivation and livestock keeping has developed in Meatu and Iramba areas respectively. The same was observed on the Kenyan side of Mt Kilimanjaro ecosystem with Maasai headers diversifying to crop cultivation because livestock keeping would not sustain their life due to lack of pastures for cattle and drought occurrence (Campbell *et al*., 2000, cited by Noe, 2003). Consequently, increase in need for settlements and crop cultivation area have resulted into reduced land for grazing, the average livestock herd size has declined forcing livestock keepers to seek alternative sources of livelihood apart

from livestock keeping hence an increase in number of people who are crop cultivators and others practicing both crop cultivation and livestock keeping.

Table 10: Population size of Iramba and Meatu 1988-2012

Year	District	
	Iramba	**Meatu**
1988	159 272	290 334
2002	248 214	367 036
2012	299 619	236 282

URT (2007, 2013)

4.5.2 Pre-independence policies and legislation

Land use change in Tanzania is critically aligned with government policies and legislation governing the natural resource base before and after independence. Most of post-independence policies have colonial policy features in an attempt to promote social and economic development using the existing resource (Lissu, 2000). Land use planning as an important component of land management was done in a centralized fashion which endangered land use rights of natives of the corresponding areas resulting into changes in the way land is distributed for use and how it was managed by the indigenous people.

Before colonization, clans, families and individuals owned land under customary law (Nahonya, 2001, cited by Furaha, 2009). In 1895, however the Germans took the land and confirmed as a public property. In that context, the German government owned all the land and the law did not allow transfer or lease of land by natives without approval. This affected natives because most of their land (in

case of pastoral lands) was taken for large scale agriculture. In the study area most of the land was taken and converted into cotton plantations in Shinyanga of which the current Meatu District was a part.

During the British rule, Land Ordinance No 3 of 1923 was introduced where all the land became public property and foreigners were given unlimited land lease (Nahonya, 2001, cited by Furaha, 2009). Furthermore, this gave foreigners power to take most of the native's lands for agriculture and natives to occupy the land in semi-arid areas of low agricultural potentials (Lissu, 2000).

At national level, Land Ordinance of 1923 concentrated land use decision making powers in Tanganyika that instigated mass evacuation program and native people were denied access to the land resources since they were regarded as destroyers of their own environment (Mung'ong'o, 1995, cited by Kangalawe, 2009). This was found all over the administrative boundaries of Tanganyika of which Iramba and Meatu Districts residents were also victims of the situation. Changes in ownership of land during colonial period caused changes in land use in the former pastoral lands and occupation of the semi-arid areas, for livestock grazing and some perennial crops like millet which became the only source of food for Singida people of which Iramba District is also a part.

Reduced right of access to resources in their area might have affected the ideology of resource ownership. Since the land left for peasant agriculture by local communities was small and in most cases infertile, pressure on the land was high, land fragmentations was inevitable and land productivity declined shortly

afterwards (Maro, 1974, cited by Christopher, 2003). This may have led to expansion of crop cultivation into former grazing lands and encroachment to areas thought not to be useful for crop cultivation, settlements and livestock grazing in Iramba and Meatu Districts of central Tanzania.

The colonial regime through her agricultural policy emphasized production of cash crops, which were for export. The emphasis implied a change in land use and cropping patterns which the indigenes had not intended. Cotton and millet production in Meatu and Iramba was introduced by Germans and rapidly spread due to suitable conditions of the areas. The spread of cotton led to the expansion of cultivated land at the expense of grazing land. In addition it necessitated intercropping of maize and sometimes millet.

4.5.3 Post independence policies

4.5.3.1 Villagization policy

Ujamaa policy was the fundamental development archetype soon after independence. Thus in July 1973, the Parliament passed the Rural Lands Planning and Utilization Act, which was later followed by the President Declaration in August 1973 of compulsory living in Ujamaa village of which all villages in Tanzania had to be registered as Ujamaa villages (Christopher, 2003). In other places, the resettlements had to be reorganized under Ujamaa Villages' settlement schemes.

In Shinyanga and Singida Regions, Iramba and Meatu Districts respectively, some villages were not resettled; rather they were coerced and registered as Ujamaa Villages in 1976 on the condition that each village had to agglomerate not less than 500 households. By this, Singida and Shinyanga Regions shuffled less than 5% of their population and some villages had to increase their geographical areas accompanied with the need for areas for crop cultivation and livestock grazing which became a root cause of land use change in the study area. In 1970's Kidaru, Tyegelo and Ndulumo were registered as Ujamaa Villages in Iramba District and afterwards Luono village was formed because of the population increases of Kidaru Tyegelo and Ndulumo villages. Therefore, present settlements patterns, areas used for crop cultivations and other non-used land have foundations to what happened during villagization policy.

Notwithstanding the actual number of families a village could hold, no criteria for establishing Ujamaa villages were laid down in consideration of natural environment of which land use is a paramount. According to Kikula (1996), Ujamaa Village Registration Act of 1975 and the Prime Minister's Circular of the same year set a minimum of 250 families per village while the United Nations Development Program (1976) suggested 250 to 450 families. Resettlement instigated land use change as areas which were unsettled became compulsory settlements with all other uses of land proceeding and other changing to match the brought population hence land use change. The condition for registration of the villages may have instigated influx of the neighbouring villages and the population composition may have affected the land use pattern due to the pressure the population may have exerted on the prevalent land resources.

4.5.3.2 Environmental protection policies

Environmental policies have been prominent in determining the past and current land use changes. Tanzania has formulated a number of policies and action plans, the first policy was adopted in 1953, which led to the establishment of forest reserves (Bagachwa *et al*., 1995, cited by NEMC, 2000). It was regarded illegal for the local people to access the forest for wood and non-wood products. Damage to forest produce, grazing, and collection of bee products, construction and occupation without permit were prohibited (NEMC, 2000). The restriction imposed on the local people necessitated them to encroach on the forest for subsistence. This could explain the change in land use which has culminated into encroachment to Maswa game reserved area in Meatu District and encroachment to the slopes of mountains in Kidaru and Tyegelo villages in Iramba District for crop cultivation and livestock grazing.

Iramba and Meatu experience long periods of drought associated with lack of pasture and increase of livestock diseases resulting into a number of pastoralists migrating to other areas. Data on cattle keeping from key informants indicated that the average number of cattle per person in 1970s to 1990s was 50-150 cattle per person to pastoralists but currently it has dropped to 10-20 cattle per person and a lot of people do not have any cattle. Majority of agro -pastoralists in Iramba and Meatu therefore, have been diversifying their livelihood system to crop cultivation, often alongside a continued commitment to cattle keeping, which imply land use changes resulting into increase in area under cultivation in comparison to the past

30 years where pastoralists were assured of pasture and the large area by then was of grazing rather than of crop cultivation as it prevails today.

4.5.3.3 Economic factors

While global economic forces might have minor influence on the local economic operations, globalization is considered to be one the factors for land use change. Like most of other countries, Tanzania adopted Structural Adjustment Program (SAP) in early 1980's, through SAP, a number of economic recovery programs were enacted to reduce poverty, the first was Economic Recovery Program (ERP 1) accompanied with market liberalization, removing state provision of agricultural subsides, price and institutional reforms. These had significant influences on land use since it changed resource management practices and cropping patterns. Prior to market liberalization in Tanzania, the government had a role in regulating market prices through rural cooperative societies. After market liberalization in the early 1990s individual farmers had free market access and market forces influenced price.

At present the market for cotton, maize and sunflower in the study villages exists because of the competition between buyers. This is a factor to the increased areas under cultivation, present agricultural intensification and diversifications in agricultural practices like the reduced number of livestock in Iramba and in increased number of pig keepers. Similarly, in Meatu District there are changes which have experienced reduced area under cotton production to increased areas

under maize and sunflowers production which are taken for both food and commercial purposes.

4.5.3.4 Changes from cotton production to other types of crops

During Focus Group Discussion participants were asked what are the anthropological factors considered to have influenced the present land use in terms of size, types of crops grown and ownership of land, participants of FGD agreed that there is decreased cotton production and an increased production of other types of crops notably maize, sorghum, millet and sunflower with the following reasons;

- It is cheaper to plant maize, millet, sunflower than cotton; FGD participants from Mwashata explained that;

  "It can take months for cotton to mature, but maize grows fast and involves fewer investments than cotton here in this village and we plant maize and other crops with no use of fertilizers while for cotton you need to use fertilizes if you want to harvest enough"

It was reported that the cost of cotton production is high,

"Cotton has a lot of disturbances which if you are not capable enough you will get little produce and these costs are the use of pesticides and use of chemical fertilizer"

- Market for maize and other crops is relatively more available than of cotton; in time when the market for cotton was assured people used to cultivate cotton for sale in 2000s. But currently the market situation is poor as buyers come only during the harvesting seasons with a fixed price per kilo. Other crops especially

maize, sunflower and millet, have assured market and they can bargain on the price to sell. One of the FGD respondents from Mwamanimba said;

> *"When you have your maize and other has cotton, the one with maize will sell earlier than the one with cotton because for maize does not need people from far away to come and buy like that of cotton, this makes people in the village to prefer maize, millet and sometimes sunflower because when you haven't even harvested ready buyers are at your house convincing you to sell which is not the case when you have cotton"*

- In Mwashata, FGD participants reported that it is dry and rainfall is unreliable, the village has been experiencing dry seasons for years which have resulted into planting of other varieties of seeds which are tolerant to dry conditions. Also other crops like sorghum, sweet potato and sunflower are found because they tolerate dry condition. Lack of enough rainfall has made people to move away from cotton cultivation as it is thought to need constant soil moisture.

The situation is different in Mwamanimba where production of cotton continues. Farmers produce cotton as they have no problem with getting market and other inputs. They reported that the price for cotton has been fluctuating time after time and reported that in the 1970s to 1980s, cotton was being bought on loan something which is not happening these days. From the 1990s to the present cotton is being bought on cash basis. One of the FGD participants reported that;

> *"In 1995 the price of cotton was very high and the next season people prepared large farms with a lot of harvest expecting the same price to*

happen but 1996/1997 cotton buying season the price dropped. Fortunately as the season was ending the price started to rise steadily from 800/= to 900/= further upwards. From 2012 onwards the price of cotton dropped to 600/= per kilo and people had a lot of cotton, this time, it is considered as a loss period"

The removal of subsides due to economic reforms had no special attention to agriculture and the environment which resulted into failure of cotton. In the study area, prior to 1980s cotton performed well as some of the necessary inputs were subsidized by the government (Larsson, 2001). Ideally market liberalization was expected to improve prices for farm inputs through suppliers' competition, instead the price for farm inputs has increased and become unaffordable to farmers. But since 1980, same crop have been losing their values due to removal of government subsidies on farm inputs which has led to low returns from cotton hence resulting into land use changes (Peters and Sankhayan, 1994, cited by Christopher, 2003). This has led to land use change as people ignored cotton cultivation and turned their attention to food crops like maize, millet, sunflower and sorghum which also are sold. Similar observation has been made by Larsson (2001), who reported similar diversification strategy on the slopes of Mount Meru where vegetable and banana have replaced coffee because of its fall in price.

When exploring land use change in form of agricultural diversification a question was asked to Iramba residents as "*why and what are agricultural diversification strategies being practiced*" FGD participants had a number of agricultural diversification practices mentioned in their villages (Kidaru and Tyegelo) including

keeping of pigs and goats, use of some varieties of maize (Pannar, Sidico, Kilima, Decay), Sunflower (Serena) of which in the past they were not using them as they used traditional varieties. Land use changes in form of diversification have reduced number of cattle and an increase of pigs and goats in Kidaru and Tyegelo villages respectively.

Participants of FGD explained about the reduced number of cattle and increase in pigs as something which is new and it has just started in 2005 because of the experienced hardships of livestock keeping in Iramba. FGD participant in Kidaru reported that;

> *"During the dry season, we had to take our cattle uphill for grazing because all places which we graze during rainy seasons are people's farms, when it is rainy season these areas are planted. Therefore, it becomes a problem for people who keep cattle because they have no place to graze them, it is a reason for most of the people to see pig keeping as an alternative"*

Also other FGD participant in Tyegelo said that;

> *"The only place where our cattle can graze is on the uphill and same places are occupied by Sukuma people from Simiyu and Shinyanga Regions who have larger herds of cattle compared to people of Iramba therefore, we have decided to reduce the number of cattle and remain with only some pairs of oxen which are useful for farming activities and start keeping pigs which grow fast and can solve most of our financial problems very easily"*

Reduced area for grazing as among the factors resulting from number of reasons for increased number of cattle from the neighboring regions of Shinyanga, Mwanza, Simiyu and Manyara, it was reported that livestock keepers have migrated with their cattle to Iramba specifically to Kidaru mountains in search of pasture resulting into competition for grazing area with invaders who have larger herds of cattle.

As an alternative response to the challenge, it has resulted into most of households to keep pigs ranging from 3 to 5 for those considered to have few pigs and 10 to 30 pigs for those who are considered to have many pigs which according to them it is cheaper to keep pigs than cattle. Most of Kidaru and Tyegelo residents keep pigs and goats compared to cattle because of the comparative advantages of pigs over cattle. One the FGD participants from Tyegelo village said that;

> *"People in this village own pigs because the World Vision Tanzania (WVT) had a project which aimed to educate people on how to do away with hunger, therefore as a strategy we were taught how to keep pigs, local chicken and local goats as an alternative to food insecurity and income poverty which was major problem here, World Vision through this project has a place which they keep pigs in this village and this place is used as learning class on how pigs are kept"*

It was observed that, pig keeping is considered advantageous in Kidaru and Tyegelo village over cattle because pigs consume most of the farm remains which in past 10 years were being thrown away therefore, remains on sunflower, maize, paddy which are highly produced in the two village are used as pigs feeds.

In the study area, market for pigs is available and selling price convinces people to domesticate them, a well fed pig of 100 to 150 days is bought at Tsh 100 000/= to Tsh 150 000/=, each day two to three pigs are slaughtered in Kidaru center. Land use change in form of diversification has resulted into reduced rate of environmental destruction as pigs do not require large area for grazing instead they are kept semi intensively. This has reduced the rate of environmental degradation and has increased household incomes.

4.5.3.5 Anthropological /cultural factors

The customary land tenure system is still dominant in Meatu. Traditionally, all land belonged to the chiefs, and subjects had use rights and enjoyed considerable security of tenure (Abrahams, 1967, cited by Ndalahwa, 1998). Every household had the right to hold land both for cultivation and for habitation.

It was reported that some 20 to 30 years ago, people of Meatu did not experience hunger as food was plenty, rainfall was available at the required times and even people who depended of crop cultivation were few compared to the present where even livestock keepers have become crop producers too. At the present food is needed for consumption, sell and future use and cultivation of large farms per household is common among the people of Meatu in Mwamanimba village a participant of FGD said that;

> *"A lot Sukuma people are having livestock and because of this we have to occupy a larger area which we use for livestock keeping and crop production"*

- Polygamy and extended family were found to be popular among the people of Meatu in Mwashata and Mwamanimba villages respectively; FGD discussants explained how they live in extended families and the reasons given were that having more than two wives is a sign of prestige and wealth of which most polygamists consider as a prestige, it was also reported that to have many children is advantageous since they are helpful in agricultural activities specifically in livestock keeping and crop cultivation. Therefore, most of the households live as extended families expecting advantages. Mwamanimba village FGD participant said that;

  "A family can have 30 people and even more than that because you can have your sons and their wives, children all of them living in one compound and using everything as one family members and this is useful to us because if you have people then you are rich because they will help in farming, grazing cattle and you feel happy, secured and united when you are living with all your people like one family"

This has resulted into land use changes since families expand farms, intensify their agriculture hence resulting to expansion of areas under cultivation, shifting cultivation, lowland farming, land degradations and all these as the mechanism of how the family will get food and other human demands. Under "cushion of culture," however, societies are subject to the fact that they neither have unlimited environmental resources nor the unlimited ability to exploit them. Indeed, according to Boserup (1965) and others, it may be precisely from these limitations that the tools, knowledge, and division of labor unique to human cultures emerge.

This holds the view that human populations receive their livelihoods from the resources of their habitats as they develop specialized technologies and work patterns (sociocultural systems) to exploit these resources.

It is different with people of Iramba where polygamists and extended families are not so prevalent as compared to that of Meatu, Tyegelo village FGD participant in Iramba said that; *"When sons have grown up, have to live their life and the only responsibility of the father is to give the son a piece of land."*

Because of living in extended families, people of Meatu have great demand for food at a family level which necessitates them to use large areas for cultivation expecting higher returns from those areas. The use of land among people of Meatu has resulted into intensive land use whereas there is no fallow period. Intercropping is practiced to make full utilization of land which has resulted into increased price of buying and hiring land in Mwashata and Kidaru villages

- Marriage ceremonies; marriage ceremonies in Meatu Districts is the task of the father's son, FGD discussant narrated that;

  "The father has to prepare a bride price which will be paid to the wife's family and as traditions of us, we prefer wives who are light skinned, we believe that light colour is richness and the bride price has to match with the richness of the women color. With this therefore a father has to pay not less than 30 cattle as bride price for his son"

It was reported that, when someone gets married, a ceremony is made where relatives, friends and neighbours have to participate by eating and drinking, which means some cattle will be slaughtered for the ceremony. Mwashata FGD participants said that;

> *"When a son marries, it's a big ceremony which parents make feel proud and if one owns goats and cattle have to share it with other people who join the celebrations"*

This implied that people in Meatu keep cattle and cultivate crops for various uses which are very expensive to attain at the expenses of land use, therefore, one has to own a large herds of livestock which has an implication to land use changes in form of changing the crop cultivation areas to become grazing area. The results are in line with Wood *et al*. (2000), who described the underlying factors for changing resource use patterns to include cultural perception of the local communities on land resources, demographic changes, macroeconomic policies and structure, poverty and inequality change in resource management responsibilities. The study also conforms to Kikula (1996), who reported that features of land use change in a particular setting do not arise accidentally in cultural setting, they are a result of long periods of experimentations culminating into well-established cultural beliefs of what is right for both the people.

4.6 Effects of Land-Use Change on Agricultural Activities

The definition of agriculture includes crop production, forestry, fruit and vegetable production. Two types of traditional rain fed agricultural production common in the study area include subsistence and a mix of commercial and subsistence agriculture.

The focus was on how land use change effects land use for crop cultivation, environment and livestock keeping in Meatu and Iramba Districts.

4.6.1 Land use change effects on land owned for crop cultivation

Sampled respondents identified that subsistence agriculture constitutes the highest percent by 85.0 % while commercial agriculture covers only 15.0 %. Moreover, the type of agricultural practice significantly depends on the land tenure system and the size of land holding of an individual.

The land ownership as shown in Table 11 ranges from inherited land (32 %) to purchased (22 %), to leased (20 %) to donated land (17.2 %) and landless (8.2 %). Respondents narrated that they grow different types of crops, including millet, sorghum, groundnut and maize which is the major crops in the study area. Millet and sorghum are the main staple food while sunflower, cotton and paddy are cash crops. From the study, it was seen that land tenure system has been changing over time because of population increase with demands from the land where most of the people who own land by lease reported that they cannot grow cash crops (cotton and sunflower) in those areas instead they have to grow crops which take short time to mature and which are not for sale.

Also it was observed that the size of farms owned differed basically with regard to the nature of land tenure with land owned through purchase showing that it has large acreage compared to the other types of land ownership. The findings described conform to Glover and Elsiddig (2012) and Thuo (2012), who reported

that, land ownership has a significant relationship with land degradation. Most of farmers who owned land by lease at the time of interview reported that they don't take/take little conservation measures of the land they use for crop cultivation with an excuse that they could not conserve or use land properly which they does not have a full mandate on it.

Table 11: Nature of land ownership (n=122)

Nature of land ownership	Frequency	Percentage
Land less	10	8.2
Inherited	39	32.0
Leased/rented	25	20.5
Purchased	27	22.1
Donated	21	17.2

4.6.2 Land use change effects to soil fertility maintenance techniques

In the study area it was observed that soil fertility is restored after the cropping phase by self-sown natural forests or grassland fallows. People have developed other techniques to increase soil fertility, especially in Meatu. There has been decreased productivity of cotton in recent years. This conforms to Larsson (2001), who found that liberalization has a profound effect upon the types of crops grown and it has resulted into degradation. Other soil fertility maintenance technique observed and reported other than natural fallow is legume/root crop rotation and the use of soil erosion barriers. The study is in line with Omotayo and Chukwuka (2009) that physical factors are among principal factors affecting soil productivity and potential of soil resources.

4.6.2.1 Legume/root crop rotation

Soil fertility maintenance technique used is a rotation of leguminous food crops with a root crop. The legume crop is usually groundnuts and cowpea. Yam which is a root crop is commonly grown in Tyegelo village and potato is in this rotation. Villagers who practice this rotation reported that it is effective in maintaining fertility for an extended period. Plots of vegetables such as tomato and spinach are grown in rotation with onions.

4.6.2.2 Soil erosion control

The technique used is confined to some locations under LVEMP Project where soil retention barriers, terraces and use of crop residues are found. Crop residues have also been found very effective in controlling soil erosion and improving soil fertility. Moreover, Oguike *et al*. (2006), cited by Omotayo and Chukwuka (2009), add that despite that crop residues usually contain far less residual nutrients (e.g. N) relative to green manure crops or legume cover crop species contribute to control of erosion. This conforms to the study area whereas it is used on steep land and in location where agriculture is less intensive and population density is lower.

Moreover, a number of very minor techniques used such as inorganic fertilizer is used for commercial vegetables in Kidaru and Tyegelo villages of Iramba Districts which are produced to be sold within the ward and others taken to Kiomboi. In Table 12 planting trees reported by 64.8 %, use of terracing by 80.3%, use of check dam reported by 59.8 % these techniques are used to control soil erosion in the study area. Very occasionally people use animal manure, especially chicken, goat manure and other organic fertilizers to maintain soil fertility around their homes.

Table 12: Soil erosion control (n=122)

Erosion control measures	Frequency	Percentage
Planting tress	81	66.4
Terracing	98	80.3
Check dam	73	59.8
Contour ridging	81	66.4

x^2=0.00

4.6.3 Land use change effects on area under cultivation

In the study an average of 86.9 % of the respondents reported that formal grazing land was put under crop cultivation, 82.8% reported that there was an expansion of farm land and cropping periods and finally 71.3% reported that there was highland farming. Agriculture expansion in terms of land used for crop cultivation and area for grazing is among serious effects of land use change, which have substantial effect on the environment (Noe, 2003 and Misana *et al.* 2012). In a similar situation, 65.6 % of respondents reported that there is cultivation of sand fans and river, shifting cultivation was reported by 80.3 % of the respondents reporting that it has happened. This might have been instigated by increase in human demand on land for subsistence agriculture. The expansion of cultivated land for subsistence purposes to nearby natural vegetation of which the environment is a part has also been reported by Mbolinyi and Ole (2003). Similarly, agricultural activities were found to expand and change land cover in Kitendeni wildlife corridor between Amboseli National Park and Mount Kilimanjaro (Noe, 2003) which conforms to this study.

Land use intensity is being increased by longer cropping periods and extended areas under cultivation were reported. In the highland, this means more plantings of main food crops like millet and maize. In the lowlands, people sometimes increase the number of plantings of traditional staples of vegetables, but this is rare. Where people have replaced the original staple with a more productive one, land use has been intensified by increasing the number of plantings before fallowing.

4.6.4 Land use change effects on environment and forest production

Firewood remains the main source of energy for most rural people in Iramba and Meatu Districts. In a focus group discussion respondents indicated using own forest/wood lands in their area and that they use the products from trees for different purposes, for example building material, fuel wood, brick making and charcoal production as shown in Plate 2 and 3.

Plate 2: Use of forest products in brick making in Meatu District

Respondents stated that the rate of deforestation for charcoal production, agricultural expansion and other activities ranges from high to moderate. However, land degradation in the study area has contributed to soil erosion. As it is shown in Plate 2, respondents reported that the severity of land degradation at present ranges from severe to very severe at 37.7 % to 48.4 % of the respondents reporting the occurrence of the phenomena. Also the severity of land degradation in 5 past years states similar results as it ranges from severe to vary severe with slight different in average number of respondents which is 44.3 % to 37.7 % of the respondents.

Plate 3: Charcoal burning in Meatu District

Moreover, the severity of land degradation (Fig. 2), respondents reported that it ranged from moderate to severe where 38.5 % to 49.2 % reported level of the phenomena. Finally, the severity of land degradation in the past 25 years shows that it ranged from moderate to severe with 47.5 % to 27.0 % of the respondents

reporting the scenario. The study conforms to Kajembe *et al.* (2005), reported that, the problem of land degradation in Tanzania has been so prevalent for so long. As a result, various soil conservation programmes have been in place to combat the problem. Demonstration plots, conservation orders and directives (e.g. destocking of livestock and controlled fires) were first introduced by the colonial government. Most of these interventions were concentrated in mountainous areas where land d degradation was most apparent (Kiunsi and Meadows, 2006).

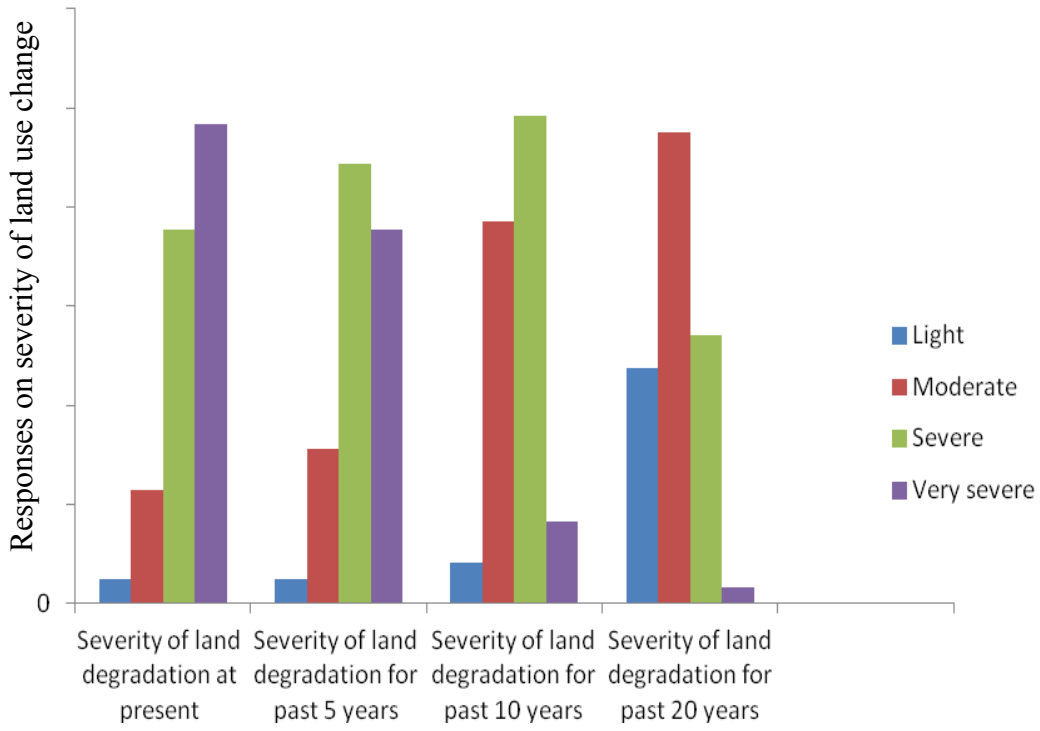

Figure 2: Severity of land degradation

Generally, the severity of land degradation seems to range from severe to very severe at present decade probably because of the increased demand from the land resources like food and energy. Also the situation seems to be less severe with an average number of respondents reporting that it was moderate to severe in the past

two decades which tell that there was a less environmental degradation in the study area. This shows that the severity of land degradation has been increasing over time from bad to worse as presented by the respondent's views.

With regards to the extent of land degradation (Fig. 3) respondents reported that it ranged from present on vulnerable land units to wide spread everywhere with 26.2 % to 73.0 % of the respondents reporting the phenomena at the time when data were collected from the study area. Similarly on the extent of land degradation in the five past years majority of the respondents reported that it ranged from present on vulnerable land units to wide spread everywhere with 37.7 % to 61.5 % of the respondents reporting a view on the phenomena.

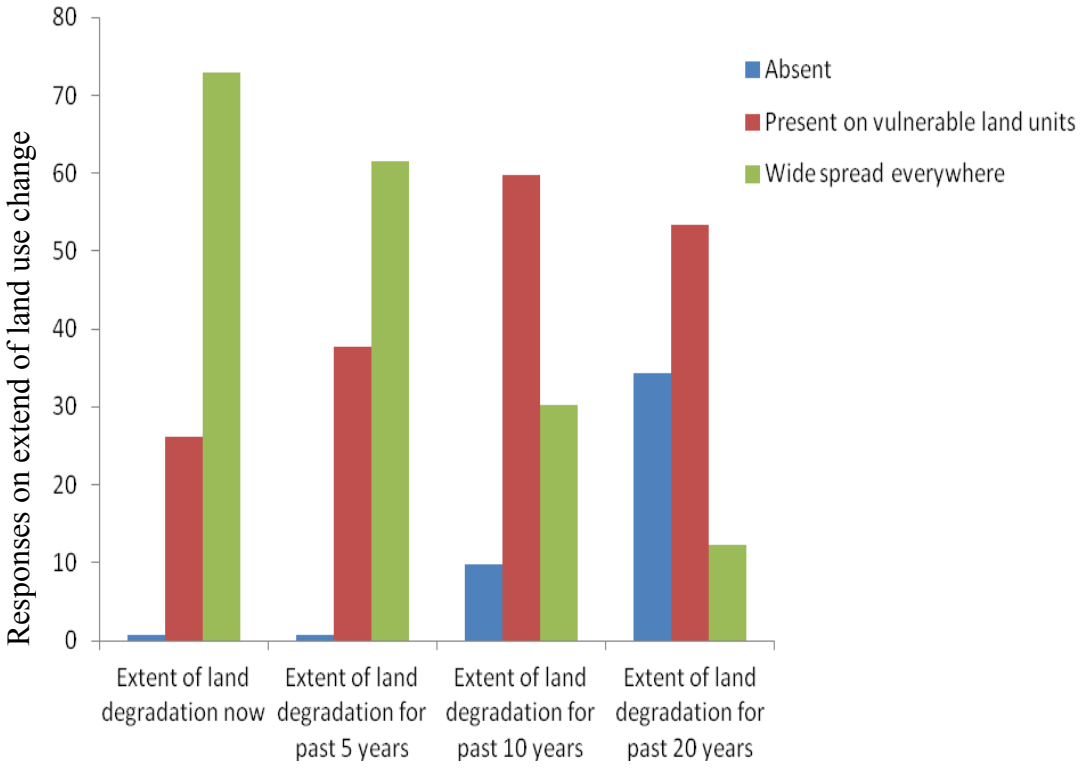

Figure 3: Extent of land degradation

Finally, the extent of land degradation in the 25 past years had quite different situation which shows that it ranged from absent to present on vulnerable land units with an average of 34.4 % to 53.3 % of the respondents reporting a scenario. In the study area, vegetation loss has occurred in all land units engaged in farming activities irrespective of other biophysical characteristics with vegetation degradation, deforestation, burning of bushes and forest. This is the outcome of crop cultivation, as semi-arid and arid lands are often accompanied by changes in soil characteristics that are unfavorable for further crop production. This results in decreased soil quality and threatens sustainability of agricultural lands which relates to the study of Ozgoz1 *et al.,* (2013) who reported the effects of soil erosion on soil quality resulting into decreased soil fertility and increased use of chemical fertilizer as mechanism to ensure crop yield are obtained for the survival of small scale farmers.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on the findings of the study, it can be concluded that, the historical trend of land use changes for 1983-1985 and 1988, 1993, 1996, 1998, 2002 and 2007 had severe droughts resulting into food insecurity, human and animal population encroachment into unused land, land resources degradation and decreased number of livestock.

Land use change is arguably the most pervasive socioeconomic force driving changes and degradation of agricultural land. Land use change, however, does not come without costs since conversion of farmland and forests to settlement development reduces the amount of lands available which would be used for agricultural activities. Soil erosion, desertification and other soil degradations associated with intensive and extensive agriculture and deforestation have reduced the quality of land resources and future agricultural productivity in the study area.

Population increase presents major challenges for farmers in Meatu and Iramba which intensifies agricultural and nonagricultural land use. Moreover, there is a possibility that the important ecosystem services will carry on being reduced and destroyed when forests are converted to agriculture which is the present scenario in Iramba and Meatu.

5.2 Recommendations

In the view of the findings of this study, the following recommendations are made:

i. Requirement for extensive research to develop a methodology that combines remotely sensed and socio-economic data to evaluate the impact of human-driven forces on land-use change and its impact on livelihood, which requires increasing the area to obtain representative area over all Simiyu and Singida Regions.

ii. Conducting environmental awareness programs to enable rural people to have a better understanding and ability to manage their land and natural environment hence reducing the extent of land degradation found in the area of study.

iii. Implementation of rangeland management by improving grazing land, grazing patterns, protecting shrubs and trees from being deforested by livestock keepers and crop cultivators who encroach to unused land from day today in search for areas for cultivation and grazing.

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APPENDICES

Appendix 1: Household Survey Questionnaire

THE DYNAMICS OF LAND USE CHANGES IN IRAMBAAND MEATU DISTRICTS OF TANZANIA

Introduction

I am Biyagila Loti, a Masters student in Rural Development from Sokoine University of Agriculture. I'm doing a research on the title above for academic purposes. I kindly request your participation by responding to this questionnaire and I assure you confidentiality of all information's you give.

Thank you in advance

GENERAL INFORMATIONS

Respondent Name……

District……..... Ward….....Village…….....

A. BACKGROUND INFORMATION'S OF RESPONDENT:

1. What is the gender of household head? Please tick one

   (1)Male (2) Female

2. What is the age of the household head? …….. Years

3. What is the highest level of education of the household head? Please circle one

   (1)Did not go to school (2) Primary (3)O' level (4)A' level (5) College(6) Other Specify……

4. Marital status of household head? Please circle one (1) Single(2) Married (3) Divorced /Separated (4) Widowed

5. What is Primary the occupation of the house hold head?

1) Crop cultivation per say2) Livestock keeping per say3) Livestock keeping and Crop cultivation4) Other occupation specify

6. What is the total number of household members ……(7)How many male ……

8. How many female …….9. How many from the above in (qn 7) support farm labour……?

Objective (2) FACTORS RESPONSIBLE FOR LAND USE CHANGES IN THE STUDY AREA.

10. How many of the following Livestock do you own?

Livestock	Cattle	Goats/sheep	Chickens	Donkeys	Pigs
Numbers					

11. What size of Land do you use for your agricultural activities in acres?[1]

Type of land	Approximate Size of each parcels of land			
	Now/acre	5years Ago/acre	10years ago/acre	20year s ago/acre
Homestead				
Non-irrigation cropland				
Private grazing				

12. What is the category of the respondent? Please circle one

(1) Landowner (2) Non land owner

13. If is a land owner what is the nature of land ownership

i) Land less ii) Inherited iii) Lease iv) Purchased iv) Donation

14. What type of power do you use on your land for agricultural activities please only one response in each column by indicating the level of use as i. Not used ii.

[1]Refers to amount of land owned by the interviewed household during the time of interview

Type of power	Not used	Slightly used	Moderately used	Mostly used
Human lobour				
Tractor				
Draft power				
Power tiller				

15. Which of the factors determines the decisions you make in use of land for faming activities in any season? Rank them in order of importance by indicating (**V**) to a required column as (1) Not at all(2) Slightly important(3) Moderate important(4) Very important (5) Extremely important

Factors	Not at all	Slightly important	Moderate important	Very important	Extremely important
Favorable Climate					
Easy to manage					
Soil fertility					
Presence of labour					
Adequate land					
Affordable price of seeds					
• Fertilizer					
• Pesticides					
Adequate storage facilities					
Reliable capital					
Adequate extension services					
Distance to the farm					
Infestations and outbreaks of diseases					
Stronger producer' s organizations					
Low or fluctuating marked prices					
Its supported by the government					

16. Do you use manure [1] .....Yes [2] .....No

17. Add commercial fertilizer [1] .....Yes [2] .....No

18. Rotate crops [1] .....Yes [2] .....No

19. Where do you sell your agricultural products?

Crops	Maize	Sorghum	Millet	cotton
Market				
Livestock	Sheep	Cattle	Goats	pigs
Market				

[1] Prisons **[2]** Barracks **[3]** Churches **[4]** locally/neighbors **[5]** Farmer's cooperatives

[6] Schools **[7]** Local shops (**8**) others specify.....

20. Do you have problems in getting market for selling your produce? Please circle one

[1] Yes [2] No

21. How far is the nearest market.....?(in km)

22. How far is the furthest market.....?(in km)

23. Do you get some extension services from Iramba District offices? Please circle one

[1].....Yes [2] …….No

Objective 3 - EFFECTS OF LAND USE CHANGES TO AGRICULTURAL PRACTICES IN THE STUDY AREA

24. What are the improved agricultural practices (intensification) you have adopted since past 20years? Please circle only one response for each item.

a) Expansion of farmland [1] ...Yes [2] ...No

b) Shifting cultivation [1] ...Yes [2] ...No

c) Lowland farming [1] ...Yes [2] ...No

d) High land farming [1] ...Yes [2] ...No

e) Establishment of land rights [1] ...Yes [2] ...No

f) An increase in commercial tree crop area [1] ...Yes [2] ...No

g) Increased production of annual crops [1] ...Yes [2] ...No

h) Decrease in soil fertility [1] ...Yes [2] ...No

i) Use of tractors [1] ...Yes [2] ...No

j) Use of animal power [1] ...Yes [2] ...No

k) Use of early maturing breeds of livestock [1] ...Yes [2] ...No

l) Use of early maturing breeds of crops [1] ...Yes [2] ...No

m) Conservation agriculture [1] ...Yes [2] ...No

n) Use of irrigation structures [1] ...Yes [2] ...No

o) Use of extension officers [1] ...Yes [2] ...No

q) Various intercropping patterns [1] ...Yes [2] ...No

r) On-farm soil conservation approaches such as contour ridging and tree-planting [1] ...Yes [2] ...No

s) Spatial expansion into the rehabilitated sand fans and former grazing areas in the lowlands [1] ....Yes [2] ...No

t) Intensified livestock-rearing: a fumbling start for stall-feeding [1] ...Yes [2] ...No

u) Trying new crops and planting techniques [1] ...Yes [2] ...No

v) Cultivating on the sand fans and riverbeds [1] ...Yes [2] ...No

w) Putting former grazing areas into cultivation [1] ...Yes [2] ...No

25. What are the new types of breeds of cattle/crops you have but were not there in past 20 year? (Diversification)

Type of livestock			
Type of crop			

26. What reasons led to these changes in the types of breeds of livestock and crops you have mentioned above. Please circle one

a) Staple food [1] ...Yes [2] ...No

b) Family size changed [1] ...Yes [2] ...No

c) Easy to manage [1] ...Yes [2] ...No

d) Favorable Climate [1] ...Yes [2] ...No

e) Higher level of productivity [1] ...Yes [2] ...No

f) Trained by extension program [1] ...Yes [2] ...No

27.Does the total area you cultivate from year to year (extensification) please circle one of the following answers(1)Increase(2) Decrease (3) Show no change

28.What are the reasons for your response above?

i)…….....……ii)……

……

iii)….....iv)…….....

..

29. What measures do you take when the productivity of your land declines? Please tick one

(a) Look for additional land [1] .....Yes [2] .....No

(b) Fallow [1] .....Yes [2] .....No

(c) Use manure [1] .....Yes [2] .....No

(d)Add commercial fertilizer [1] .....Yes [2] .....No

(e)Rotate crops [1] .....Yes [2] .....No

f) Abandon the land [1] .....Yes [2] .....No

g) Went for other activities apart from agriculture [1] .....Yes [2] .....No

30. Do you use of the following soil erosion control methods? Please circle one response only

a) Tree planting[1] .....Yes [2] .....No

b) Terracing[1] .....Yes [2] .....No

c) Check dam[1] .....Yes [2] .....No

d) Cultivating across slopes [1] .....Yes [2] .....No

31. How do you evaluate trend of land degradation over time?

	Now/2013	5 years ago/2009	10 years ago/2003	20 years ago/1993
Severity of land Degradation [1]				
Extent of land Degradation [2]				

[1]1: light; 2: moderate; 3: severe; 4: very severe

[2]1: absent; 2: present on vulnerable land units; 3: widespread everywhere

32. What are the signs of land degradation that are noticed in the village?

i).....ii).....

iii)..... iv).....

30. Do you have additional issues to forward pertaining points discussed?

…….....

.....

Special remarks of the interviewer

Appendix 2: Interview guide for Focus Group Discussion

THE DYNAMICS OF LAND USE CHANGES IN IRAMBA AND MEATU DISTRICTS OF TANZANIA

1. How do you assess the emerging economic opportunities (demand for maize and sunflower oil) to land use changes for agricultural practices in Iramba/MeatuDistrict?
2. What do you consider as the activities apart from agriculture that are taking place in Iramba District which causes land use change for agricultural practice?
3. What are the anthropological factors that you consider have influenced the present land use in terms of size, types of crops grown and ownership of land in Iramba District?
4. What do you consider as the behavior of indigenous residents of this district to have any influence on land use change for agricultural practices?
5. What do you consider as the position of the present government and non government organization that are surrounding this ward to the present land use for agricultural practices?
6. What are the improved agricultural practices (intensification) you have adopted since past 20 years since you have been practicing agriculture?
7. What new breeds/types of breeds of livestock s and crops in place?
8. What reasons led to these changes to the mentioned types of crops/livestock's?

Appendix 3: Interview guide for key informants

THE DYNAMICS OF LAND USE CHANGES IN IRAMBA AND MEATU DISTRICTS OF TANZANIA

Name of organization.....

Name of the respondent.....

Position held.....

1) For how long have you been in Iramba? .....

2) What major changes in land use that are noticed in Iramba

i).....ii).....iii).....

.....

iv).....v).....

3) What do you consider to the main causes of the land use noticed above?

i).....ii).....

iii).....iv).....

4) What are specific extensification (projects, programs) related to land use in place that have been implemented over the years

i)…….....ii)…….....……

iii)…….....……iv)….....……..

6)What messages/ innovations have been promoted?

i).....ii).....

iii)..... iv).....

7) What have not been achieved so far?
i) ……..... i).....

iii).....iv).....

8) What could have been done differently?

i)……ii)…….....……

iii).....iv).....

9)What are the causes of agricultural diversifications in relations to land use changes in Iramba District.

i)…….....ii)…….....……

iii)…….....……iv)…….....……..

10. What do you consider to be the reasons for the present agricultural intensification that is found in Iramba District?

i)…….....ii)…….....……

iii)…….....……iv)…….....……

11. What do you consider to be the technological changes that have contributed to land use change in Iramba District.

i)…….....ii)…….....……

iii)…….....……iv)…….....……..

12. How is land degradation a problem in this area?

i).....ii).....

iii).....iv).....

14. What is the historical perspective of land use change in Iramba District?

Appendix 4: List of items directly observed by the researcher in the field

THE DYNAMICS OF LAND USE CHANGES IN IRAMBA AND MEATU DISTRICTS OF TANZANIA

1. Settlement patterns in the study areas
2. Other economic activities which have influence to land use changes apart from agriculture
3. Land use changes specifically

a) Cultivated areas

b) Fallow lands

c) Sparse to dense tree cover

d) Open grassland

e) Wooded grassland

f) Severely eroded areas

g) Sand rivers with fresh sand accumulations and

h) Water sources

4. Farming systems (intercropping, mixed farming, monoculture, shifting cultivation and population distribution
5. Distribution and location of social and technical infrastructures in the study area
6. Size of land divided for different purposes study area