

**LAND TENURE, FARM FRAGMENTATION AND AGRICULTURAL
PRODUCTIVITY IN KILOSA DISTRICT, TANZANIA**

**BY
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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
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ABSTRACT

This study was conducted in three wards of Kilosa District (i.e. Rudewa, Chanzuru and Mabwerebwere) to assess the effects of land tenure and farm fragmentation in the district. A sample of 90 households was selected for the study. Thirty households were selected from each ward. The general objective of the study was to assess the existing land tenure systems and farm fragmentation and their effects on agricultural productivity. The specific objectives were to identify the existing land tenure systems in the study area, to assess factors causing farm fragmentation and to assess the effects of farm fragmentation on agricultural productivity. Linear regression and correlation techniques were used to analyse the factors causing farm fragmentation and correlation analysis was used to assess the relationship between farm fragmentation and agricultural productivity. Customary land tenure (78%) was the most prevalent type of tenure system in the study area. The regression analysis indicates that farm fragmentation is greatly influenced by household size and education level of the heads of household and was statistically significant at $P < 0.01$ and the distance from homestead at $P < 0.05$. The results from correlation analysis indicate that that public land and customary tenure systems are positively associated with the level of farm fragmentation at $P < 0.1$ and 0.01 respectively. Furthermore, it was observed that age of the heads of household and the distance from homestead are positively associated and statistically significant at $P < 0.1$ and $P < 0.01$ levels respectively. From the study results, it is recommended that policy makers should intervene by reframing land policies in order to provide land security which will facilitate land use and increase agricultural productivity. It is also recommended that government intervention in land administration is of crucial importance to improve

land uses which allocate rights in land use as well as land-use regulation where by land-use planning and enforcement and the adjudication of land use conflicts are controlled.

DECLARATION

I, Peter Pacific do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and it has neither been submitted nor being concurrently submitted for degree award in any other institution.

Peter Pacific
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Date

The above declaration has been confirmed by

Dr. Reuben M. J. Kadigi
(Supervisor)

Date

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DEDICATION

This work is dedicated to my beloved wife Patricia D. Sangali and my daughter Brytness P. Sangali for their patience, inspiration and heartfelt encouragement during the whole period of my studies at SUA. May God bless them all.

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LIST OF ABBREVIATIONS

CPR	-	Common Pool Resources
FAO	-	Food and Agriculture Organisation
Ha	-	Hectares
JI	-	Januszewki Index
NBS	-	National Bureau of Statistics
NLP	-	National Land Policy
NLPPC	-	National Land Policy Planning Commission
SI	-	Simpson Index
SPSS	-	Statistical Package for Social Sciences
Tshs	-	Tanzanian shillings
UDSM	-	University of Dar es Salaam
URT	-	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Land is one of the major means of production, it contains a good number of minerals and other resources and it is a primary input. It is also a factor of production which is not consumed but without which no agricultural production is possible (Tsoxo, 2006). Land can be put to many uses such as cultivation, grazing, forestation, tourist purposes (e.g. game reserves and national parks), water conservation, mining and other uses which are essential in the economic production (Tsoxo, 2006). All organisms including human beings depend on land as a life supporting system.

Land tenure is a relationship, whether legally or customarily, among the people or individuals or groups with respect to land (Yao, 2000a). Land in this case also includes natural resources such as water and trees. There is a profound relationship between land and people. The land ownership varies in accordance with the rights of the society or the state. Although land tenure is secure under most customary land rights, formal land titles do not necessarily equal to higher land security (World Bank, 2003). Moreover, land is one of the natural resources that have remained unequally distributed in many places around the world.

Farm fragmentation is defined differently by different people. Yan (1998) defines farm fragmentation as the subdivision of farm property into undersized units which are too small for rational exploitation; and the excessive separation and dispersion of the parcels forming parts of a single farm. The size of landholdings is gradually

decreasing as these holdings become fragmented into small plots. Small plots become a problem when they are further fragmented into several pieces of land, that is land fragmentation which leads to physical dispersion of parcels (Niroula and Thapa, 2005).

Land fragmentation is a result of different factors and reasons which are determined by topography of the country, soils and climate and population of the area (Kalanthari and Abdollahzadeh, 2008). Of recent, land ownership has become a worldwide problem due to population increase. For example, in China, there is a relatively scarce land resource as opposed to rapid population increase. By 2005, China's population reached 1.3 billion living on 960 million hectares of land in a country whose arable land accounts for only 13.5% of the total land area (Shushao, 2005).

According to the World Bank's (2003) report, 84% of the rural population depends on agricultural land and 1.8 to 2 million smallholder farmers operate on 1 hectare of land. Over time and due to a high population growth and the customary tenure, land has been subjected to sub-division among family members leading to land fragmentation.

1.2 Statement of the Problem and Justification of the Study

Land tenure is an important part of social, political and economic, cultural and institutional structures which determine a means of land holding (Arua, 1997). Socio-economic factors include demographic changes which influence land tenure. It possesses economic value by virtue of competition for its use between different

individuals and groups. As the area of land per head of household declines, the relative value of land rises and land becomes increasingly a source of conflict among individuals and communities (Arua, 1997). This is the same case happened to the study area in the past few years, due to reason that individual tenure has not been able to meet the rising demand for land, owing mainly to the small size of individual holdings. The ability of the agricultural sector to provide employment competitively with other sectors depends on various factors including land tenure. When the land tenure system leads to the overvaluation of land, rural wages and working conditions may be less attractive than urban alternatives and serve as a major determinant of outmigration (Hansungule, 2007). Under such conditions social cohesion and social justice do not always prevail.

Cultural factors include traditional norms, beliefs and values. Excessive subdivision of the land as a consequence of inheritance systems results in the fragmentation of holdings and a high number of small plots boundaries may be poorly defined after each subdivision. Migot-Adholla *et al.*, (1991) reported that sub-Saharan Africa has the distinguishing features of different tenure regimes concern restrictions on the individual holder's ability to transfer land and the categories of persons to whom land may be transferred. The same authors asserted that because land is an integral part of the social system, and legitimate use is traditionally determined by birth, affinity, common residence and social status or some combination of these, therefore transactions may be limited to the members of the lineage. This hinders the emergence of market transactions in land whereby access is ideally determined by supply and demand factors as well as entrepreneurial ability. It also hinders the

emergence of modern property rights systems founded on principles of contractual law and economic efficiency. Since title to land is often undefined, boundary disputes are frequent (Fabiya and Adegboye, 1977). Menkiti (1972) cited by Arua (1978) argued that owing to such disputes, vast tracts of prime agricultural land may be underutilized while farmers complain of insufficient land. A good tenancy system should give adequate security of tenure to the occupant who is the person cultivating the land. This contributes to both agricultural development and land resource conservation. Under insecure tenure, a farmer is tempted to exhaust the soil in order to reduce production costs, while the landlord and the community bear the final costs.

Institutionally, a tenure system influences the volume of agricultural credit and the actual distribution of credit, especially where the existing credit systems place undue emphasis on land as a form of collateral. Conversely, land tenure systems which prevent or limit the mortgaging of land impede the delivery of credit. Thus the insistence on land as security reinforces inequalities between farmers which in turn affect agricultural productivity.

Although a lot of efforts have been made towards issues concerning land tenure, utilization and land management little research has been done on how the existing land tenure systems fit and how they affect agricultural productivity. Therefore, this study aims at mapping the existing land tenure systems through investigating the factors involved in tenure systems, their influence in farm fragmentation and effects on agricultural productivity.

This study will generate useful information which will create awareness among the farmers, government leaders, other stakeholders, and the general public in the study area on the existing problems concerning land tenure systems. Such information would be instrumental in formulating appropriate policies that seek to serve the best interests of the people in improving agricultural productivity.

1.3 Objectives of the Study

1.3.1 General objective

The main objective of this study was to assess the existing land tenure systems, farm fragmentation and their effects on agricultural productivity.

1.3.2 Specific objectives

- i) To identify the existing land tenure systems in the study area
- ii) To assess factors causing farm fragmentation in the study area, and
- iii) To assess the effects of farm fragmentation on agricultural productivity

1.4 Research Hypotheses

- i) The existing land tenure systems have no significant effects on farm fragmentation.
- ii) Farm productivity is affected by the level of farm fragmentation.

1.5 Organisation of the Report

This dissertation is organised into five chapters. Chapter one presents the introduction, chapter two reviews relevant literature concerning land tenure and farm fragmentation. Chapter three presents the methods and materials used in the study.

Chapter four presents the results and discussion and chapter five presents conclusion and recommendations from the findings of the study.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter reviews relevant literature on the effects of land tenure and farm fragmentation on agricultural productivity. The chapter is intended to shed some light on how smallholder farmers in the rural areas are altered by different tenure systems used and the impact of such tenure systems on farm fragmentation and their implication on agricultural productivity. The chapter looks at the concepts of land tenure systems; evolution of land tenure systems in Tanzania; customarily land tenure systems; and the concept, theory, causes and measures of farm fragmentation. Finally, the chapter also looks at the benefits and costs of farm fragmentation.

2.2 The Definitions and Concept of Land Tenure System

Land tenure is defined as the relationship whether legally or customarily among the people, individuals or groups with respect to land (Yao, 2000a). Land tenure is also described as a means or mode of holding certain piece of land (Ogolla and Mugabe, 1996). The term tenure was derived from the Latin word “*tenere*” which means “to hold”. Tenure defines the social relations between people with respect to the objects, in this case land includes natural resources such as water and trees (Ogolla and Mugabe, 1996).

Land tenure is an institution of rules invented by societies to regulate behaviour (Yao, 2000b). Rules of tenure define how property rights to land are to be allocated within societies. They define how access is granted to the rights to use, control, and transfer land, as well as the associated responsibilities and restraints. In simple

terms, land tenure systems determine who can use what resources for how long, and under what conditions (Yao, 2000b).

Land tenure is an important part of social, political, and economic structures. It is multi-dimensional, bringing into play social, technical, economic, institutional, legal and political aspects that are often ignored but must be taken into account (Yao, 1998). Land tenure relationships may be well-defined and enforceable in a formal court of law or through customary structures in a community. Alternatively, they may be relatively poorly defined with ambiguities open to exploitation (Yan, 1998). Therefore, knowledge on different land tenure systems is of crucial importance so as to increase agricultural productivity.

Generally, land tenure is often categorized as:

- Private: the assignment of rights to a private party who may be an individual, a married couple, a group of people, or a corporate body such as a commercial entity or a non-profit organization. For example within a community, individual families may have exclusive rights to residential parcels, agricultural parcels, and certain trees. Other members of the community may be excluded from using these land areas without the consent of those who hold the rights.
- Communal: the right of commons may exist within a community where each member has the right to use independently the holdings of the community. For example, members of a community may have the right to graze cattle on a common pasture.

- Open access: specific rights are not assigned to anyone and no-one can be excluded. This typically includes marine tenure where access to the high seas is generally open to anyone; it may include rangelands and forests where there may be free access to the resources for all. The important difference between open access and communal systems is that under a communal system, non-members of the community are excluded from using the common area.
- State: property rights are assigned to some authority in the public sector. For example, in Tanzania forest lands may fall under the mandate of the state, whether at a central or decentralised level of government.

2.3 Land Tenure System in Tanzania

Land tenure is among the crucial issues to most communities in Tanzania; this is because over 80% of the Tanzania population depends on land based resources for agricultural production and other economic activities. In Tanzania, all land belongs to the state under three main forms: general land, village land, and reserved land (URT, 1999). General land is described as the land which is neither village land nor reserved land, while village land is the land which is under the jurisdiction and management of a registered village (Willy, 2003). Each village is required to define three land use categories of the land found within the village borders, that is, communal village land, individual family land and reserved land. Reserved land is defined as land which is reserved and governed for the purposes subject to nine listed laws (LA 199: 5.6). These laws include environmental protection areas such as

national parks, forest reserves and wildlife reserves as well as areas intended and set aside for spatial planning and future infrastructure development (Willy, 2003).

The state ownership of land was the result of the nationalisation of land by the colonial government in 1923. This system was abolished after independence but it was reinstated during the Arusha Declaration in 1967, which was also aimed at giving villages more authority on land ownership. Reinstating of the state ownership came upon the realisation that effective implementation of land policy is important for sustainable and systematic land utilization and land based resources. It was also intended to make farmers have secure land ownership (Shirley, 1999).

According to Lundgren *et al.* (1993) cultivating on a privately owned land involve high investment in various aspects of soil conservation. In this respect, it has been observed that investment in soil conservation is higher in privately owned land than it is in rented communally owned land. Traditionally, grazing land and water holes have been free for all to access and use (Christianson *et al.*, 1993). For instance, Barbaigs used their grazing land communally and made the best use of scarce resources by seasonal grazing systems (Sosovele and Kulindwa, 2002). There is always a control over customary land and traditional institutional procedures as well as a strict observation of the existing rules.

2.4 Evolution of Land Tenure Systems in Tanzania

Land tenure system in Tanzania has been characterised by dualism of both statutory and customary land regimes (Shivji, 1998). This heterogeneity is reminiscent of the political history of the country, particularly the colonial period whereby land was

under the control of the state. This implies that land as a resource was intended to benefit the colonial masters as opposed to the ordinary citizens particularly farmers.

The evolution of land tenure in Tanzania can be examined under three main eras namely, pre colonial, colonial, and post independence periods (Shivji, 1998). Prior to colonial period, land holding in Tanzania was based on customary laws of different tribes in the respective areas (Kisoza, 2007). Land allocation was controlled by the recognized authorities under chiefs, elders and headmen. Later, there was communal land for grazing and forest lands for gathering fire-wood. At this moment, there was abundance of land and each member of the family had a definite share in land holding under clan tenure, but none had the right to dispose off the land.

During the colonial regime the property ownership of all land resources came under the control of the state. This regime deprived local communities of the customary ownership of land resources which were put under the control of the state and foreigners (URT, 1994). The institutional mechanism used to affect this was through the introduction of legal investment, laws, decrees and regulations (Shivji, 1998). Colonial authorities deprived the indigenous populations of rights over the land, leading to bloody “Majimaji” rebellion of 1886 to 1893 (URT, 1994 cited by Kisoza, 2007). This is because the property regime was aimed at facilitating the exploitation of resources and assets in the colony (Shivji, 1998).

During post independence period, the state adopted virtually the same colonial land ordinance in the land tenure system. For example, the Tanganyika Land Ordinance of 1963 and subsequent laws retained the radical title where all the lands in the country were public lands vested on the President (Tenga, 1987). Land was held on

behalf of all the people of Tanzania (URT, 1994). For the past 40 years until 1995, there was no comprehensive land tenure policy, save for some land tenure conversions (Okoth-Ogendo, 1991). For example, the freehold titles (Conversions) and Government Lease Act No. 24 (Cap.523) of 1953, customary leaseholds (Enfranchisement) Act No. 47 of 1966, Rural Farm Acquisition and Re-grant Act No. 8 of 1966 were among the legal instruments that could facilitate land tenure conversions (URT, 1994). According to Shivji (1998), none of these measures was aimed at land reform or land redistribution.

However, substantial changes in land tenure came about through other policies. More importantly, the later colonial land reforms and modernization ideology continued to influence and direct post independence policies with varying, mostly adverse effects on customary land (Shivji, 1998). Modernising the traditional systems meant removing the people from their traditional surroundings and institutions and integrating them into the capitalist market institutions. These policies were implemented through a number of programs, namely settlement schemes and group ranch projects, nationalisation, “villagelisation” operation, village tilling and legislation, and economic liberalisation (Kihondo, 1999)

2.4.1 Customary land tenure system

Customary land tenure or indigenous land tenure is a system whereby land ownership is vested in the community, clan, or household. The system is largely characterised by unwritten local practices and norms that are flexible, negotiable and which are often location specific (Cotula *et al.*, 2004 cited by Kaduma, 2007).

Individual households or clans have clearly defined rights of use over different parcels of land. These family rights are transferred from one generation to the next in accordance with the prevailing rules of succession (Migot-Adhola and Bruce, 1994). However, there are arguments that the African customary land tenure system excludes non members of the clan or family from transactions in land, and hence distorts land markets and undermine full integration of rural economies (Harrison, 1972 cited by Migot-Adhola and Bruce, 1994). Although these arguments may be valid in some ethnic groups, there is also evidence in some parts of Tanzania where customary land tenure allows transfer of land ownership from one clan or family to another through marriage and sales (URT, 1994).

2.5 Tenure and Common Pool Resources

Common pool resources (CPR) are the resources that are used in common. CPR is a sub category of public goods. Increased ecological concerns changed an old controversial debate on tenure and CPR. The argument against communal management arrangements in favour of private management systems has become even stronger with regards to agricultural land. At the same time, research findings on communal management system and experiences from pilot development activities have questioned the privatization argument and suggested that there might be alternatives (Birgegard, 1993 cited by Kisoza, 2007).

2.6 Land Tenure, Farm Fragmentation and Agricultural productivity

Land is a fundamental factor of production in the agricultural sector. It has an essential role to play in increasing as well as sustaining agricultural productivity.

The extent to which this role is performed is determined partly by methods of land acquisition and arrangements for the ownership and use of land (Arua, 1997). These methods are what known as land tenure. Different types of tenure systems determine the means of land ownership whereby influence different land uses which in turn have an impact on agricultural productivity. According to Arua, 1997 customary land tenure systems are related to family and inheritance systems, and based on the concept of group ownership, this result to increase in farm fragmentation due to increase in population of the family members, therefore farm fragmentation may affect agricultural productivity within the community depending on how the individual utilize the available small plot for production purposes.

This implies that if a certain tenure system does not favour all producing groups then will not be useful in production process. For example, the current customary laws do not provide women adequate right to use land because of tradition and customs. Hansungule (2007) ascertained that though women are the greatest users of land, they do not enjoy equal rights of access to land in both customary and leasehold tenures. The situation results to decreased agricultural productivity due to a reason that there is no enough tenure security to optimize the use of land resources. Security of tenure is the certainty that a person's rights to land will be recognized by others and protected in cases of specific challenges. People with insecure tenure face the risk that their rights to land will be threatened by competing claims, and even lost as a result of eviction. Without security of tenure, households are significantly impaired in their ability to secure sufficient food and to enjoy sustainable rural livelihoods. The attribution of land tenure security may change from context to context. For

example, a person may have a right to use a piece of land for 6 month growing season, and if that person is safe from eviction during the season, the tenure is secure. By extension, tenure security can relate to the length of tenure, in the context of the time needed to recover the cost of investment. Thus the person with rights for 6 months will not plant trees, or invest in irrigation works or take measures to prevent soil erosion as the time is too short for that person to benefit from the investment. The tenure is insecure for long-term investments even if it is secure for short-term ones.

The importance of long-term security has led Arua (1997) to argue that full security can arise only when there is full private ownership (e.g., freehold) as, under such tenure, the time for which the rights can be held is not limited to a fixed period. The author argue further that only an owner enjoys secure rights, and holders of lesser rights, such as tenants and have insecure tenure because they are dependent on the will of the owner. It is then imply that land tenure security comes only with holding transfer rights such as the rights to sell and mortgage.

2.7 Land Policy in Tanzania

The national land policy of 1995 sets the direction for land reform for significant changes to land acquisition property rights. The land reform distinguishes between the land under the authority of central government and the land under the village authority. Land Act, 1999 section 58 entitled elected village councils to be the land managers charged with the supervision of adjudication and registration of village land within their villages, including range and forest land (URT, 1999). The national

land policy (NLP) provides incentives for more efficient use of land and its resources. As Mariki (2000) observes, land policy encourages legal ownership of land by individuals, the private sector, communities and village through acquisition of title deeds, and these measures are meant to reduce land use conflicts and increase the value of land. The NLP links land development with other policies of all land based sectors including livestock, agricultural policies, natural resources and settlements (Tsoxo, 2006).

To facilitate proper planning and use of land for development of all sectors, the national land policy uses planning commission known as national land policy planning commission (NLPPC) which was established in 1984. The NLPPC focuses on coordinating activities of the bodies concerned with land use planning as well as enhancing cooperation between the land users (Tsoxo, 2006). The NLPPC is also tasked to enhance private and public participation in programmes related to land use planning and ensuring accountability of the users or developers. Despite the existence of this body for two decades, there have been limited strides towards achieving the stated objectives and the much desired land use planning at a village levels.

2.8 Concept of Farm Fragmentation

Farm fragmentation has been defined in different ways: for example, Yao (1998) defines farm fragmentation as the subdivision of farm property into undersized units too small for rational exploitation; and the excessive separation and dispersion of the parcels forming parts of a single farm. Farm fragmentation is also defined as a

situation where a farming household possesses several non-contiguous land plots often scattered over a wide area, which is a common phenomenon in many countries around the world. Such a phenomenon is often viewed as an obstacle to agricultural productivity and modernization (Bentley, 1987).

2.8.1 Theory of farm fragmentation

The term farm fragmentation is used as a synonymy of field scattering or field dispersion (Kadigi and Mbiha, 2000). Farm fragmentation however is used to describe the process whereby a larger land holding is divided among several heirs, thus resulting into smaller units without necessarily increasing field dispersion per household (McPherson, 1982). McPherson (1992) further argues that farm fragmentation is not only a unique characteristic of agrarian structures in developing countries but also a common feature in many early European farming communities.

According to Shushao (2008) fragmentation means a land holding consisting of several scattered plots over a wide area. On the other hand Agarwal (1972), basing on a detailed review of work on land consolidation, defines land fragmentation as a decrease in the average size of farm holdings, an increase in the scattering of each farmer's land, and a decrease in the size of the individual plots in a farm holding. In contrast with the views in the above definitions, Kalanthari *et al.*, 2008 see fragmentation as a stage in the evolution of the agricultural holding in which a single farm consists of numerous discrete parcels, often scattered over a wide area. Therefore, from these arguments farm fragmentation is basically associated with some sort of risks. The risk theory of farm fragmentation, the nature and level of

fragmentation of farms appear to be the outcome of a combination of factors which influence supply and demand driven factors (Kadigi and Mbiha, 2000).

2.8.2 Causes of farm fragmentation

The causes of farm fragmentation can be divided into two broad categories. The first category regards fragmentation as a result of supply side factors whose explanations treat fragmentation as an exogenous imposition on the farmers. These supply side factors are partial inheritance system or population pressure, significant imperfections in the land market and the breakdown of common property system under the pressure of population growth (Arsalanbod, 2000). The theory explains further that farm fragmentation is a result of an increase in population densities which create more pressure on land hence increasing the rate of field scattering (Kadigi and Mbiha, 2000). Farm fragmentation leads to a decrease in agricultural production resulting from increased travelling time between fields, reduced scope for irrigation and soil conservation measures, loss of land for boundaries and access routes and other externalities such as conflicts for boundaries among neighbours (Kadigi and Mbiha, 2000).

It is logical to argue that partial inheritance leads to land fragmentation when land with similar quality is equally divided among heirs. This supply side explain land consolidation as imperfection of the land market.

According to Arsalanbod (2000), supply side explanations are not sufficient to explain fragmentation in many areas in which land fragmentation is not related to partial inheritance system or population pressure, significant imperfections in the

land market and the breakdown of common property system under the pressure of population growth. But fragmentation is also seen as a result of rational economic decision. This is the demand side explanations which presume that farmers, given a freedom of choice, choose levels of fragmentation that are beneficial, and that the private benefits of fragmentation exceed private costs (Kadigi and Mbiha, 2000). Firstly, land fragmentation may be logical and responsive to soil and crop variations or to spreading the risk of climate and soils. Small field tends to reduce the damage of soil erosion and protect crops in a severe climatic condition. Since crops have distinctive growth requirements, a diversification in agricultural production caused by land fragmentation may reduce the risk of climate and soils in total agricultural production. This production diversification may also ease the seasonal labour bottleneck.

Secondly, land fragmentation may be suitable for certain technological and natural conditions and the scattering of land reduces the risk of total loss from drought, flood, fire and other natural disasters, price uncertainty, and other changes in crop production by diversifying cropping mixtures across different growing conditions. This is particularly true when risk-spreading mechanisms, such as insurance, storage or credit, are not well developed (Blarel *et al.*, 1992).

An increasing human population and the intensity of cultivation coupled with overgrazing are believed to have contributed immensely to the severe soil and land fragmentation that reduced the carrying capacity of land (Kalantari *et al.*, 2008). Scattering of land for inheritance leads to land fragmentation when farmers desire to

provide pieces of land to several heirs. This situation resulted into increased farm fragmentation in most developing countries (Udo, 1965).

The alternative risk-spreading mechanisms such as insurance, storage or credit lead to land fragmentation and this becomes a means for risk reduction. When food commodity markets fail, land fragmentation may be beneficial for crop diversification, allowing farmers to grow (non-marketed) subsistence (Fenoaltea, 1976). Fenoaltea, 1976 argues further that the scattered pieces of land enable farmers to allocate their labour over the seasons.

2.8.3 Measures of farm fragmentation

Despite being a common phenomenon, measures of land fragmentation are diverse. In the past, many ways were used to measure land fragmentation. The diversity nature of measure of land fragmentation meant that the extent of land fragmentation varies greatly in different countries hence fragmentation became a confusing term (Walker, 1990). Generally, a distinction can be made between single dimension indicators and integrated indicators. Single dimension land fragmentation indicators are used in many studies.

According to Walker, 1990, there are three single indicators which are used to identify the level of farm fragmentation which are: (i) the number of land owners per country, (ii) the number of users per country and (iii) the overlap of these two indicators. The fragmentation of managed land is often much lower in the areas where land leasing is common. Bentley (1987) identifies six parameters to measure the extent of farm fragmentation. These are farm size, total number of plots in the

farm, average plot size, distribution of plot sizes, spatial distribution of plots and the shape of plots. Farm size is used to measure the total holding of a farm.

The author also identifies the size and spatial distribution of plots (i.e. distance) as the most significant indicators of land fragmentation. The shape of the plot is an important parameter when mechanization is introduced into an agricultural system. For example, farm machinery is regarded to be most efficient on rectangular plots. In contrast with the single dimension indicators, the integrated indicators try to capture the information from several single indicators into one index. The two most popular integrated indicators are the Januszewski Index (*JI*) and the Simpson Index (*SI*) (Blarel *et al.*, 1992).

The *JI* value combines information on the number of plots, average plot size and the size distribution of the plots. The *JI* has three properties which are (i) fragmentation increases when the number of plots increases, (ii) fragmentation increases when the average plot size declines, and (iii) fragmentation decreases when the inequality in plot sizes increases. The smaller the *JI* value the higher the degree of land fragmentation. This index, however, fails to account for farm size, plot distance, and the shape of the plots.

The Simpson Index (*SI*) resembles, to some extent, the Januszewski's index. Contrary to the *JI*, a higher *SI* value corresponds to a higher degree of land fragmentation. The value of the Simpson Index can be determined by the number of plots, average plot size, and the plot size distribution. However, *SI* does not take into account the farm size, distance, and the plot shape.

Simpson Index for the level of farm fragmentation is stated as follows;

$$SI = 1 - \sum_i A_i^2 / A^2$$

Where:

SI = Simpson Index,

$i = 1 \dots \dots \dots n^{\text{th}}$ plot

A_i = area of the i^{th} plot

$\sum A_i$ = total farm area

The value of Simpson Index is between 0 and 1, the higher the *SI* values the higher the degree of land fragmentation.

2.8.4 Benefits and costs of farm fragmentation

The persistent and widespread nature of land fragmentation in rural societies relate to the trade-off of its benefits and costs for the individual farmer or the society as a whole. The presence of social costs and benefits suggests that the optimal level of fragmentation for private farmers may not be the same as the social optimum (McPherson, 1982).

Different farmers perceive the benefits of land fragmentation differently. Some farmers prefer fragmented plots to reduce the risk of climate change, soil, fire and drought through the spatial diversification of activities and to have access to land with different quality; farm fragmentation allows farmers with scattered plots to benefit from risk management through the use of multiple ecozones and crop scheduling practice (Bentley, 1987). Fragmentation also makes it possible for farmers to grow a variety of crops that mature and ripen at different times, so that

they can concentrate their labour on different plots at different times, thereby avoiding household labour bottlenecks (Bentley, 1987).

◀ **CHAPTER THREE** ▶

3.0 METHODOLOGY

3.1 Overview

This chapter presents a description of the study area, research design, sample size, sampling procedure, data collection sources and data collection methods and tools. Also presented in this chapter are the data analysis methods and the materials which were used to meet the study objectives as well as conceptual framework and limitation of the study.

3.2 Description of the Study Area

3.2.1 Location of the study area

This study was conducted in Kilosa district which is among the six districts of Morogoro region. The district is located in the north western part of the region. It lies between latitude 6°S and 8°S and longitude 36°30'E and 38°E. The district shares borders with Kilindi (Tanga) and Kiteto (Arusha) districts to the north, Mpwapwa (Dodoma) and Mvomero (Morogoro) to the east and west respectively, and Kilombero (Morogoro) and Kilolo (Iringa) district to the south. Kilosa district has a total area of 1 456 798 ha. It has an average north-south length of 180 km with an east-west width of 80 km. Kilosa district is divided administratively into nine divisions with 36 wards and 164 villages (Shishira *et al.*, 1997).

3.2.2 Soils and land cover

Soils in the district range from dark-red-brown sand loam in most parts to sand clay in the valleys (NBS, 2002). Different soil types support different land covers and uses. However, the district is dominated by Savannah grasses extending from lowlands to highlands thus providing a variety of flora and fauna (species specification) products to the communities around. The road covers and uses in the district are as follows: About 4.9% is settlement and urban areas, 19% of land area comprises Mikumi national park and Selous game reserve, 4.5% catchments and plantation forest reserves and 71.6% comprises forests on general land (Shishira *et al.*, 1997).

3.2.3 Climate and altitude

The rainfall distribution in the district is bimodal, with short rains in October to January and long rains in February to May. The annual rainfall is between 800-1400 mm and the mean annual temperature in Kilosa town is 25⁰C. The district lies between 200 and 700 m above the sea level. Both climate and altitude support a wide range of land covers and uses (NBS, 2002).

3.2.4 Population

According to the 2002 Tanzania national census, Kilosa district had 105 635 households and a population of about 489 513 persons (NBS, 2002). The average household size was 5 persons with the population growth rate of 2.6. In 2005, the district was assumed to have a constant growth rate and the same average household

size. There are three major indigenous ethnic groups in the district namely, Kagulu, Sagala and Vidunda, and all these are agriculturalists. The district has immigrant groups such as Maasai, Sukuma and Hehe who are involved in farming, business and pastoralism.

3.2.5 Socio-economic activities

The main economic activities in the district include farming, livestock keeping and off farm activities such as formal employment and trading of marketable agricultural products.

3.3 Research Design

Cross sectional research design approach was used in the study whereby data were collected from the field at a single point in time. The cross sectional design was adopted because it is cheap, quick and it is efficient in terms of utilization of limited resources such as finances, labour, transport and time.

3.4 Sample Size and Sampling Procedures

The sample size from which the data were collected comprised of 90 respondents. This sample size was convenient and met study objectives. Purposive samplings was conducted and choose Kilosa district because of large area surrounded by forests, Mikumi national park and Selous game reserve which in turn result to land scarcity therefore causing fragmentation. Multistage sampling technique was used in collecting the data from the respondents. Kilosa district has many wards, but three wards were selected for data collection as they had land scarcity and land conflicts among farmers and pastoralists. Simple random sampling technique was used in

three villages from each ward which had scattered and small plots indicating existence of farm fragmentation, making a total of nine villages. In each village, 10 respondents were randomly selected.

3.5 Sources of Data

3.5.1 Primary data

The sources of primary data were heads of household from the field, village leaders and key informants at village and district levels.

3.5.2 Secondary data

Secondary data were obtained by reviewing relevant literature. The potential sources of secondary data were books, research papers and journals in libraries and internet.

3.6 Data Collection Methods and Tools

Tools for the study included focus group discussion, key informants, and structured questionnaires. Focus Group Discussion was applied to capture non quantifiable information especially on the existing land tenure systems, the level of farm fragmentation and their effects on agricultural productivity. The discussions targeted on areas with high level of farm fragmentation in the study area. This helped to gather data from many respondents in a short time. A group of eight farmers per discussion was used; a maximum number of eighty people per group were found convenient for logistic purposes.

Key informants were used to gather knowledge on the issues concerning land tenure and farm fragmentation. Key informants are people with great depth of knowledge

on matters under land tenure system and farm fragmentation. For this study, the key informants were village leaders and agricultural extension officers. A structured questionnaire was used to capture primary data concerning the effects of land tenure systems and farm fragmentation in the study area. Relevant questions were asked by the researcher to the respondents on face-to-face questions and answers. The answers were filled in the spaces provided in the questionnaires as the responses were received from the respondents. The level of farm fragmentation was measured by using Simpson Index (*SI*) using the formula as outlined in the literature review.

3.7 Data Analysis Methods

3.7.1 Descriptive analysis

The study data were analysed through descriptive technique. Descriptive summary statistics such as frequency distribution, means and percentages were used mostly for demographic characteristics of respondents and partly in the specific objectives of the study.

3.7.1.1 Existing land tenure systems in the study area

Tenure systems in the study area were analysed using descriptive statistics such as percentages and frequencies. The systems were described basing on the information given by key informants and other respondents in the study area.

3.7.2 Inferential analysis

The quantitative analytical techniques used include linear regression model and correlation analysis and t-tests for the objectives number two and three.

3.7.2.1 Assessment of factors influencing farm fragmentation in the study area

The factors causing farm fragmentation were analysed using linear regression model and correlation analysis. The linear regression analysis was used because it helps to determine the relationship between independent and dependent variables. The model was specified as follows;

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \dots + \beta_n X_n + \varepsilon \dots\dots\dots (1)$$

Where;

Y= Level of farm fragmentation

α = Constant coefficient when other variables are held constant

β_1 - β_n = The coefficients of respective independent variables

X_1 = Distance from homestead (km)

X_2 = Education level of the heads of household (years)

X_3 = Household size

X_4 = Number of land plots possessed

ε = Random error term

3.7.2.2 Evaluation of effects of tenure systems on farm fragmentation

The effects of different types of tenure systems on the level of farm fragmentation were analysed using correlation analysis to determine the relationship between tenure systems and farm fragmentation. The level of farm fragmentation was measured using Simpson Index.

3.7.2.3 Evaluation of effects of farm fragmentation on agricultural productivity

The effects of farm fragmentation in agricultural productivity were analysed using correlation analysis to determine the relationship between fragmentation and agricultural productivity. The level of farm fragmentation was measured using Simpson Index while agricultural productivity was measured by production per unit area, which imply the number of tonnes produced in an area of one hectare for individual farmer (tonnes/ha).

3.8 Conceptual Framework for the Study

The conceptual framework underlying this study based on the existing land tenure systems and farm fragmentation with their associated effects in agricultural productivity.

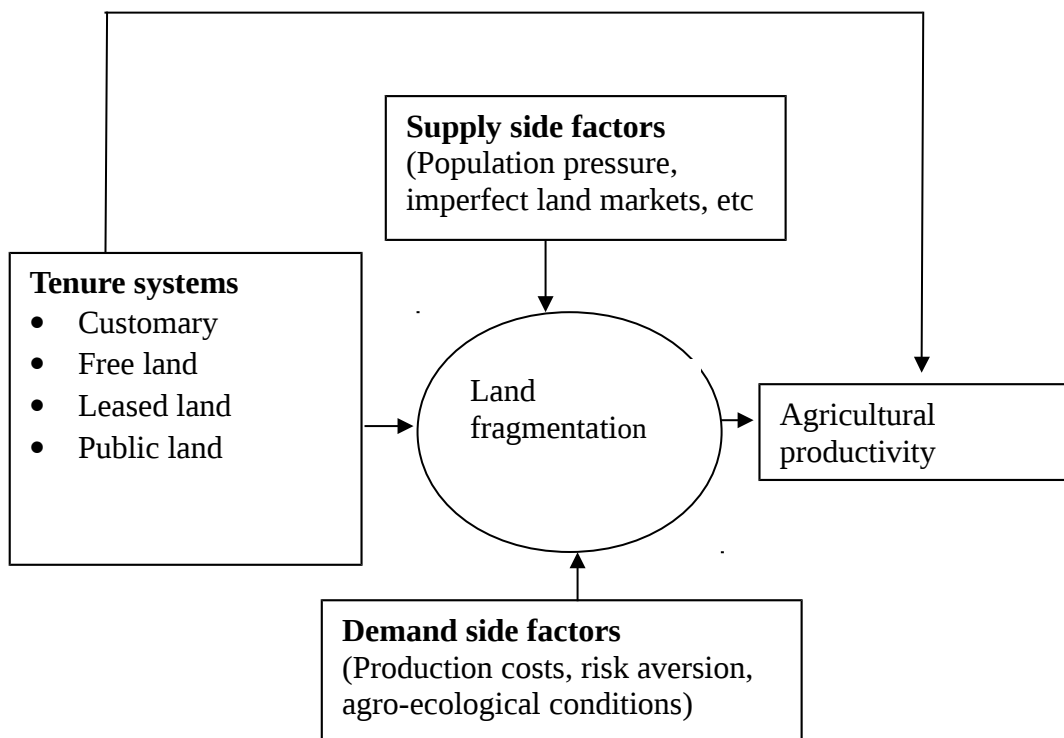


Figure 1: Conceptual framework of land tenure and farm fragmentation

The conceptual framework shows the relationship between land tenure, farm fragmentation and their effects in agricultural productivity. Land fragmentation at the household level is considered as an endogenous variable and the other factors are exogenous variables. Different types of tenure systems are associated with farm fragmentation. These types include customary land tenure, free land, leased land and public land. These tenure systems determine the means of land ownership thereby determine different land uses which in turn have an impact on agricultural productivity.

According to literature there are two causes of farm fragmentation, namely supply side and demand side. On the supply side, partial inheritance system or an increase in population pressure and significant imperfections in the land market have an impact on the level of farm fragmentation either positively or negatively. Likewise, the demand side factors which are production costs, risk aversion and agro-ecological conditions influence the extent at which land can be fragmented or consolidated in the production process. These demand side and supply side factors influence the resulting level of fragmentation and therefore influence agricultural productivity especially when farmers decide either to fragment or to consolidate their land holdings.

3.9 Limitations of the Study

The current study regarding the effects of land tenure and farm fragmentation on agricultural productivity was constrained by respondents' poor memory on income obtained from crop and livestock production, expenditure on agricultural inputs and

expenditure on basic needs such as food, education and health services. Thus, the researcher had to calculate and sometimes make some approximations for the data provided.

During the data collection exercise, the study area was hit by heavy floods therefore it was difficult and expensive to travel from one place to another. Also these floods constrained access to some areas where information was needed therefore making the data obtained at a high cost. Also, such a trend resulted into delays in completing the research work.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSIONS

4.1 Overview

This chapter present and discuss the results obtained from the field. The chapter begins by looking at demographic characteristics of the heads of household, followed by the factors influencing farm fragmentation and the association between farm fragmentation and agricultural productivity. This was done in order to find information about study objectives and research hypotheses.

4.2 Demographic Characteristics of Heads of Household

The demographic characteristics of heads of household in the study area have important social and economic implications towards the existing land tenure systems, farm fragmentation and agricultural productivity. The socio-demographic data collected included; age, level of education, gender, occupation and household size (Table 1).

4.2.1 Age of the heads of household

The results indicate that the ages of many heads of household (63.3%) range from 25 to 45 years, followed by those whose ages range from 46 to 60 years (28%) , followed by 4.4% of those whose ages were above 60 years. The heads of household

with the age below 25 years were the minority group comprising only 3.3%. The highest percentage reflected in the age range of 25-45 could be explained by the fact that these heads of household are in the active age group. This is important in provision of active labour in agricultural production as age usually influence the level of agricultural productivity because active age group tend to produce more. This finding support the observation made in the earlier findings by Regnald (2006) who argued that age reflects decision making abilities. These together have an impact on one's ability to work and hence affect individual productive levels.

4.2.2 Gender of the heads of household

Gender plays an important role in tenure systems in many places. The results of the analysis reveal that most (73.3%) of the heads of household surveyed were male headed and only 26.7% were headed by females. This indicates that men in most of households of sub-Sahara African countries are decision makers as opposed to women. This is because in some tribes and clans, the distribution of land between a male and a female is not equal. Males are given more opportunities for land holding than in the case for females.

4.2.3 Household size

The household size was obtained from the heads of household whose members live together in contact by sharing resources including basic needs. The results show that 64.5% of the heads of household had family members between five and eight people, 30% had between one and four and only 5.5% had more than nine people. This family size indicate available workforce for production though for other

households it does not hold the truth because other family members are not in a working group due to age and being at school.

Table 1: The demographic characteristics of the heads of household (N = 90)

Variable	Percentage
Age structure	
< 25	3.3
25 – 45	63.3
46 – 60	28
>60	4.4
Total	100
Gender	
Male	73.3
Female	26.7
Total	100
Main occupation	
Farming	85.6
Formal employment	11.1
Business	3.3
Total	100
Educational level	
Informal education	2.2
Primary	85.6
Secondary	8.9
College	3.3
Total	100
Household size	
1 – 4	30
5 – 8	64.5
> 9	5.5
Total	100

4.2.4 Level of education of the heads of household

Education level plays a significant role in understanding land tenure systems and their effect on farm fragmentation because people with high literacy level tend to optimize means of land ownership. The results indicate that, the majority (85.6%) of

the heads attained primary education, 8.9% had secondary education, 3.3% had college education and 2.2% had informal education. These findings indicate that most of the farmers take up farming activities after completing their primary education. Because of low education level of farmers, a high proportion of the respondents involved in farming indicating that low level of education limits farmers' opportunities in accessing other activities apart from farming. According to Mongi (2005) education has always been valued as means of liberation from ignorance and enables a person to perform non-traditional roles.

4.2.5 Main occupations of the heads of household

The main occupations of the heads of household found in the study area include farming, business and formal employment. The results indicate that 85.6% of heads were engaged in farming activities, 11.1% of them were in formal employment and only 3.3% were engaged in business activities. Having the highest percentage of household heads engaged in farming is attributed to strong land holding as well as low level of education which limits them on performing other non-farming activities.

4.3 Land Tenure Systems and Agricultural Productivity in Kilosa

A number of land tenure systems were mapped in the study area. The associated effects of land tenure systems on agricultural productivity varied significantly from one type of tenure system to another. Customary land tenure system was found to be the most prevalent type of land holding, particularly for natural pasture resource in

the area. The results indicate that 77.8% of the respondents were using customary land tenure systems.

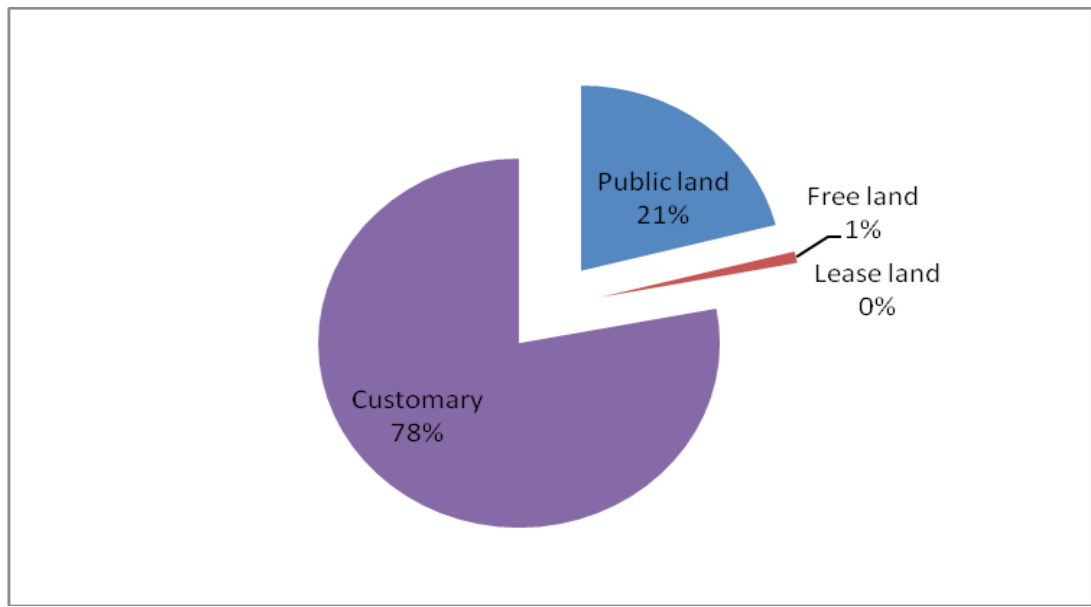


Figure 2: Types of land tenure systems in the study area

Private tenure in the study area is only predominant with the household or residential plots and plots for agricultural productivity which to some extent is limited to grazing reserves. Other means of land acquisition in the study area include public land (21%) and free land holding (1%). Lease land tenure system was not observed in the study area. Customary land tenure system laws and rules have in one way or another influenced agricultural activities. Farmers reported that they are at times restricted from using land for farming because these areas are privately owned. Thus, these areas remain idle leading to a low productivity. These findings are consistently in line with the findings from earlier studies by Famoriyo (1980) who argued that customary land tenure systems are related to family and inheritance systems, and are based on the concept of group or private ownership of absolute

rights in land, with individuals acquiring usufructuary rights. This reduces the access to land utilization among individual members in the society especially when other members are excluded in right to possess land. This has been argued further by Arua (1997) who reported that women normally cannot own or inherit land under customary law, although they retain use rights during their lifetime as long as they remain in the husband's household.

4.4 Factors Influencing Farm Fragmentation in the Study Area

Linear regression analysis was used to establish the relationship between farm fragmentation and its causative factors in the study area. The value of Simpson Index was used to show the level of farm fragmentation. The results were obtained as shown in Table 2.

Table 2: Regression analysis for farm fragmentation and independent variables (N = 90)

Variable	B	Std. Error	T	Sign.
Constant		0.194	1.05	0.000
Age of respondents	-0.008	7.495	-0.25	0.800
Distance from home	0.395 **	0.081	11.28	0.046
Number of plots	0.004	0.870	0.	0.909
			11	
Education of respondents	0.22 ****	0.266	6.	0.000
			37	
Household size	0.81 ****	0.039	25.45	0.000

$R^2 = 0.76$, Adjusted $R^2 = 0.690$, **** statistically significant at $P < 0.01$ level, ** statistically significant at $P < 0.05$, * statistically significant at $P < 0.1$.

The results of regression analysis reveal that farm fragmentation is greatly influenced by the household size. The relationship between farm fragmentation and the number of people per household was highly significant at $P < 0.01$ level of

significance, the household size indicates a positive coefficient (0.82). This implies that as the number of people increases per household, the more the farms get divided into several plots thus increasing the level of farm fragmentation.

In addition, households with more people tend to cultivate more plots than households with fewer people provided they are active in farming activities. This supports the hypothesis that partial inheritance system or population pressure causes land fragmentation. It is logical to argue that partial inheritance leads to land fragmentation when land with similar quality is equally divided among heirs.

Educational status of the heads of household has an impact on the level of farm fragmentation and this was significant at $P < 0.01$. Educational level reveals a positive coefficient (0.22) in farm fragmentation. This implies that an increase in the education level results to an increase in the level of farm fragmentation. Farmers with high literacy levels tend to acquire more land from different areas which basically translates into increased productivity when they efficiently use their land holding.

The results reveal that there is a relationship between farm fragmentation and the distance between the plots and the homesteads. The distance between the plots and the homesteads was significant at $P < 0.05$. The positive coefficient (0.4) of distance between the plots and homestead reduces agricultural productivity because the labour hour is reduced due to time lost in walking. The reason for this as provided by farmers was that when many plots are located further, it helps to reduce the risks of pests, diseases, and soil erosion. This perception is also shared by Kadigi and Mbiha (2000) who argue that the risk theory of farm fragmentation assumes that

farmers will tend to adopt a risk averse behaviour by spreading parcels in different locations. The theory acknowledges the heterogeneity and risky nature of the agro-ecological environment in which these farmers operate.

Table 3: Correlation analysis for farm fragmentation and types of tenure systems (N = 90)

Variable	Coefficient B	Sign.
Free land	0.58	0.273
Public land	0.117	0.100
Customary land	0.350	0.000
Lease land	-0.192	0.65

(Using Pearson correlation, 2- tailed, N = 90)

The results from correlation analysis (Table 3) indicate that among the assessed variables, free land, public land and customary tenure systems are positively associated with the level of farm fragmentation. Public land and customary land tenure systems were significant at $P < 0.1$ and $P < 0.01$ levels respectively. Public land (0.117) was positively correlated and was significant at $P < 0.1$. Customary land tenure (0.350) being significant at $P < 0.01$ level and mostly used type of tenure system affect the level of farm fragmentation. This may hold truth especially when small portion of land is more divided to other family members due to an increase in population in the family. The negative association was shown between free land tenure systems on the level of farm fragmentation which shows that lease land tenure systems have a negative relation with the level of farm fragmentation in the study area. This findings support the hypothesis that land tenure systems has an effect on the level of farm fragmentation.

**Table 4: Correlation analysis for farm fragmentation and selected variables
(N = 90)**

Variable	Coefficient B	Sign.
Age of heads of household	0.175	0.100
Household size	0.117	0.273
Distance from homestead	0.370	0.000
Number of plots	0.192	0.70
Education level of heads of household	0.058	0.589
Types of tenure systems	-0.114	0.283

(Using Pearson correlation, 2- tailed, N = 90)

The results from correlation analysis (Table 4) indicate that among the assessed variables, five are positively associated with farm fragmentation except the types of tenure systems which had a negative association with farm fragmentation. Only the variables of the age of the household heads and the distance from the homestead were significant at $P < 0.1$ and $P < 0.01$ levels respectively. The age of the heads of the household (0.175) was positively correlated and was significant at $P < 0.1$ level, implying that an increase in the age of the head of the household influences positively the level of farm fragmentation. This sound valid because when farmers get older there is a tendency of increasing family size which in turn affects farm fragmentation due to an increase in population pressure. The distance from homestead (0.370) being significant at $P < 0.01$ level implies that farm fragmentation increases when distance increase. Farmers tend to cultivate small plots in different areas due to distance from home because of labour time lost in travelling, operational difficulties such as moving heavy inputs and equipments, and

pest control. Furthermore, it is difficult to supervise labourers in large scale farms. The negative association was shown between customary, public land and free land tenure systems on the level of farm fragmentation.

4.5 Correlation Analysis between Farm Fragmentation and Agricultural

Productivity

The results of correlation analysis indicate that there is a positive relationship between farm fragmentation and agricultural productivity at $P < 0.01$ (Table 4). This implies that farmers will be encouraged to produce when productivity increase which results to division of small plots. On the other hand, farm fragmentation may increase the level of agricultural productivity. This can be attributed to the fact that farm fragmentation helps in spreading the risk of climatic change and other hazards including the soil and crop variations. This point supports the argument that farm fragmentation is beneficial and it is the farmers' choice to fragment their land holdings.

Table 5: Results of correlation analysis (N = 90)

		Productivity (tonnes/ha)	Land fragmentation
Productivity (tonnes/ha)	Pearson	1	0.458 **
	Correlation		
	Sig. (2-tailed)	0.00	0.000
	N	90	90
Land fragmentation	Pearson	0.458 **	1
	Correlation		
	Sig. (2-tailed)	0.000	0.00
	N	90	90

** Correlation is significant at $P < 0.01$ (2-tailed).

4.6 Benefits and Costs of Farm Fragmentation

The persistent and widespread of land fragmentation in the rural societies are based on the trade-off of its benefits and costs to individual farmers and society as a whole.

The findings of this study reveal that social costs and benefits of farm fragmentation for private farmers differ significantly from farm fragmentation obtained from the society.

The benefits of land fragmentation varied from one individual to another. The argument of farmers towards farm fragmentation was that the fragmented plots reduce the risk through the spatial diversification of farming activities as well as access to more land in different areas.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

There were a number of land tenure systems identified in the study area. The associated effects of land tenure systems in agricultural productivity varied significantly from one type of tenure system to another. The ownership of land with the highest percentage responses of customary land tenure system is due to inheritance and other traditional beliefs such as marriage. Other types of tenure systems found to exist in the area include free land and public land. Lease land was not observed in the study area. This means that customary land tenure system is the basic means of land ownership for most of the farmers.

The results of regression analysis indicate that farm fragmentation is greatly influenced by household size and education level of the head of the household and was statistically significant at $P < 0.01$ and the distance from the homestead at $P < 0.05$. As for the household size, the results show that as the number of people increases per household, the more farms get divided into several plots thus increasing the level of farm fragmentation. Furthermore, households with more people tend to cultivate more plots than households with fewer people provided that they are able to produce. This supports the hypothesis that partial inheritance system or population pressure causes land fragmentation. The results also show that the education level of the heads of the household has an impact on the level of farm fragmentation. This implies that an increase in the level of education results to an increase in the level of farm fragmentation. This means that farmers with high

literacy levels are more aware on the importance of land acquisition, therefore they tend to acquire more land from different areas translating into an increased productivity. The regression results indicate further that the distance between the plots and home implies that as more plots get located further, farm fragmentation increases because farmers will have different plots at different areas. At this point of view imply that farm fragmentation is beneficial to farmers because having many plots located further helps in reducing risks of pests, diseases and soil erosion. However, it may result to decrease in agricultural productivity especially when many working hours are lost during walking.

Also from this study; the results of correlation analysis indicate that public land and customary tenure systems are positively associated with the level of farm fragmentation at $P < 0.1$ and 0.01 respectively. This implies that the two types of tenure systems being the most used in land tenure systems affect the level of farm fragmentation. In customary laws, when farms get divided among family members due to increase in family members, it results to increase on the level of farm fragmentation. From these results, it is revealed that land tenure systems have an effect on the level of farm fragmentation.

On the other hand, correlation analysis revealed further that age of the heads of household and the distance from the homestead is positively associated and is significant at $P < 0.1$ and $P < 0.01$ respectively. This means that the level of farm fragmentation was affecting the age of the heads of the household. This is logical especially when it is associated with marriages and an increase in the number of

family members. On the other hand, the distance from homestead increased farm fragmentation because farmers tend to decrease the area of production when the farm is located further due to time lost in travelling from home to the farm. It is also difficult to control pests and diseases, moving heavy equipments, inputs and machinery and labour supervision. Therefore farmers are likely to cultivate small plots in different areas which also help in risk aversion.

A positive association was also observed between farm fragmentation and agricultural productivity at $P < 0.01$ which support the stated hypothesis. This is because households with many fragmented plots may use the land rental market to decrease the dispersion of their land and increase production efficiency. In other words, land renting in and out influences positively the level of farm fragmentation.

Secondly, land fragmentation may be a reasonable response to soil and crop variations or to spreading the risk of climatic and other hazards. Also land resource is rarely homogeneous in terms of soil types, water and nutrient holding capacities and agro-ecological conditions.

Basing on the results of the linear regression analysis and correlation analysis it can be concluded that land tenure systems have an effect on the level of farm fragmentation and therefore influence agricultural productivity in the study area.

5.2 Recommendations

Basing on the observations from the research, the following recommendations can be made:

- i) Land policies should be revisited because customary land tenure system being the most used type of tenure system should be viewed for improvement so as to increase land utilization and productivity. Land tenure under customary laws does not provide adequate security to land owners which affect productivity since ownership is uncertain. Not only that but also it is gender unbalance because women are less considered in land ownership. The government should intervene by reframing land policies, in which through customary laws provision of certificates and land title will improve land security and access to financial services.

- ii) Government intervention in land administration is very important in order to improve land uses. This is because land administration comprises an extensive range of systems and processes to administer which include land rights where by the allocation of rights in land, the delimitation of boundaries of parcels for which the rights are allocated, the transfer from one party to another through sale, lease, loan, gift or inheritance, and the adjudication of doubts and disputes regarding rights and parcel boundaries will be controlled. Not only that but also it will give land-use regulation where by land-use planning and enforcement and the adjudication of land use conflicts will be controlled.

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APPENDICES

Appendix 1: Questionnaire for land tenure and farm fragmentation in Kilosa District

A: Household information

1.0: General information

Enumerator name.....

Date.....

Questionnaire number.....

Division.....

Ward.....

Village.....

2.0 Background information of respondent

2.1 Name of respondent.....

2.2 Are you the head of the household? (1) Yes (2) No

2.3 If not, relationship of respondent with the head of household..... (1) Wife (2)

Uncle (3) Husband (4) Aunt (5) Son (6) Daughter (7) In law (8) Others..... (Please specify)

2.4 Gender of the head of the household (1) Male (2) Female

2.5 Age of head of household

2.6 Marital status of head of household (1) Single (2) Married (3) Separated (4)

Widowed

2.7 Main occupation of head of household (1) Farming (2) Employed (3) Business

(4) Others..... (Specify)

2.8 Household size..... (number)

Please complete this table for all family members (including children) currently residing in your household

No.	R/ship to HH head	Sex: M=1, F=2	Age (years)	Education level	Occupation	Full=1, Part time=2, other occupations=3 No work=0
1.	HH head					
2.	Spouse					
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						

2.9 Are you resident of this village? (1) Yes (2) No

2.10 How long have you lived in this village? years

3.0 Land tenure systems

3.1 What are the types of tenure systems exist in the village? (1) Customary land tenure (2) Free lands (3) Leased land (4) Public land

3.2 How many hectares do you own? ha

3.3 Have you sold or permanently transferred any of your land holdings to other farmers in the past ten years? (1) Yes (2) No

3.4 If yes, please complete this table for all parcels which you have sold or permanently transferred to other users. (Table of land acquisition)

Parcel (ha)	Year originally acquired	Form of acquisition: Inherit=1, Purchase=2, Gift=3, Village Govt.=4,Others =4 (specify)	Year of transfer	Form of transfer	Document used: Title deed=1, Customary=2, Rented/borrowed=3, Offer of right of occupancy=4.No document=5	Price (Tshs)	Reason (s)

3.5 If you inherited your land holding, did you inherit the entire holding of your parents?

(1) Yes (2) No

3.6 Have you leased land ten years ago? (1) Yes (2) No

3.7 If yes, a)..... ha b) At what price? Tshs/ha

3.8 From whom did you lease the land? (1) Private farmer ha (2) Village governmentha (3) othersha (Specify)

3.9 Would you like to own or lease more land? (1) Yes (2) No

3.10 If yes, what constrained you from buying or leasing more land? (1) Lack of information (2) Lack of available land (3) Legal constraints (4) Others (Please specify)

4.0 Land use, management and farm fragmentation

4.1 How many fields do you have? (Number)

4.2 How many ha did you cultivate last season? ha

4.3 For how long have you been cultivating that area?years

4.4 Does your household have fields which previously were cultivated but currently not in use? (1) Yes (2) No

4.5 If yes, what are the reasons for abandoning the fields? (Circle that apply)

1. Machine application is not possible because of steep elevation of the land
2. Machine application is not possible due to fragmentation of the land holding
3. Due to low production per unit area
4. Due to distance of the arable plot from the homestead
5. Due to employment of members of the household off the farm
6. Due to old age
7. Due to unorganized purchase of agricultural inputs and low selling price of products
8. The young people are not interested in farming
9. For the needs of my family, there is no reason cultivating the entire land holding
10. Lack of credit
11. Cultivated all the land
12. Others..... (Specify)

4.6 Is your land for farming adequate? (1) Yes (2) No

4.7 If not, what are the reasons?

4.8 If not, what are your plans?

4.9 What future plans do you have concerning agricultural production?

4.10 Are you planning to change the present land use? (1) Yes (2) No

4.18 What are your comments on improving land tenure systems so as to increase agricultural productivity?

Appendix 2: Checklist on land tenure and farm fragmentation for key informants (District Agricultural Officer, Ward Agricultural Officer)

1. Date:
2. Designation
3. What is the size of land in your area? ha
4. What are the land use options in the area?
5. What size is arable for agricultural production? (ha)
6. How much of land is not agriculturally productive (refer to bare land and rocky) and how is it used?
7. What are the types of existing land tenure systems present in your area?
8. Which one is the most commonly used? Please give reason(s)
9. Do you have land conflicts?
10. If yes, what is the source of these conflicts and how do you solve them?
11. What are the forms of land acquisition present in the area.....
12. Which documents are commonly used in land acquisition?
13. What other products do people get from land? Please list all goods and services which are available in the area.
- 14 What are the reasons for land fragmentation in the area?

15. What is/are the reason(s) of farm fragmentation?
16. What is/are your suggestions in order to improve land tenure systems for the farmers desired land size so as to increase agricultural production?