LAND TENURE SECURITY, FARM INVESTMENT AND TECHNICAL EFFICIENCY IN GHANA

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MICHAEL AYAMGA

THIS DISSERTATION IS SUBMITTED TO UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF DOCTOR OF PHILOSOPHY DEGREE IN DEVELOPMENT STUDIES

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DECLARATION

I hereby declare that the work presented in this dissertation is the result of my own investigation, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award or degree in any University.

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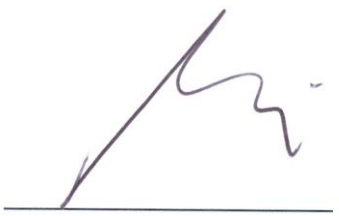

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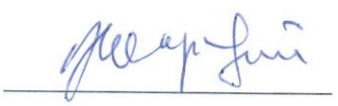

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ABSTRACT

Governments and policy makers in Sub-Saharan Africa are increasingly becoming aware of the implications of land market imperfections for long-term sustainable economic growth and development. A direct consequence is the implementation of land administration reform programmes across the sub-continent, driven largely by neo-classical theory arguments that individualisation of land tenure (leasehold and freehold ownership) increases tenure security of the landholder, increases investment and also leads to the emergence of markets that transfer land to producers able extract higher value of product from land (productive efficiency). Land tenure insecurity has often been associated with land use arrangements that confer land rights to groups rather than to the individual end user. With over 80% of land in Ghana is held under such communal arrangements, there are concerns over how indigenous Ghanaian land use arrangements and land rights forms influence holders' evaluation of their tenure security and by extension their willingness to undertake long-term land improvement investments.

This study examines how land tenure arrangements in Ghana influences land tenure security, farm investments and technical efficiency, using data from six regions in Ghana. The study is anchored in the theories of evolutionary land rights, share tenancy, efficiency and the household. The study specifies a household investment model and a frontier model to analyse how indigenous Ghanaian land use arrangements affect farm investments and technical efficiency respectively. The study finds that private ownership of land significantly influences the probability of households deciding to invest while documentation of land rights did not. With respect to the levels of household investments in soil and water conservation and in irrigation, both individual ownership and documentation of rights have significant positive effects. The study also finds that land transactions that transferred permanent rights to the holder such as outright purchase and cash renting are negatively correlated with technical inefficiency, an indication that monetisation of land transaction helps to reduce tenure insecurity. Technical inefficiency is also positively associated with production on family or sharecropped land. Among other things, the study recommended interventions such as imposition of idle land taxes and minimum lease terms to discourage speculative demand for land and uncertainty associated with short term land use arrangements respectively.

DEDICATION

I dedicate this dissertation to the Memory of the late Professor Thomas Bayorbor.

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I give glory to God for sustaining me through this PhD research and my stay at the University of Ghana. I acknowledge the invaluable contributions of my esteemed supervisors; Professor Ernest Ayeetey, Professor Wayo Seini and Rev. Dr. Samuel Asumming-Brempong. I appreciate your mentorship and patience in guiding me through the PhD research process. I would like to thank Dr. Anik Bhaduri of the Centre for Development Research (ZEF) University of Bonn, for his invaluable suggestions at the conceptualisation stage which helped shape the focus of this research, and for the software support he provided during data analysis.

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CHAPTER ONE
INTRODUCTION

1.1 Land Tenure and Economic Growth

Land tenure and its influence on investment, economic growth and development have become central issues in research and policy. Governments and policy makers in developing economies are increasingly becoming aware of the implications of land market imperfections for long-term sustainable economic growth and development. In almost all developing economies, there appear to be consensus on the link between well-defined and protected land rights or tenure security on the one hand and investment, land use efficiency and economic growth on the other. Ownership of land is perceived to be able to improve access to finance to enable households make indivisible investments they would otherwise not have been able to undertake. Access to land is even suggested to have impact on household nutrition and use of family resources including labour (Burgess, 2001). Codification and protection of land rights is therefore widely regarded as preconditions for increased investment and economic growth.

Population growth and urbanisation are increasing pressure on land across several African countries. Improving productivity and sustaining growing populations in the course of development requires sustained investments in land that cultivators would likely make if land rights were secure (Boserup, 1965). Efficient land transfer mechanisms are expected to transfer to the tenant or new owner, a gamut of rights that define how land is used as a factor of production and also a store of wealth. Producers who have insecure or short-term land rights are unlikely to invest their full effort (Marshal, 1890; Mill, 1848) to make long-term improvements

attached to the land (including services), or to exchange it with producers who could make better use of the land, thereby reducing productivity and possibly hindering emergence of a vibrant non-farm economy. Where land transactions adequately protect the rights of the contract holder, they are induced to produce the optimal level of output where the marginal product of the worker's extra effort equals the marginal cost of applying that effort and therefore leads to efficient allocation of resources (Varian 1993; Ahmed 2002). The perceived benefits associated with individualisation of land rights have continued to drive land policy and research in countries whose economies are largely driven by land based activities such as crop agriculture. The dominant theme in most of the land research in Sub-Saharan Africa has revolved around the land factor, land tenure security and access to credit, farm investments and productivity; with a growing number of studies seeking a better understanding of land transfer mechanisms and how the resulting land transactions influence land tenure security, investment and productivity.

1.2 Tenure Insecurity, Investment and Productivity: The Theory

Neo-classical theory has over the years profoundly articulated the privatisation of land rights as a precondition for investment and economic growth. Individualisation of land rights is perceived to provide incentives for agricultural investment, improve access to credit as well as reduce fragmentation and conflicts over land.

Figure 1.1 highlights the relationship between land tenure security (individualised land rights) and productive efficiency within the context of neo-classical theory of land tenure. The theory argues that well-defined and protected land rights influences efficiency and economic growth by providing security that increases the willingness of individuals to invest, improves credit demand

supply and, and facilitate efficient land transactions that enable producers with higher abilities gain access to land.

Figure 1.1: Theoretical Relationship between Tenure Security and Productive Efficiency

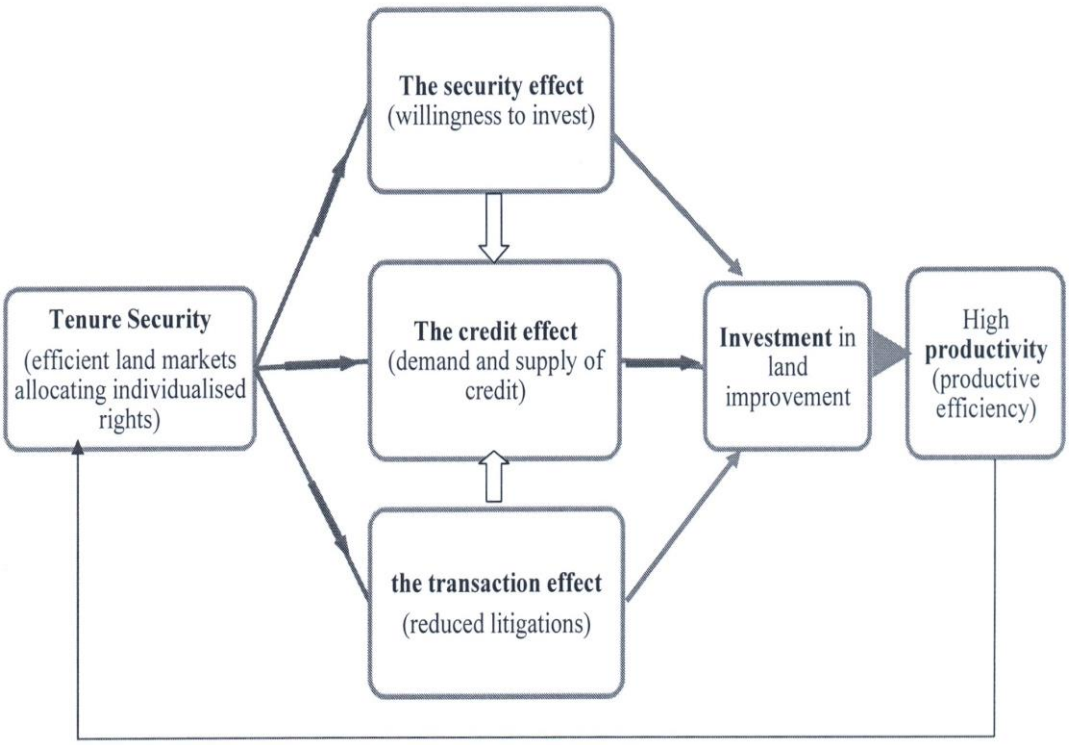


Figure 1.1 illustrates how demand-side (incentives to farmers) and supply-side (incentives to lenders) factors interact in neo-classical hypotheses of land tenure security:

(i) Individualisation increases investment by improving tenure security. Higher tenure security increases expected investment returns, thereby increasing the demand for capital (including credit) for land investments.

(ii) Individualised land rights accompanied by transferable titles improve the creditworthiness of the landholders, thus enhancing the lands' collateral value, and thereby raising lenders' expected returns.

(iii) Individualisation will cause efficient land market to emerge. Land will be transferred to those who are able to extract a higher value of product from the land as more productive users bid land away from less productive users i.e. land is allocated to more efficient producers. In addition, increased tenure security would reduce both transaction costs and the incidence of disputes, thus freeing up resources, which would otherwise have been used for litigation.

(iv) Improved productivity or productive efficiency further increases the incentives of individuals to acquire private land rights, thus reinforcing tenure security.

These neo-classical assumptions have fuelled the widespread call and concerted efforts by policy makers in developing countries to harmonise and formalise land transactions as preconditions for privitisation of land rights.

Across Africa, access to land is largely governed by indigenous land tenure systems which usually involve diverse combinations of "statutory" and "customary" entitlements, and multiple and overlapping rights over the same resource. Earlier emphasis on replacing "customary" with "modern" tenure systems has given way to recognition that land policies and laws must build on local practice (Cotula, 2007). This shift in policy thinking underscores the need for better understanding of how land tenure systems across Africa affect tenure security and investment decisions and by extension land productivity.

Tenure insecurity is defined as the perceived probability or likelihood of losing ownership of a part or the whole of one's land without his/her consent (Sjaastad and Bromley, 1997; Alemu, 1999). The strength of this perception may have a bearing on how farmers manage their land and this in turn has an effect on agricultural production and sustenance of the people who directly depend on it. By providing incentives for exerting non-observable extra efforts (Deininger and Feder 1998) and for the use of purchased inputs, tenure security may have an impact on productivity and farm output, even in the short run. On the other hand, tenure insecurity discourages investment in land by removing the incentives for it, as the likelihood of losing the rights to collect future or expected stream of benefits from efforts and investments are high (Alemu, 1999; Maxwell and Wiebe, 1999; Deininger and Feder, 1998; Li, Rozelle, and Brandt, 1998; Kidanu and Alemu, 1994; Lawry, 1994).

Despite the cogent arguments linking protected (individualised) land rights to increased access to finance, high investment and productivity (efficiency), existing empirical studies have failed to establish strong links between land rights, investment, and agricultural productivity on African croplands (Gavian and Fafchamps, 1996). Empirical evidence from studies in Ghana, Rwanda and Kenya found minimal relationship between land rights and credit (Migot-Adholla, Hazell, and Place, 1991). The study attributed this lack of correlation to thin formal and informal capital markets. With respect to the relationship between land rights and investment in long-term land improvements, input use, and productivity, the evidence from Africa is also weak. In areas of Kenya with land registration, no link was found between land titling and long-term investments to improve land (Barrows and Roth, 1989). Weak relationships were also discovered in Ghana and Rwanda (Migot-Adholla et al., 1994; Migot-Adholla, Hazell, and Place, 1991).

The apparent failure to link individualised land rights to improved access to credit, investment in land and productive efficiency in some countries or at some particular points in time does not in any way render research into land tenure and land productivity in other countries or at different points in time irrelevant. Instead, it calls for continuous investigation as access to information and data improves, as capital markets expand and as land tenure systems evolve in response to increasing population and urbanisation. This study of land tenure in Ghana and its influence on farm investment and technical efficiency is intended to contribute to the knowledge of how land rights obtained through various land use arrangements influence tenure security and consequently farm investment decisions and productive efficiency. The research issues addressed by the study are largely driven by three fundamental socioeconomic arguments:

1. Since land tenure (in)security is to a large extent determined by existing land tenure system (Hayami and Otsuka, 1993), its influence on investment and land productivity is expected to vary significantly across countries and across different locations within countries. This is because land tenure systems differ widely among African countries. Even within some countries, land tenure systems vary from one ethnic group to the other or from one region to the other. The implications of these marked variations in land tenure systems and by extension perceptions of tenure insecurity are that cross-country adoptions and applications of land policies may be limited. Country or location-specific studies on land tenure and its influence on investment and land productivity are therefore required to support policy decision making in land administration.

2. It is also important to indicate that protected land rights are necessary but not sufficient conditions to guarantee improved access to credit, increased investments in land and land productivity. For example, well developed and competitive capital or financial markets, are required for protected land rights to facilitate access to financing. Sufficient human capital and functioning labour markets are also important in facilitating household farm investments (Place and Hazell, 1993). In most African countries, financial markets are either emerging or are thin and transforming rapidly. It is plausible to argue that capital and financial markets in Ghana have undergone significant transformation in the last decade. An assessment of how land rights combine with these market changes to influence access to finance, land investments and productivity would be useful for policy making in general and land administration reform in particular.

3. The relationship between land tenure security and productive efficiency has been a subject of debate among researchers. Authors like Dorner (1972) and Harrison (1987) describe indigenous African land tenure as static constraints that increase insecurity and reduce lenders willingness to finance investments. These group of authors who advocate for reform in African land relations liken land use under indigenous African land tenure to Hardin's (1968) “tragedy of the commons”, which argues that systems of shared property are subject to systematic over-use and degradation of the natural resource base, implying the need to enclose common resources and individualise their ownership (Quan, 2000). Others like Boserup (1981), Cohen (1980), Noronha (1985) and Bruce (1988) however perceive indigenous African land tenure as dynamic and changing in response to factor prices. The latter group of authors do not see any urgent need for extensive efforts

to accelerate the rate of privatisation of land rights (land registration and titling programmes), arguing that farm households will acquire complete set of rights over their land as population pressure increases and agricultural commercialisation proceeds. Again, these debates underscore the need for continuous assessments of the land tenure system to ascertain the extent to which it poses as constraint to productivity or how the indigenous land tenure systems are evolving over time in response to market factors.

1.3 Land Tenure and Rights Transfer Systems in Ghana

Land tenure in Africa largely refers to the social relations and institutions governing access to and use of land and natural resources. In Ghana, land tenure is portrayed as either customary (or traditional) or state (or statutory). Each of these is often described and distinguished from the other in terms of characteristics and forms of management (Bentsi-Enchill, 1964; Benneh, 1975). Customary land tenure in Ghana is characterised by its unwritten rules and laws, based on local practices and social norms that are flexible, negotiable and location-specific.

Customary land tenure systems are usually managed by a traditional ruler, land or earth priest, council of elders, family or lineage head. Its principles stem from rights established through first clearance of land, or conquest even though British colonial rule has to a large extent influenced the land tenure system in Ghana. Various legislation and interventions by colonial and post independence governments led to the establishment of the pluralist legal system in which English common law was grafted onto Ghanaian communal societies without taking into account the differences between the early 19th century capitalist economic structures and the egalitarian communal institutions of Ghana (Agbosu et. al., 2007). The legal pluralistic land administration has

laid the foundations for conflicts between customary law and practice and Anglo-American common law, its notions and conceptions of tenure. The ensuing conflict in administering land with a combination of statutory and customary law is widely regarded as obstacle to socio-economic development (Ibid). Ghana's Constitution and other supporting legislation outline four main land ownership types (Agbosu et.al. 2007):

i. Customary (Stool/Skin) land — acquired by discovery, conquest, as gift, or by purchase.

About 80% of land in Ghana is held under this category

ii. State acquired — by compulsory acquisition using the State Lands Act 125, of 1962, and by purchase (18%);

iii. Vested lands — Administration of Lands Act, 123 of 1962 for the management of stool/skin/family lands (2%); and

iv. Private — Family/individual ownership which may fall within any of the above three categories.

Literature suggests a marked variation in land transfer systems across Ghana. Paramount/allodial title to land depends on the descent group. Among the matrilineal descent group in Ghana like the Akan, paramount/allodial title land was vested in the stool or the "oman". Which means unallocated or abandoned land belongs to the stool whilst all allocated land is mainly under the control of the matrilineage. Once allocated to the family, land is inherited by one of a man's brother's or sister's sons and is ideally not subdivided. Those excluded from family land by the succession process were able to establish use rights on new lands allocated to them by lineage heads (Kasanga, 1988; Asenso-Okyere, 1993). Among the patrilineal descent groups such as Ewe and Dangme Paromount / allodial, title to land is vested in the family and in the 'quarters' among most of the Ga. Thus the patrilineage maintains a general authority over lineage land but

its leadership varies significantly among groups depending on the level of centralisation and degree of stability. Generally, male children succeed their fathers although there may be differences depending on the locality. In the Northern part of Ghana allodial title is vested in the tendanaa (Earth priest) and chiefs. Like most patrilineal societies, land in Northern Ghana is mostly passed on to male children. Strangers cannot buy land but are given to cultivate temporarily (Ibid). Two features of Ghana's land tenure systems are often associated with land tenure insecurity and disincentives for investments. First, the bulk of land is held and administered by customary law where use rights are allocated to clans and families rather than to individuals. Secondly, access to land is based on kinship or membership of the land owning clan. Where land is allocated to individuals or groups outside the land owning clan or family, the absence of well-defined rights and incentive structures for land transaction are seen as major challenges to investment. These two features of land tenure in Ghana are the central issues of the study's research problem.

1.2 Problem Statement and Motivation

According to the neo-classical hypothesis, existing land ownership and transfer systems significantly affect land investment decisions and productivity (Barrows and Roth 1990). The neo-classical economic theory of land tenure argues that individualisation of land tenure (leasehold and freehold ownership) increases tenure security of the landholder, increases investment and also leads to the emergence of markets that transfer land to producers who would extract higher value of product from land (Barrow and Roth 1990; Johnson, 1972). The tenets of the neo-classical theory implies that land tenure arrangements which assign rights to the community or to landlords, rather than to the actual land users would induce tenure insecurity

and discourage long-term investment in land improvement (Hayami and Otsuka, 1993). With communal land ownership being a dominant feature of land holding in Ghana, an understanding of how this influences tenure insecurity, investment and productive efficiency would be useful for both land administration and agricultural policy in Ghana.

As already indicated, empirical evidence has failed to strongly link privatised land rights to investment, credit access and productive efficiency. These failures seem to have intensified scepticism over attempts to encourage land titling in several African countries while strengthening the position of authors like Boserup (1965), Cohen (1980) and Noronha (1985) who see indigenous African land tenure as dynamic and on an evolutionary path to land market efficiency. These authors argue that farm households will acquire complete sets of rights over their land as population pressure increases and agricultural commercialisation proceeds. It will therefore be important to assess, in the case of Ghana, whether land tenure systems have evolved in tandem with the principles of economic efficiency and whether population pressure, agricultural intensification and commercialisation have stimulated the acquisition of complete rights over land. While it may be plausible to argue that usufruct rights granted by most indigenous land tenure arrangements are sufficient to provide security for farm investment, it is equally, if not more important to ask questions as to whether the usufruct rights obtained through these indigenous land tenure arrangements can provide the needed security to support the level of investment required to modernise and commercialise agriculture in Ghana.

In 2005, the Institute of Statistical, Social and Economic Research (ISSER), conducted a survey on land tenure which showed that issues relating to land ownership and use arrangements

bothered a significant number of households in Ghana. Among the issues that concerned respondents most were high prices of land (48%), disputes between landlords and tenants (17.5%), insecurity of tenure (14.3%) and uncertainty about ownership (10.7%). An assessment of how these land related problems affect land tenure security, farm investment and productivity would be useful for land administration and land policy formulation in Ghana.

Most of the important food crops like maize, soya, cowpea, rice, groundnut among others are produced by smallholder farmers under rain fed conditions across Ghana. Maize production under rain-fed conditions using traditional methods, yields on the average, 1.5 metric tonnes per hectare while, yields as high as 5.0-5.5 metric tonnes per hectare have been realised by farmers using improved seeds, fertiliser, mechanisation and irrigation. Soya yields average at 0.8 metric tonnes per hectare, although soya has been demonstrated to grow at yields of as much as 4.5 metric tonnes per hectare under the best commercial agricultural practices in Ghana (MCA, 2010).

Rain-fed rice production contributes 84% of total current production, generating average paddy yields of 1.0-2.4 metric tonnes per hectare. Irrigated production which accounts for only 16% of production produces average paddy yields of 4.5 metric tonnes per hectare. Because of the lack of irrigation and poor yields, domestic rice production has not grown as fast as domestic demand (Ibid). According to the Ministry of Food and Agriculture (MoFA), investment in irrigation and other forms of mechanised farming is required to achieve the attainable yields of 4.0-4.5 metric tonnes per hectare (Ibid). Clearly, technical inefficiency is a major problem in Ghana's

agriculture and an assessment of how land tenure insecurity contributes to technical inefficiency is an important step towards addressing the issue of inefficiency in crop production.

In Ghana, low levels of agricultural investment (about 4% of total investments) as well as investments in improving the productivity of land necessitates the development of mechanisms to provide incentives for such investment (Aryeetey and Udry, 2009). Under development in Ghana has among other things, been linked with the problems of security of title (Agbosu, 2000) and gender disparity with respect to access to and control of productive resources including land (Tsikata 2003). A survey by ISSER in 2005 showed that 83% of land holders had not made any land related investment over a period of five years (Twerefou et al., 2011). Only 16% of farm households surveyed made mechanisation (Equipment/ technology/ machines/ tractors) related investment while 14% made investments in irrigation (Ibid).

Even though a multiplicity of factors account for the low agricultural investment in Ghana, the land tenure system and land administration has often been cited as a disincentive for land investment. Aryeetey and Udry (2009) reports that, land and its management in Ghana has often been poorly understood and is generally perceived to induce tenure insecurity. Assessing how land management or land use arrangements influence tenure security and farm investment will lend empirical support to the perceptions associated with land tenure, investment and productivity in Ghana.

This study is motivated by the fact that research into how indigenous land tenure arrangements influence tenure security and by extension plot holders' willingness to undertake long-term soil

improvement and irrigation related investments is limited. While rights obtained through indigenous processes may be sufficient to induce a farmer to purchase fertiliser, the same set of rights may not provide enough security to induce the farmer to make investments that could mechanise and expand production.

While there have been no studies in Ghana assessing productive efficiency under different land tenure arrangements, studies on how tenure security influences investment and access to finance are not only more than a decade old but also limited in terms of Regions and Districts covered (Place and Hazell, 1993; Migot-Adholla et. al, 1994). Significant advances in data collection and processing, improvements in capital and financial markets which are necessary conditions for access to credit and investment, as well as the existence of nationwide data on land in Ghana makes such a study useful. This study seeks to contribute to close this knowledge gap by decomposing investment and assessing the effects of tenure security on the decision to invest and the level of investment. In addition, Migot-Adholla, et. al (1991) and Place and Hazell (1993) in their studies of security of land tenure and productivity in Ghana concluded that, the seemingly weak correlation between land rights on the one hand and access to credit, increased investment and productivity on the other was due to thin formal and informal capital markets. This study provides an opportunity to re-examine this assertion given that both formal and informal capital markets in Ghana have improved considerably over the past decade.

Even though studies exploring the relationship between land tenure and investment have attributed the failure to link land tenure security and farm investment or productivity to thin financial, labour and inputs markets, an important factor that could influence farm household

investment and which this study takes into consideration is the value of potential losses in the event that the farmer loses his/her rights to land. While farmers may not be significantly influenced by their land rights when investing in medium-term soil improvements (manuring and fallowing or even land conservation practices like bunding), the same cannot be said if the farmer is investing in long-term or fixed improvements (irrigation and fencing), the cost of which may take several years to recoup. This study factors in irrigation-related investment by combining household investments in irrigation and soil conservation. The approach aims to specifically examine the influence of land tenure insecurity on farm households' investment behaviour in instances where the investments in question are relatively substantial and the time dimension required to recoup the investment is relatively longer.

The issue of resource allocation under different land use arrangements has also been a subject of debate in theory especially on the subject of enforceability of land and labour contracts (Otsuka, Chuma, and Hayami, 1992). Marshal (1890) and Mill (1848) concluded that share tenancy resulted in inefficient resource allocation, arguing that because the share tenant received as marginal revenue only a fraction of the value of his/her marginal product of labour, his [the tenant's] incentive to supply labour or other inputs at the optimum level was limited'. On the other hand, Cheung (1969) and Johnson (1950) have contended that, if effort is costlessly enforceable, sharecropping arrangements can be as efficient as owner-cultivated and fixed-rent tenancy. Ahmed (2002) reports that, relative to land cultivated by owners and fixed-fee rental land, alternative land tenure systems such as sharecropped and gifted land prevailing in Ethiopia were less efficiently cultivated and resulted in considerable economic losses to farmers due to the

[1] The tenant receives a predetermined share of the output (e.g.40%) and also pays or decides on variable input use. The exogenously determined share of the output may under value his labour and variable input contribution or over compensate the landlord for use of the land.

restrictions imposed by landowners on the latter. They suggested that, policies that facilitate individualised land transactions would result in considerable gains to farmers in particular and the national economy at large.

There are several land ownership and use arrangements in Ghana. However, knowledge on how these land holding arrangements influence farm investment and technical efficiency is limited. Empirical quantitative evidence of which land use arrangements produce efficient outcomes is not available. For ongoing land administration reform to support the development of efficient land markets or transfer regimes, knowledge of how land holding regimes affect efficiency in terms of production is important. In other words there must be answers to the question of which land use arrangements in Ghana should policy support and which ones should be discouraged and if possible discontinued.

Given the multiplicity of land transfer mechanisms and land holding arrangements across Ghana, there is the need to explore how land holding arrangements in Ghana have evolved over the years and how land rights allocations under the various arrangements impact on investment and land use efficiency. An efficient land market should allocate land such that soils of equal quality will have equal marginal productivity. Where marginal productivity is high, then such land should be allocated to producers who can invest in more intensive exploitation of it. Where there are inherent differences in the capabilities of producers, for example because of the differences in their resource endowment, an efficient land market should concentrate land in the hands of better endowed producers. In instances where there are concerns of equity and the poor's access to

land, policy may be formulated to influence how land markets may be facilitated while at the same time ensuring equitable allocation.

The predominant practice where the control over land is vested in the community rather than in the individual has implications for land conservation and improvement investments (Hayami and Otsuka 1993). In line with the above arguments, the study poses the following questions:

1. What are the predominant land transfer arrangements and land rights forms in Ghana? Have population pressure and agricultural intensification influenced land acquisition and land rights in Ghana?
2. How have indigenous land tenure arrangements in Ghana influenced land tenure security? What factors explain or influence tenure security in Ghana?
3. How have land rights holdings and the associated tenure insecurity influenced the "investment hypothesis"?
4. What relationships exist between indigenous land tenure arrangements and agricultural productivity? How have different land holding and transfer mechanisms in Ghana affected productive efficiency? Have individualisation and land titling influenced productive efficiency and farm investment in Ghana?
5. What are the options for state intervention in the functioning of land transfer mechanisms in Ghana? Should government intervene in land market through restrictions of land transactions?

Answers to these questions would generate information that would help to close the knowledge gap in relation to how various land transfer mechanisms in Ghana allocate land rights and how

these allocations influence tenure security, farm investment and land productivity. The knowledge generated would contribute in shaping Ghana's vision and objective for land administration reform. Few studies carried out on the subject in Ghana either did not focus on highlighting the linkages between tenure security and productive efficiency, (see for example Osei-Akoto et. al., 2007; Dzanku, 2007; Besley, 1995) or when they did were not comprehensive enough in terms of geographical coverage to capture the diversities that exist in Ghanaian land use arrangements and land markets (Place and Hazell, 1993). This study will examine the differences in land rights holding across Ghana and how the different land holding arrangements influence land tenure security, farm investment and technical efficiency. It is common knowledge that changes in population, diversification and commercialisation in agriculture, as well as significant improvements in capital and financial markets have occurred in Ghana over the last decade. In addition, the availability of country wide data on land and other relevant attributes make it worthwhile investigating the response of land relations in Ghana to these developments. It is particularly important to examine how land rights are evolving and how such evolutions impact on tenure security and land productivity.

1.3 Objectives of the Study

In general, the study focuses on assessing land holding arrangements in Ghana and how the resulting allocations of rights influence tenure security, investment and productive efficiency. The specific objectives are:

1. To analyse the diversity and evolutions in land rights holding in Ghana.
2. To empirically examine determinants of tenure security in Ghana.

3. To analyse the effect of indigenous land ownership and use arrangements on farm investment.
4. To analyse technical efficiency in alternative land holding arrangements and examine factors that explain technical inefficiency in Ghana.
5. To explore the implications of the study's findings for land management policy in Ghana.

1.8 Organisation of the Dissertation

The dissertation is presented in seven chapters. Chapter two reviews relevant literature on the history and evolutions of land tenure in pre-colonial, colonial and post-independence Sub-Sahara Africa; the history and nature of land markets in Sub-Sahara Africa; land tenure systems and drivers of land administrative reform in Ghana and, the theory on land tenure security, farm investment and productive efficiency with focus on Sub-Sahara Africa. Chapter three presents the study's theoretical framework and methodology. The chapter highlights the theoretical foundations of the methods, the analytical models employed by the study, and provides an overview of the study area as well as the data used by the study. The results of the study are presented in chapters four, five and six. Chapter four presents the analysis of land rights and land rights evolutions in Ghana. The relationships between land ownership or usefruct arrangements, tenure insecurity and farm investment are discussed in chapter five. Chapter six explores technical efficiency under alternative land holding arrangements in Ghana. A general summary, policy implications and recommendations are presented in chapter seven.

1.9 SUMMARY

Chapter one explored theoretical and empirical perspectives of land tenure, farm investments and land productivity in developing economies. The chapter outlined the study's research problem, objectives and motivation. It is argued in this chapter that land tenure and land transactions in Ghana could be inducing tenure insecurity and constraining farm investment and land productivity. This assertion was based on the fact that indigenous land tenure systems in Ghana mostly assign land rights to groups (stools, skins, clans, etc) and not individual users which according to literature induced insecurity. The study further argued that insufficient knowledge on how land holding arrangements in Ghana influence tenure insecurity, farm investment and productive efficiency constituted a limiting factor in both land administration reform and growth of the agricultural sector. Against this backdrop, the study argued that there was the need to examine the predominant land use arrangement and land rights forms in Ghana and to analyse how these arrangements and rights evolved over time. The chapter also demonstrated the need to examine land tenure insecurity and how it influenced farm investments and technical efficiency in Ghana. The study was justified on the grounds that the principal output of the study would lend empirical support to perceptions of land tenure security in Ghana and how tenure insecurity affected farm investments and land productivity in Ghana.

CHAPTER TWO

REVIEW OF RELEVANT LITERATURE

2.0 INTRODUCTION

The linkage between land use arrangements and the allocation of resources in production has been a subject of debate for over two centuries. Nineteenth century economists, Alfred Marshal and John Stuart Mill are among the pioneers in terms of research that explored the links between land tenure security and optimal allocation of resources in production (Marshal, 1890; Mill, 1848). Their hypotheses have served as bases for research and land policy around the world for several decades. In Africa, the body of literature seeking to highlight the linkages between land use arrangements and productivity has grown dramatically with no apparent consensus on how Africa's complex land tenure systems are influencing tenure security on the one hand and productivity on the other. This chapter reviews literature on the evolution of Africa's largely plural land tenure systems, highlighting the influence of colonial and post-independence land policies in the shaping of land relations in Africa. Literature on the history and the nature of land markets and land transactions in Africa, land rights and tenure insecurity under indigenous tenure systems in Sub-Saharan Africa with emphasis on the customary land tenure system of Ghana are also explored.

The chapter also reviewed the literature on the underlying theories, methodological approaches and empirical findings of land-related research in Africa and elsewhere. In this regard, the chapter specifically, explored literature on:

i. the evolutionary theory of property rights which links population growth and agricultural intensification to the evolutions in land rights;

ii. the household production model which provides the theoretical basis for household farm investment; and,

iii. the theory and empirical evidence of land tenure insecurity, investment and productive efficiency in Sub-Saharan Africa.

2.1 Historical Perspective of Land Tenure in Pre-Colonial Sub-Saharan Africa

Much of the account on pre-colonial land tenure and land administration in Sub-Saharan Africa is based on indirect evidence from several sources (See Biebuyck, 1963; Elias, 1956; Glazier, 1984; Hecht, 1982; Lewis, 1979; Maini, 1967; Meek, 1949; Snyder, 1981, and Thomson, 1976). The literature suggests that clearing of land and subsequent use was the principal mode of establishing initial rights over land in pre-colonial Sub-Saharan Africa. The first cultivator of a piece of land, in the absence of more powerful interests, was entitled to use it. Literature refers to this person as the "maitre du feu" (the master of fire, a reference to a common method of land clearing). Anybody who later tried to establish rights of use within the area already cleared and controlled had to seek permission from the maitre (or his descendants, since rights were usually inherited by his progeny). Where no distinct lineages existed, permission had to be obtained from the chief or village head (Feder and Noronha, 1987). The system was however different under Islamic law where ownership of land was mainly established by "vivification" i.e. to cause something to come to life. In the case of land, vivification was demonstrated by the act of cultivation, or boring and enclosing underlying streams (Anderson, 1954; Middleton, 1961).

In times that land was abundant, access to it was not difficult. It was obtained either by residence or by acquiring "membership" in a group-which could be done by tracing real or fictional genealogies. The admission of outsiders, even slaves, was common (Barnes, 1954; Gluckman, 1941; Van Velsen, 1964). Under such systems of land use, one person could cultivate crops, while, on the same land, another could have rights to trees; or land could be used by cultivators during the cropping season and by herders in the off-season or during fallow periods.

2.2 Land Administration in Colonial and Post-Independence Sub-Saharan Africa

The impact colonialism has had on customary resource tenure systems across Africa is immense. Local groups and individuals as well as the colonial administration manipulated customary law for their own ends, as colonial courts responsible for applying "native" law distorted it by filtering its norms through European legal concepts (Chanock, 1985; Berry, 1993). Land tenure constituted the basis of definition and administration of the systems of government employed by colonial governments. In British colonies, land was vested in chiefs and not individuals[2]. Land rights were therefore principally acquired by membership of the chief's ethnic group. The French initially took the opposite view. They believed that only individual rights to land existed (Feder and Noronha, 1987). The British chose to rule through traditional leaders, who were free to make rules within their "spheres of competence," including land rights.

The French chose to assimilate and therefore drew no distinction between a dependency and metropolitan France. In defining the concept of land ownership, the colonial powers drew a distinction between occupied lands (which were therefore owned) and unoccupied lands (vacant

[2] Africans were seen as people on a lower evolutionary rung and thus at a stage where land ownership vests in chiefs, and not individuals. The system in British colonies was designed such that land rights would flow from membership of the chief's ethnic group.

and "without a master"). The unoccupied lands were deemed open to settlement, as happened in Kenya, Zambia, and Zimbabwe; or to lease by foreign concessionaries, as, for instance, in the Cote d'Ivoire and Congo; or for use for other public purposes. These distinctions were much influenced by European conceptions of title and property (Ibid).

The creation of districts by the British and cercles by the French and Belgians significantly affected indigenous farming systems (Feder and Noronha, 1987). Initially, the districts and cercles were based on ethnic identity, real or assumed, and had two consequences. First, it initiated and entrenched ethnic divisions or differences. Second, it restricted movement outside the district by the introduction of the "pass" system (a badge of both identification and confinement) and kept trade to within each district. In pre-colonial days, it had been relatively easy to become a member of a group, and the absence of well-defined boundaries permitted both shifting cultivation and migration. All that was changed: land for cultivation now had to be found within the district or cercle.

After independence, Sub-Saharan African countries adopted varied approaches in land tenure administration (Ibid). These approaches to land tenure can be divided into three main types:

a. Countries that allow the acquisition of individual title: Cote d'Ivoire (without any restrictions on the power of the title-holder); Kenya and Malawi (with restrictions on the title-holder).
b. Countries that recognize different types of tenure: Senegal and Sudan (both individual title and nationalization of non-titled lands); Bostwana, Ghana, Lesotho, Liberia, Mali, Sierra Leone, Swaziland, Uganda, and Zimbabwe (individual title, indigenous systems

and public lands); and Cameroon (individual, group, indigenous systems and public lands).

c. Countries that vest title to land in the state, so that individuals have rights only of use and occupancy: Ethiopia, Mauritania, Nigeria, Tanzania, Zaire, and Zambia. This classification needs to be qualified. First, there is an overlap between the countries in (b) and (c): where indigenous systems are recognized in group (b), this usually means that the individuals or groups covered by those systems have rights only of occupancy and use. In that sense, they share the approach of countries in (c): examples are Botswana and Zimbabwe (A similar practice applies in Senegal and Sudan where, with the nationalization of untitled land, the government recognizes only user rights of occupants). Second, in Malawi, indigenous systems are recognized for untitled land.

2.3 Land Markets, Transactions Rights in Sub-Saharan Africa

In terms of land markets in Africa, distinction is made between commercial and non-commercial transactions (Sjaastad, 2003). Commercial transactions refer to a host of diverse land transfer arrangements including sales, barter, mortgages and pledges, and various types of rental contracts. Non-commercial transactions include both permanent land allocation such as succession and gifts — and temporary land transfers in the form of borrowing (Ibid).

Evidence of land markets characterised by outright sale of land existed in pre-colonial Sub-Saharan Africa even though the factors explaining the emergence of such markets are not documented. In West Africa for example, the production of commercial crops like palm oil led to development of land markets even before colonisation. In the Gold Coast, land sales had

started at the turn of the century and had been given judicial recognition (Grier, 1981). In Nigeria, land sales had begun in the southern provinces even before the colony of Lagos was ceded in 1861 and was common in northern Nigeria in the first decade of the twentieth century (Rowling, 1946; Watts, 1983). The evidence of outright land sales was however discounted by the West African Land Committee in 1912 as being insufficient and inconclusive. Several commissions in other parts of Sub-Saharan Africa also failed to acknowledge evidence of land sales, perhaps blurred by preconceptions of what "native" groups could actually do. In Kenya, the Carter Commission ignored evidence that land had been traded in the Kiambu region by Kikuyu (Sorrenson, 1967). Land sales were common among the Arusha, Sambaa, Hayya, and Chagga in Tanzania. The Sambaa in particular did not even require the consent of kin to do the sale (Hailey, 1957). Land sales among the Sukuma in Tanzania began long before the German occupation in 1891, but were stopped by the Germans (Malcolm, 1953). In Malawi, the Land Commission in 1921 failed to admit evidence of land and individual titling in the Marimba and West Nyasa districts. The apparent development of land markets was most likely curtailed during colonisation as colonial governments sought to reorganise land institutions and access arrangements to their own advantage.

After independence, African governments tried to modernise customary land tenure systems, to replace them with "more modern systems" characterised by property rights, legislation, and based on the concepts of private ownership, titling and registration since customary land tenure that emerged during and after independence in several SSA countries apparently did not provide adequate tenure security to encourage investment required to improve agricultural productivity (Swynnerton, 1954; Wilson, 1971). To facilitate the modernisation of indigenous land tenure

systems, many African governments assumed key roles in land relations either directly, through land nationalisation, or through registration programmes aimed at creating private ownership rights. However, these interventions largely failed to support the development of efficient land markets due to bureaucratic/arbitrary approval and title registration systems. As a result, informal land markets have emerged where land is sold or pledged at prices that contain high risk premiums and causing significant deviation between social value of land and the market value of land (Feder and Noronha, 1987). A growing body of literature from many parts of West Africa has documented the emergence of land rentals and sales within local tenure systems (Lavigne-Delville, Toulmin et. al., 2001; Mathieu et. al., 2003). Several land transactions (sales and pledges) take place in these informal and parallel markets. The major problem with most transactions in the informal land markets has to do with the difficulty in enforcing such transactions in a court of law. As a result, prices in the informal markets contain risk premiums that cause a deviation between the social value of land and its true market value. Land sales may be disguised as the sale of trees or houses, as in Malawi (Ibik, 1971); or as a pledge, with the pledgee paying an amount equivalent to the purchase price of the land so as to avoid getting the permission of the village headman, as in Nigeria (Lunning, 1965).

The land tenure systems that evolved across Sub-Saharan African countries after independence are largely regarded as customary even though attempts have been made to formalise land administration systems across the sub-region. The main feature of customary land tenure is the application of customary or traditional law as the basis of land administration. Customary "law" is a body of (usually unwritten) rules founding its legitimacy in "tradition", i.e. in its claim to have been applied for time immemorial. Customary law regulates a wide range of issues

including family relations, property law, and resource tenure systems — the bodies of rules and institutions governing the way land and natural resources are held, managed, used and transacted (Adams, Cousins et. al., 1999; Cotula, 2006). Land tenure systems regulate the "bundle of rights" existing over each piece of land, including "operational" rights (right to access land, to cultivate it, to withdraw produce, etc.) and management rights (e.g. the right to allocate and transfer land). Even though the content of customary land tenure is extremely diverse, and may vary from village to village, the primary feature is the same. Customary land tenure systems are alliance-based (Magnant, 1993) and rely on principles which usually include primacy of first occupants; access to resources linked to community/lineage membership; relatively easy access to usufruct rights for incomers when land is abundant, but differentiation between "autochthons" and "incomers"; cultivation rights secured through labour and continuous use.

Land rights may be viewed as a bundle of distinct privileges i.e. right to use, right to plant trees, right to rent, right to sell, and so forth (Feder and Noronha, 1987). Security of land rights under indigenous African land tenure system is mainly determined by continuous use of land. An individual or group is entitled to undisturbed possession of some allotted land as long as it is being used. The period of use varies according to the type of crops grown, so farmers often lengthen the period of use by planting trees. Thus, in most African countries, the main purpose of planting tree crops such as cocoa and coffee is to retain undisturbed possession of the land so long as the trees survive (Levin, 1976).

In most Africa, land is usually held by clans or families on the basis of diverse blends of group to individual rights, accessed on the basis of group membership and social status, and used through

complex systems of multiple rights (Thebaud, 2002). The customary resource tenure in a farming context entails collective rights, but typically involves the allocation of farming rights over specific plots by the land management authority (e.g. the "chief") to smaller family units. The nature of these smaller units and of the farming rights they hold vary considerably from place to place. In many cases, farming rights are conditional upon the continued use of the plot. And, while such rights are often inheritable, restrictions usually exist on sales (especially to outsiders), although certain transactions may be allowed (gifts, loans, etc.) and some systems do allow land sales.

Land rights allocated to tenants or non-indigenes are increasingly restricted. At first, outsiders or non-indigenes were allowed access to marginal land. But as land became scarce and land values rose, most of the rights these outsiders enjoyed were curtailed. Non-indigenes were no longer able to integrate or become members of the land group, and so could not gain access to land (Haswell, 1963; Hecht, 1982). Restrictions are placed on the types of crops that tenants (or "stranger farmers") can cultivate. For instance, in Ghana and Cameroon, tenants are not allowed to plant cash crops (Adegboye, 1974; Dravi, 1984); in Zanzibar, they are not allowed to plant trees, particularly the valuable kola tree (Middleton, 1961). The basis for the restrictions is to deny tenants the opportunity of claiming title to land by virtue of their length of possession.

2.4 Land Tenure Systems of Ghana and the Drivers of Land Administration Reform

Like several countries in Sub-Saharan Africa, the land tenure system in Ghana is diverse with complex institutions and land relations. Kinship, social and other political relations form the basis of rules governing access to land and vary slightly among different ethnic groups. Based on these general rules, lineages and individual families are able to secure clearly defined rights

which are transmitted from generation to generation in accordance with rules of succession (Migot-Adholla, et al., 1994). The rules are largely unwritten and are based on local practices and norms that are flexible, in some instances negotiable and location-specific.

Existing land relations in Ghana were established during the pre-colonial and colonial period. In the pre-colonial era, natural resources such as land were held by communities under local rules and practices commonly called customary law. Tenure systems varied from place to place with clear, north-south differences as well as differences between the centralised, chieftaincy-based, matrilineal Akan system and the lineage-based landholding systems of the patrilineal Ewe and Ga.

Like in other Sub-Saharan African countries, Ghana's customary land tenure has been profoundly influenced by decades of British colonial rule and interventions by succeeding post-independence governments. Group or communal ownership was the predominant feature of land holdings in pre-colonial Ghana. In fact some commentators held the view that communal ownership of lands under traditional schema was a colonial invention to bolster the policy of indirect rule- the dual mandate even though such assertions are not back by evidence and their validity is doubtful (Agbosu et al., 2007).

The colonisation of the Gold Coast led to the emergence of two economic systems- a capitalist system in commercial and urban centres and the traditional communal system characterised by subsistence agriculture which was dominant in the countryside. The dominant capitalist sector produced property owners consisting of European and national entrepreneurs whose attempts to acquire private ownership of land created problems as the concept of private ownership of land

was completely alien at the time. The resulting tenure insecurity made land titling a major policy concern for both pre-colonial and post-colonial governments (Ibid). Land use patterns in many parts of the territory were being transformed from mere shifting cultivation to the acquisition and development of land on permanent basis in response to increased demand for oil palm and other forest products brought about by the industrial revolution (McPhee, 1926).

The rapid growth of the cocoa industry accompanied by the mining boom at this period in turn increased demand for concessions and led to a sharp appreciation in land values. The appreciation of land values introduced the twin problem of uncertainty of title and costly litigations as communal land boundaries were un-surveyed, un-demarcated and undefined. The growing use of land for large-scale commercial production entailed the acquisition of the land, i.e. the basic means of production, for the exclusive (as opposed to communal) use of individuals or groups of people. These developments, which intensified over the years, constitute the driving force in the shaping of customary and statutory land tenure in Ghana commonly referred to as legal pluralism (Agbosu et. al., 2007).

In response to problems of tenure insecurity in the dominant capitalist sector of urban Ghana, the Land Development (Protection of Purchasers) Act, 1960 and the Farm Lands (Protection) Act, 1962, were enacted to protect the interest of potential transferees in land. These two acts were enacted to safeguard the interest of purchasers of land and their successors whose titles were found to be defective after farm or buildings were constructed on the acquired lands. The Land Development and Farm Lands Acts however proved ineffective in dealing with the twin problem of title insecurity and title litigation partly because the provisions were designed as *ad hoc* measures (Ibid).

Ghana started implementation of the International Monetary Fund (IMF) and World Bank structural adjustment programmes (SAP) in the early 1980s. The policy foundations of such programmes were imbedded in expression such as the "private sector is the engine of growth"; "government has no business doing business" etc. Such laissez-faire ideological mantra required that government create enabling environment for the private sector to lead and drive the economy (Agbosu et al. 2007). Land administration reform was seen as an important step towards creating the needed conducive environment since the consolidation of private rights in land is an imperative for private growth and development. Land title registration reform was therefore pivotal in Ghana's SAP with IMF/World Bank committing loans to finance the project. The Land Title Registration Law (PNDC Law 125) was thus enacted to satisfy the demands of the local and international business community by confirming, consolidating and crystallising in legal form the private landed rights acquired in the last 100 years through the commercialisation, usurpation and privatisation of communal lands.

The account on the evolution of Ghana's land tenure system and land administration seems to confirm assertions that land relations in most Sub-Saharan African countries are the product of colonial governments' perception and management of land not as a factor of production but as a tool for governance through which colonial governments could assert their control on the colonies. This is evident in the fact that market oriented land transactions that were emerging across Africa prior to colonisation disappeared in colonisation and failed to re-emerge long after several SSA countries had attained independence.

Opinions continue to differ on how to reposition land markets in Sub-Saharan African on the path of efficiency i.e. facilitate the development of land markets that would not only define and adequately protect property rights in land but also facilitate the transfer of those rights to producers with highest abilities (see Dorner, 1972; Harrison, 1987; Cohen, 1980; Noronha, 1985, and Bruce, 1988).

2.5 Evolutions in Indigenous Land Tenure Systems

Neo-classical theory has been used to analyse and explain the evolution of African land tenure systems. According to Ault and Rutman (1979), indigenous African land tenure systems have evolved according to the rules of economic efficiency. Under conditions of very low population density the supply of land exceeds the demand, even at zero price, so a tenure system based on use rights emerges. They claim that once the demand for resources exceeded the supply at zero price, individual rights to property were exercised. The "evolutionary theory of property rights" posits that population pressures and increased land scarcity would stimulate a transition from communal land ownership to more individualised rights (Boserup, 1965; Ault and Rutman, 1979 Platteau, 2000, and Chauveau, 2006). The evolution of permanent and enforceable land rights is closely related to increases in population density, advances in farming technology, and the emergence of agricultural markets. As land becomes scarce, societies can no longer rely on long fallow periods to maintain land fertility (Feder and Noronha, 1987).

Agricultural intensification is a multi-dimensional process of response to increasing population density, technological change, and commercialisation, or to any combination of these. It is characterised by substitution of labour for land in the initial stages and a shift from forest fallow

through bush and grassland fallow. This is followed by more continuous cropping and systems of crop rotation and soil improvement (including green and animal manures, and compost), followed by additional modern yield-enhancing inputs such as chemical fertilizers, insecticides, and high-yielding seed varieties (Boserup, 1965; Geertz, 1963; Netting, 1968; Waddell, 1972; Pingali, Binswanger, and Bigot, 1987).

In the context of the evolutionary land rights theory, population pressures and land scarcity have led to greater individualisation of land rights, which in turn have resulted in the commoditisation of land relations and market transfers. Increasing commercialisation of agriculture, particularly since colonial times (when commercial crops such as oil palm, cocoa, coffee, cotton and groundnuts were introduced), have given rise to gradual but meaningful changes in land tenure practices in the direction of enhanced individualisation of tenure. In Mali, for example, the sequential relationship between greater individualisation of land rights and the commoditisation of these rights is widely confirmed, as is the relationship between demographic pressure (mainly caused by migration) and the emergence of sales (Djire, 2004). Evidence from other West African countries like Burkina Faso and the Ivory Coast suggest the emergence of cash-based land transactions. In Burkina Faso for instance, Dabire and Zongo (2005) report acute monetisation of land transfers in the Comoe Province among incomers from the northern cotton zones and returnees from the Ivory Coast settling outside their regions of origin. Accompanying the monetisation of land transaction is the formalization of sales through written documentation even though such documents are reported to have little or no legal value.

In the forested regions of Ivory Coast, the emergence of market transactions is associated with the long history of immigration driven by the local cash crop economy where incomers have gained access to land by acquiring cultivation rights on woodland or cleared land, but also by "buying" this type of land or purchasing plantations from migrants leaving the region (Colin and Ayouz, 2006; Kone et. al., 2005).

Using data from Ghana, Kenya, and Rwanda, and supported with historical evidence Migot-Adholla et. al. (1991) concluded that in rain-fed cropping areas, indigenous African tenure systems have been flexible and responsive to changing economic circumstances. Where population pressure and commercialization have increased, the indigenous tenure systems have autonomously evolved from a system of communal property rights towards one of individualized rights.

Proponents of the evolutionary theory of land rights argue that, households would acquire broader and more powerful sets of transfer and exclusion rights over their land as population pressure increase and agricultural commercialisation proceed (Cohen, 1980; Boserup, 1981; Noronha, 1985; and Bruce, 1988). Under such conditions individualisation of land rights would be spontaneous. If indeed indigenous African land tenure systems are truly dynamic, then the relevance of interventions by governments in Africa to facilitate a process of adaptation and the so-called modernisation in land relations is questionable.

2.6 Land Tenure security, Farm Investment and Productive Efficiency: The Relationship in Theory

The principal effect of lack of secure ownership is uncertainty in a farmer's mind about the value of improvements made to the land. This uncertainty tends to increase as farming becomes more commercialised. The strength of this perception is expected to have a bearing on how farmers manage their land and thus should influence agricultural productivity (Sjaastad and Bromley, 1997; Alemu, 1999).

In theory, tenure security (often equated to individualisation and land title registration) is assumed to engender both demand and supply side effects on productivity (Platteau, 1995). On the demand side, it provides incentives for investing in soil conservation measures, land improvements and other productivity-enhancing operations since farmers are assured of reaping the stream of benefits associated with their investments. Also, it leads to efficient cropping choices and, in particular, it removes decision biases in favour of short-cycle crops that arise from tenure insecurity.

On the supply side, land titling is expected to facilitate farmers' access to credit to finance farm investment projects (Barrows and Roth, 1990). The creation of legally binding and protected property rights in land would ultimately eliminate multiple claims of land rights and hence allow for free transferability of land. The free transferability of land rights is expected to enhance efficiency and farm productivity as land would be transferred to more dynamic or to producers with greater abilities to utilise land. Individualisation is also expected to avert the tragedy of the

commons where land under communal ownership is highly fragmented and managed inefficiently.

Most of the theoretical approaches to analysing the relationships between land tenure arrangements and farm investment have their roots in the household model under the theory of the household (Sadoulet and de Janvry, 1995); and the neo-classical theory of land tenure security and productivity (Barrows and Roth, 1990). These theories describe the household as a semi-commercialised entity that combines in a single institution, decisions relating to production, consumption, and reproduction over time (Sadoulet and de Janvry, 1995). The neo-classical hypotheses imply that tenure insecurity constraints the household by limiting their willingness to invest and produce at optimal levels as well as their access to financing. The household in theory is a semi-commercialised entity in the sense that it engages in production to produce output, retains a part of this output and sells a part to generate income for consumption, savings and investment. When all markets work, the only linkage between production and consumption decisions is through the level of farm income achieved in production. When not all markets work, there are direct interrelations between production and consumption decisions.

Fundamentally, the household decision maker is confronted with the problem of simultaneously managing production, consumption and work decisions. These distinct optimisation problems must be integrated in one single household problem. Sadoulet and de Janvry (1995) specify the structural form of the model as follows:

$$\underset{q_a,x,l,c_a,c_m,c_l}{Max} \quad \mu(c_a,c_m,c_l;z^h), \qquad \textbf{utility function}$$

$$s.t.: g(q_a,x,l;z^q) = 0 \qquad \textbf{production function}$$

$$p_x x + p_m c_m = p_a (q_a - C_a) + w(l^s - 1) \qquad \textbf{cash constraint}$$

$$c_l + l^s = E, \qquad \textbf{time constraint.}$$

Where: z^h denotes household characteristics, p_a *and* p_m represent prices of commodities c_a and c_m, consumed by the household. p_a also denotes the market price for q_a output produced by the household. c_l are l^s denote time spent at home and work respectively out of a total time endowment E. z^q represents firm characteristics and p_x of input x that the household employs in production.

Combining the last two constraints yields;

$$p_a c_o + p_m c_m + w c_1 = \pi + wE = y^* \qquad \text{full income constraint}$$

$$where\ \pi = p_a q_a + p_x x + c_1, \qquad \text{farm profit}$$

Households are regarded as risk averse and will self-protect by exercising caution in their production decisions if institutional arrangements provide imperfect insurance (Morduch, 1995). Peasant households produce under high levels of uncertainty induced by natural hazards (weather, pests, diseases, natural disasters); market fluctuations; and social uncertainty (insecurity associated with control over resources, such as land tenure and state interventions, and war). These conditions pose risks to peasant production and make farmers very cautious in their decision making (Walker and Jodha, 1986). In his criticism of the profit maximising approach in peasant production modeling, Lipton (1968) argues that under risk and uncertainty, the peasant's objective is to secure his/her household needs from current production or face

starvation. Lipton further argues that under such conditions, there is no room for aiming at higher income levels by taking risky decisions (Lipton and Longhurst, 1989). Given that land use arrangements affect tenure security, the questions of how tenure insecurity influence production decisions relating to investment and efficiency are plausible and can be studied using household models.

2.7 Land Tenure and Productive Efficiency Relationship: The Empirical Issues in Research

In the early to mid-twentieth century, two schools of thoughts had emerged with opposing views on sources of inefficiency in the agricultural sector of Least Developed Countries (LDCs). The first school comprised land 'reformists' who argued that land tenancy arrangements in LDCs were responsible for the apparent inefficiency in the agricultural sector. According to this school of thought, land tenure arrangements such as sharecropping resulted in inefficient allocation of resources and also reduced tenants' incentive to improve agricultural land (Georgescu-Roegen, 1960; Issawi, 1957; Heady, 1947; Shickele, 1941; Marshall, 1930). To solve the problem, the 'reformists' proposed measures such as rental rate reduction, land redistribution, abolition of sharecropping, and minimum term leases as policy instruments that could improve development prospects. On the other side of the debate was the "equal efficiency" school who argued that land tenure had no bearing on productive efficiency and that poverty of the agricultural sector was due to factor endowment (mainly a large body of unskilled labour relative to land and capital). The "equal efficiency" school also reject reformists' arguments in support of land reform, stressing that those arguments were founded on normative welfare criteria rather than the positive criterion of economic efficiency (Cheung, 1968, 1969a).

As the debate waged, empirical dimensions were introduced in an attempt to resolve the controversy (Ibid). Reformist seeking to establish that choice of land tenure systems had implications for resource allocation and efficiency in the farm sector, supported enquiries that compared productive efficiency under different land tenure arrangements (usually owner-operated as against shared tenure arrangements). The hypotheses of both reformists and "equal efficiency" schools of thought have continued to shape research several decades later.

Studies analysing productive efficiency in alternative land holding arrangements have employed two approaches in the estimation of technical efficiency. One approach is the non-parametric, non-stochastic, linear programming (data envelopment analysis) which suffers from the criticism of failing to take into account the possible effects of measurement error and other noise in the data (Coelli, 1995). The second employs stochastic frontier models to estimate the inefficiency component of the error term but also suffers the disadvantage of imposing explicit and possibly restrictive functional forms on the technology. This notwithstanding, the stochastic frontier modelling has been widely applied in studies assessing technical and allocative efficiency under different land tenure arrangements in Africa (Kariuki et. al., 2008; Ahmed, 2002).

Conventionally, the general hypotheses highlighting the relationship between secure land rights and productivity are set as follows:

i. The Security Hypothesis:

Uncertainty regarding ownership reduces farmers' willingness to make long-term investments that would improve land productivity. Increased individualisation of rights

improves farmers' abilities to reap returns from investments on land (Feder et. al. 1988). Tenure security is measured by multiple indices such as perceptions of degree of security, duration of tenure holding (number of years that land is operated by the same household), differences in land rental arrangements, and farm characteristics such as distance from homestead and fragmentation of plots.

ii. The Credit (Market Participation) Hypothesis

Working in tandem with the security hypothesis is the credit hypothesis. Individualisation of rights leads to greater demand for land improvements as well as for complementary inputs as farmers are assured of reaping returns to investment in land while at the same time improving the credit-worthiness of the farmer and enhancing his chances of receiving formal credit. Both of these demand-side and supply-side mechanisms interact to increase investments in land and input use, which in turn lead to greater land productivity.

Concerns over inefficient allocation of resources under shared tenancy arrangements has fuelled most of the calls for land reform in Africa to support the privatisation and protection of individual land rights. From the neo-classical view point, land arrangements that facilitate the acquisition of individual rights would cause efficient land markets to emerge where land will be transferred to farmers who are able to extract a higher value of product from the land (Barrows and Roth, 1990). This view is also articulated by authors such as Hayami and Otsuka (1993) and Burgess (2001). On the other side of the debate are authors (Georgescu-Roegen, 1960; Issawi, 1957; Heady, 1947) who espouse the views of the equal efficiency school, arguing that different land tenure forms lead to the same resource allocation and that land tenure arrangements had

little bearing upon technical and allocative efficiency. The group attributes poor agricultural productivity in Africa to factor endowments. The views of both schools have implications for the value of land policy and land reforms. The relative efficiency of the land ownership and tenancy empirical issue in the quest to provide empirical support to back the various arguments.

2.8 Land Tenure Security, Farm Investment and Productivity: The Empirical evidence

A large body of theoretical literature has developed on comparative technical efficiency of land holding arrangements, and accompanied by a growing number of empirical studies in Africa and Asia (Otsuka and Hayami, 1988; Otsuka, H. Chuma et. al., 1992). Most of these studies have however produced mixed results with majority failing to provide evidence of Marshallian inefficiency. Marshallian refers to inefficiency that arises out of unwillingness on the part of tenant plot holders to invest their full effort or resources out of fear of appropriation of their rights to land in the future. Marshallian inefficiency was first associated with sharecrop arrangements but was later also been associated with land transactions that did not transfer full and permanent rights to new owners or tenants (Marshal, 1890).

Evidence from across Africa seems to suggest that the impact of individualized titling on smallholders' access to credit is negligible. In Kenya for example, a World Bank survey could not establish any significant relationship between the possession of title and the use of formal credit (Migot-Adholla et. al., 1991). In the case of Rwanda and Ghana similar World Bank studies did not find any significant correlation between the extent of (informal) individualization of land tenure and recourse to credit. More precisely, no significant relationship could be found

between the percentage of households receiving formal credit or any credit and the proportion of land held with "complete transfer" rights (Migot-Adholla et. al., 1991; Place and Hazell, 1993).

On the relationship between land title and investment, most empirical studies assessing the relationship between land titling and investment in land improvements have produced inconclusive results. In Ghana for example, Migot-Adholla et. al. (1991) found that increasingly individualised land rights do not appear to have any effect on agricultural investment and yields. The study made similar findings for Rwanda and Kenya. In Zimbabwe, Harrison (1987) found little variation in the productive performance between small holder farmers with no land title and large scale commercial farmers with land titles.

Some few studies however find evidence of higher efficiency on individualised plots. In India, Shaban (1987) found that yields on owner-cultivated plots were 16% higher than yields obtained under sharecropping by the same farmer. Laffont and Matoussi (1995) found significant evidence of Marshallian inefficiency in a study in Tunisia; Gavian and Ehui (1998) found total factor productivity to be lower on contracted land (fixed rent, sharecropped, borrowed or gifted land) than on owner-operated land. Ahmed et. al. (2002) found significant inefficiency on sharecropped land but not so on land under fixed-rent contracts. In Eritrea, Tikabo and Holden (2004) found land productivity to be significantly higher for owner-tenants than for pure owner-operators and owner-landlords, showing that land is transferred from less efficient to more efficient land users (Tikabo and Holden, 2004).

One major criticism against the credit hypothesis is its application in economies with weak financial sectors and where market access (especially for credit) is limited to a small proportion

of the population. Given that the credit and tenure security hypotheses appear not to function in the African context, it is important to explore the possible reasons for the phenomenon. A number of studies including Okoth-Ogendo (1976), Collier (1983), Noronha (1985), Bruce (1986) and Barrows and Roth (1989) outline some possible factors responsible for the apparent inapplicability of the credit and land tenure security hypotheses in Africa. First, it is evident that land registration procedures in most African countries are inefficient and most produce land titles that are ineffective. Ineffective land title is not considered reliable collateral and would most likely be rejected by most formal and semi-formal credit institutions. Secondly, it is difficult to foreclose land and other landed property because the markets are thin and inefficient. A third and more prominent reason is the limited participation in markets for the greater majority of the populations.

2.9 SUMMARY

This chapter reviewed literature on indigenous land tenure systems in Sub-Saharan African and Ghana in particular, exploring the historical antecedent of policies and interventions that have shaped land relations and research in Sub-Saharan Africa over several decades. The chapter specifically explored the literature to highlight the history and evolutions of land tenure in pre-colonial, colonial and post independence Sub-Saharan Africa; the history and nature of land markets in Sub-Saharan Africa; land tenure systems and drivers of land administrative reform with focus on Ghana and, the theory and empirical evidence on land tenure security, farm investment and productive efficiency in focus in Sub-Saharan Africa.

According to the literature, land tenure systems and markets in Africa may have derailed from trajectories of efficiency during colonisation. The diverse, complex and often inefficient land markets associated with Africa are largely attributed to colonial policy on land. This is evidenced in literature by the existence of land markets characterised by monetised land transactions in pre-colonial Sub-Saharan Africa on the one hand and complex, diverse and communal oriented land tenure systems in post-independence Sub-Saharan Africa on the other hand (Grier, 1981; Rowling, 1946; Watts, 1983). The literature also suggests that current land systems and policies across SSA are the result of attempts by post-independence governments to streamline land policies in the course of development, often in response to perceived failures of existing land relations to either deliver required expanses of land for development or the required gamut of land rights and accompanying documentation.

The desire to transform land systems and land administration in Africa into efficient land transfer mechanism has placed land reform at the centre of policy and research for several decades. Over time, two schools of thought had emerged with one group advocating for the complete overhaul of land institutions and land laws in Africa, arguing that indigenous land tenure systems in Africa constituted static constraints that induced insecurity and limited the extent to which land rights could be used to facilitate access to finance for investment (Harrisson, 1987; Dorner, 1972, Marshall, 1890 Georgescu-Roegen, 1690). The other school of thought recommends caution in states' intervention in land relations and argues that land tenure systems in Africa will evolve over time in response to market forces and also in response to agricultural intensification and commercialisation (Boserup, 1981; Cohen, 1980; Bruce, 1988). The hypotheses of these two schools of thought have been central issues in land research for several decades. The literature

has demonstrated that lack of clear-cut consensus among researchers on the relationship between indigenous land tenure systems, tenure security and productivity, with a growing number of studies yielding mixed and inclusive results. The lack of empirical evidence on the relationships between indigenous land tenure systems on the one hand, and land tenure insecurity and productivity on the other hand, leaves a knowledge gap in the literature that this study seeks to address.

CHAPTER THREE
THEORETICAL FRAMEWORK AND METHODOLOGY

3.0 INTRODUCTION

Chapter three discusses the conceptual and theoretical frameworks of the study. The Chapter elaborates on theoretical and analytical frameworks within which the study is situated, clearly outlining the empirical models as well as definition and measurement of variables contained in the models. Testable hypotheses and apriori expectations regarding key relationships between variables are also presented in this chapter. The study area and key attributes of the data used are described in detail in the final section of this chapter.

3.1 Operationalisaton of Concepts

Operationalisation of concepts presents the operational definitions of key concepts contained in the study topic based on theory and empirical works. The section outlines working definitions of the three key themes of the study i.e. land tenure insecurity, farm investment and technical efficiency. The section also explains how the empirical issues related to the key terms are measured.

3.1.1 Definition and Measurement of Land Tenure Security

The primary effect of a lack of secure ownership of land is the uncertainty in a farmer's mind about the value of improvements made to the land (Sjaastad and Bromley, 1997; Alemu, 1999). This perception of tenure insecurity is also an important determinant of farmers' willingness to invest in land improvements and use improved farming practices, suggesting that improved tenure security is important for sustainable land management in the region (Gebremedhin et. al.,

2002). This uncertainty tends to increase as farming becomes more commercialised. There is ample evidence that the incidence of land disputes and land grabbing by larger or more powerful farmers increases as the potential return to land rises (Baron, 1978; Clark, 1969; Feeny, 1982; Kemp, 1981; Tanabe, 1978).

Land tenure security has been defined as the individual's perception of his/her rights to a piece of land on a continual basis, free from imposition or interference from outside sources, as well as the ability to reap the benefits of labour or capital invested in land, either in use or upon alienation (Place, Roth and Hazell, 1994). The definition has three dimension i.e. the breadth, duration and assurance. Breadth refers to the quantity or bundle of rights held and includes the right of use and withdrawal, exclusion and the right to transfer ownership. Duration is the length of time that a given right is legally valid. Assurance implies that rights (breath) and duration are known and held with certainty. It is the degree of certainty that one's tenure rights will not be violated that explains tenure security.

Because tenure security is not directly observed, devising an objective index of tenure security to correlate with agricultural performance and other outcome variables has so far been problematic (Roth and Haase, 1998). Several measures of tenure security have been employed by researchers. The most common is a self-reported binary indicator which represents some underlying variable. This indicator takes a value of 1 if the underlying variable takes positive values and 0 when the underlying variable takes negative (Alemu 1999; Holden and Yohannes 2002; Matchaya, 2009). The self-reported binary indicator of tenure security suffers from problems inherent in questions about people's perception of the security of their tenure. For example depending on how questions are posed there is the likelihood individuals may frequently report insecurity in

anticipation of some form of help or may not correctly understand the question (Matchaya, 2009). The second problem with the self-reported binary indicator of tenure insecurity is the fact that the measure fails to take into account the underlying causes of insecurity. The binary perception of insecurity is usually obtained by asking individuals whether they fear losing their land in the future? It is obvious that the response to this question will vary significantly if the dimension of fallowing or leaving the land idle is added i.e. if the farmer is asked whether he or she fears losing her land if it is not cultivated for a specified period of time.

In some studies, land tenure security is captured by documentation or registration of land rights (Feder and Onchan, 1987; Migot-Adholla et. al. 1991; Hayes et. al., (1997). In this regard, all land that is registered and has a title is considered secure land while that which does not have a title is insecure. This definition is criticised for assuming that land title is analogous to security and ignoring the fact that context specific customary laws and institutions are also important in determining land ownership security.

Goldstein and Udry (2008) use a measure of tenure security which probably takes into account context specific customary laws and institutions that govern land tenure security. In their study of land rights and agricultural investment in Ghana, Ibid established a relationship between land fallowing and security of tenure. The study demonstrated that farmers who lacked local political power and were not confident of maintaining their land rights fallowed their land for less than technically optimal durations at the expense of large proportion of their potential farm output.

Even though the use of fallowing period as proxy for tenure security is less explored compared with the self reported binary indicator of perception of tenure security, land fallowing as an indicator of tenure security is probably a more realistic measure of insecurity within the context of most indigenous land tenure systems across Sub-Sahara Africa. It is also a better proxy for assurance dimension of land tenure security.

One factor often overlooked in the operationalisation of land tenure security is the fact that plots are virtually never lost while under cultivation or the fact that land rights tend to become weaker if land is put into fallow over extended periods (Goldstein and Udry, 2006; Quisumbin et. al., 2001). This implies households would feel more secure with plots they can fallow or leave idle for specified periods of time without the fear of losing their rights to the plots.

This study measures tenure security by the number of years households can leave their plots uncultivated and still maintain ownership of the land. This definition measures the assurance dimension of tenure security i.e. the confidence that the rights of the household will not be violated even when the land is not under cultivation or policed.

3.1.2 Investment: Definition and measurement

Investment in farmland is an inter-temporal phenomenon, where the household expends resources to improve a piece of land at a given time, and expects to reap a stream of future returns in the form of increased productivity or profit. Feder and Onchan (1987) conceptualises household farm investments in the presence of land tenure insecurity as a dichotomous choice between two alternatives. The household chooses between investments in capital equipment, which is not lost in the event of eviction or long-term land improvements, which are completely

lost in an eviction. The household invests in the first period and produces in the second, with the objective of maximising expected terminal wealth which consists of production value, land value, and returns to non-agricultural activities; less any debts incurred through credit use at the end of the second period. In land related investment, the period over which the household expects to control land rights which entitles it to reap the returns to investment is an important determinant of both the decision to invest and how much to invest. Thus there exist two distinct levels of investment decision making in the household. The first involves a binary decision to invest or not to invest taking into consideration factors that influence the household's land rights; and secondly, how much to invest which also depends on tenure security and some socioeconomic factors. The study measures household long-term land investment expenditure at two levels:

i) A binary indicator (takes a value of 1 if the household invested and 0 if the household did not undertake any investment) is used to measure the incidence of household investment in long-term soil conservation and irrigation related investments.

ii) The Ghana Cedi value of the investments (i.e. the amounts households spend) in long-term soil conservation and irrigation related investments.

3.1.3 Productive Efficiency

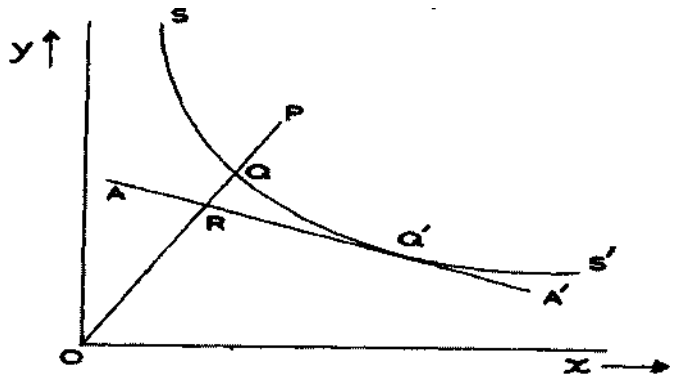
Efficiency denotes the success at producing as large as possible an output from a given set of inputs (Farrel, 1957). Productive efficiency is often viewed from two perspectives:

i. Technical efficiency: Produce the most output with a given level of inputs

ii. Allocative efficiency: Produce a given output as cheaply as possible.

This simplified definition of efficiency is illustrated in Figure 3.1 (Farrell, 1957). The vector $\overline{OP}$ shows input combinations of a given firm in an industry. The isoquant SS' is the assumed efficiency frontier for the industry. The isoquant SS' is assumed convex to the origin and is nowhere positive (Farrell, 1957). The firm operating at P is inefficient because it could produce on the same isoquant using less quantities of input X and Y. The firm producing at Q is more efficient because it produces the same level of output as P using OQ/OP of each input. The identity OQ/OP is the technical efficiency of P. The ratio takes the value 1 for a perfectly efficient producer and 0 for a perfectly inefficient firm. It is also important that the

Figure 3.1: Efficiency in Production



Source: Farrell, 1957

measure of efficiency takes into account prices of the factors in the combination of inputs X and Y. Farrell (1957) states that Q' and not Q will be optimal production if AA' has a slope equal to the ratio of prices of factors X and Y. The cost of production at Q' will be a fraction (OR/0Q) of production of Q and is denoted the allocative efficiency of Q. If the observed firm were perfectly efficient both technical and in respect of prices, its cost would be a fraction of OR/OP (Ibid). The ratio OR/OP is conveniently the overall (or economic) efficiency of the firm and is equal to the

product of technical and allocative efficiencies. There have since been several applications and extensions of the Farrell model to include the stochastic frontier model.

The study focuses on measuring and analysing technical efficiency under different land holding arrangements in Ghana.

Several hypotheses explaining the link between land tenure security, land investments and technical efficiency have been propounded. Notable among the hypotheses are the Boserup population pressure hypothesis (Boserup, 1965) and the household production capacity hypothesis (Alemu, 1999). These hypotheses have been tested in a variety of studies ranging from those that seek to establish the link between land rights and productive efficiency (e.g. Kariuki et. al., 2008; Ahmed, 2002) to those studying tenure security and land investment (e.g. Hayes et. al., 1997; Holden and Yohannes, 2002 and Hagos and Holden, 2006). These studies provide useful theoretical basis for this research.

3.2 Theoretical Framework

This section presents the theoretical framework on which the study's approaches are based. The section provides a theoretical anchor for the analytical tools and models adopted by the study to analyse evolutions in land rights holdings in Ghana as well as the relationship between land tenure security, household farm investment and technical efficiency. The section first provides an overview of the analytical tools employed in the analyses of data, and then followed by the theoretical foundation or justification for the analyses.

3.2.1 An Overview of the Study's Approach and Theoretical Models

Four analytical techniques are used in this study. The first technique involves the use of descriptive statistics to test the evolution of land rights in Ghana. The evolutionary theory of land rights hypothesis which posits that demographic growth and agricultural intensification push towards greater individualisation and commercialisation of land rights is tested. The second is the estimation of the stochastic frontier model that examines the influence of land tenure arrangement on technical efficiency. The stochastic frontier analysis which also models technical inefficiency as a function of other household socioeconomic covariates has as a theoretical basis; the equal efficiency school hypothesis which argues that land tenure has no bearing on productive efficiency, and the 'land reformists' school hypothesis which contends that land tenancy (such as sharecropping) results in inefficient allocation of resources and reduces the incentive to improve agricultural land (Ip and Stahl, 1978). The third technique employs qualitative choice modelling to examine the determinants of tenure insecurity. The factors that influence tenure insecurity are analysed using the binomial probit model. The fourth method examines the influence of tenure security on farm investment decision making using the model of the household and following after Feder (1987).

3.2.2 The Evolutionary Theory of Land Rights and Individualisation of Land Rights

Two schools of thought have emerged over the years with divergent views on the influence of indigenous African land tenure systems on land productivity and on how to transform property rights in land in Africa. On the one side is the group this study refers to as the "reformists" who argue that African governments and state institutions must necessarily intervene to streamline land relations and introduce efficiency in land markets i.e. facilitate the development of land

transfer systems that allocate land to users with greatest ability (Dorner, 1972; Harrison 1987). On the other side of the debate are the "pro-evolutionists" who espouse the view that indigenous land tenure relations adapt in response to market forces and that the widespread calls for government interventions in land markets were unnecessary.

The central tenet of the evolutionary theory of land rights is that, under the joint influence of increasing population pressure and market integration, land rights spontaneously evolve towards individualisation and that this evolution eventually leads rights holders to press for the creation of duly formalised private property rights - a demand to which the state will have an incentive to respond.

The evolutionary theory of land rights predicts that demographic growth and agricultural intensification would increase the value of land and lead to a progressive transition from communal tenure toward greater individualisation of land rights. This entails the concentration of the bundle of rights in the hands of a single rights holder, and translates into increasingly monetised access to land through sales and rental (Boserup, 1965; Colin, 2005). At the earliest stage, agriculture is characterised by abundance of land (mostly communally owned) and the predominance of rudimentary systems of farming such as shifting cultivation. As population pressure increases, the period of fallow shortens and shifting cultivation is replaced by systems of rotation and modern soil improvement practices. These changes are also stimulated by the introduction of commercial tree crop production, which tends to enhance rights of exclusion of individuals even though the basic control over outsiders' access to the land continues to be exercised by the community.

3.23 Theoretical Framework for Land Tenure security

The theoretical model for land tenure security is based on the argument that households who hold more land than they are able to cultivate face the risk of losing their plots either through appropriation by state authorities or through encroachments by other land users. As a theoretical basis for assessing the determinants of tenure insecurity, the study draws from Alemu (1999). In a study of land tenure and soil conservation in Ethiopia, Alemu (1999) hypothesised that relative farm size influences households' perception of their tenure security. Under the Ethiopian land administration (Proclamation 31, 1975, "Public Ownership of Rural Land"), households with relatively large farms risk losing the farms through re-distribution if the households exhibited a lack of capacity to cultivate the farms either by fallowing or renting out land.

In the Ghanaian context, some attributes of the land tenure system indicate the Alemu (Ibid) relative farm size hypothesis is applicable to some extent i.e. modelling farm size as a source of tenure insecurity. While under communal systems idle land may be taken up by relatives or natives, private owners of large farms may have to spend huge amounts of resources to police and protect idle lands or risk encroachments. Even in situations where land rights were well-defined and documented, inability to cultivate or develop land for long periods of time may often lead to encroachment and subsequent litigation. Under such circumstances, tenure insecurity (TI) arising out of disputes or potential conflicts over land would directly relate to farm size. In testing Alemu (1999) hypothesis, the study adopts and modifies the framework used by Holden and Yohannes (2002). Holden and Yohannes (2002) modelled the land tenure security-farm size

relationship as: $I^s = I^s(F^r)$; (3.1)

where I^s denotes the probability of the household losing its land due to appropriation by government. F^r represents relative farm size. This implies $\frac{\partial I^s}{\partial I^s} > 0$.

However, if the household is well endowed in terms of resources, it would either cultivate all its farmland or use its resources to police and protect its rights. Under such conditions, farm size would not necessarily induce tenure insecurity and equation (5.1) becomes $I^s = f(F^r, R(F^r))$ (3.1.2)

with the first order derivatives as: $\frac{\partial I^s}{\partial F^s} = \frac{\partial f}{\partial F^r} + (\partial f / \partial R)(\partial R/\partial F^r) < 0$ or > 0. If $(\partial f / \partial R)(\partial R/\partial F^r)$ dominates $\frac{\partial f}{\partial F^r}$, then household resource endowment and other socioeconomic factors cancel the effect of insecurity arising out of the inability to cultivate or develop large tracts of idle land. The net effect of the derivatives would most likely differ by location as well as other cultural and demographic factors.

3.2.4 Land Tenure Insecurity and Farm Investment: The Theoretical Model

The theoretical model for assessing the influence of tenure security on investment is based on Feder (1987) framework. Feder's framework for tenure insecurity and investment is developed as an optimisation problem. Tenure insecurity is represented by the probability of being evicted from one's land. The farmer chooses between investments in capital equipment, which is not lost in the event of eviction; and land improvements which are completely lost in the event of eviction. The farmer invests in the first period and produces in the second period with the objective of maximising expected terminal wealth at the end of the second period.

Theoretical model for assessing the relationship between tenure security and household farm investment is based on neo-classical assumption of a utility maximising household confronted with some set of economic, technological and social constraints. Based on Feder (1987) framework and Hagos and Holden (2006) household land conservation investment is modelled as a utility function. The (Ibid) model assumes that the household's utility is increasing in present value of future income stream (π), and household characteristics and asset wealth (H^c):

$\max_{I_t} U\,[E(\pi_t); H_t^c]$ Subject to $E(\pi_t) = \sum_{t=1}^{t} \delta^t\,(ptq_t hA_t E[\omega_t] - cI_i(\epsilon_e) I_{it}; H_t^c$

$$q_t = y(s_t, K_t)$$

$$s_t = s_o(1 - er(\varphi^t, \sum_{t=1}^{t} I_{i\omega})) \qquad (3.1.3)$$

Equation (3.21) specifies the value of future income stream (π_t) at the end of the household's planning (T) as accumulated annual crop revenues less the unit cost (cI_i) of conservation investment (I_i) discounted by δ^t, which, in turn is a function of household asset wealth and household characteristics (H_t^c). The unit cost of conservation investment is assumed to be decreasing in level of farmer experience ($cI_i(\epsilon_e) < 0$). The expected crop revenues are given by the product of crop price (p_t) and yield(q_t), and land area (A_t) and dichotomous expectation of land tenure in the period t($E[\omega_t]$). Yield in season t is assumed to be concavely increasing in soil depth ($q'(s_t) > 0$) and also a function of other conditioning factors (K_t) such as weather, pests and soil fertility.

The theoretical model also takes into account factors such as erosion that may affect soil condition and thus influence conservation investment decisions. Soil depth increases linearly with initial soil depth ($s'(s_t) > 0$) and decreases concavely with erosion ($s'(er) < 0$). The erosion function is bounded to the interval [1, 0] and increasing in factors (Φ) that govern soil propensity

to erode, (er' (Φ) > 0) such as slope, soil type, vegetation cover and other plot and soil characteristics. Erosion is further assumed to be concavely decreasing in cumulative soil conservation investment ($er' \, ^{\Sigma I\omega^{-1}}\varphi < 0$). From this relation, the optimal soil conservation investment where marginal utility of cumulative added yield equals cumulative discounted cost of conservation investment are deduced.

Spatial and temporal characteristics of technologies have significant influence on the relevance of tenure insecurity (Knox et. al., 1998). Tenure insecurity may not significantly affect short term land investments if costs and benefits accrue in the short term rather than over a longer time period. The common hypothesis is that tenure insecurity will have more impact on decisions such as tree planting, building of conservation structures or irrigation, and less impact on the use of fertilizer, seeds and other inputs that yield returns in the short run. Tenure insecurity will therefore not affect the intensity of use of purchased farm inputs but could influence the decision to grow perennials, plant trees, construct stone bunds or even use manure.

3.2.5 Technical Efficiency: The Theory and Measurements

Technical efficiency analysis is dominated by two separate approaches: the nonparametric Data Envelopment Analysis (DEA) and the parametric Stochastic Frontier Analysis (SFA). The origins of Data Envelopment Analysis date back to Farrell (1957), but its current widespread use is largely due to the influential work by Charnes et. al. (1978). The sixties and seventies saw the birth of SFA in the works of Aigner et. al. (1977) and Meeusen and van den Broeck (1977), among others. Stochastic Frontier Analysis builds upon the classic econometric regression approaches (see Aigner and Chu, 1968) to production function estimation, which relies heavily

on the ex ante specification of the functional form. The main attention has been in the decomposition of the residual into a non-negative inefficiency term and an idiosyncratic error.

By contrast, Data Envelopment Analysis has focused on the nonparametric treatment of the frontier, which does not assume a particular functional form but relies on the general regularity properties such as monotonicity, convexity, and homogeneity. However, Data Envelopment Analysis attributes all deviations from the frontier to inefficiency, completely ignoring any stochastic noise in the data. In summary, it is generally accepted that the virtues of Stochastic Frontier Analysis lie in the stochastic, probabilistic treatment of inefficiency and noise, while the virtues of Data Envelopment Analysis lie in its general nonparametric frontier (Bauer, 1990; and Seiford and Thrall, 1990).

3.2.6 The Stochastic Frontier Model

The conventional stochastic frontier model specifies output as a function of inputs and some unknown parameters. Consider a production function $q, = f(x_i; \beta)$ (3.1.4)

where q_i is output, x_i is a vector of inputs and β is a [k x 1] vector of parameters to be estimated. We can think of efficiency as being measured as 4-, multiplied by the theoretical norm where $\varsigma_i \in [0,1]$ such that $q_i = f(x_i ,;\beta)\ \varsigma_i$. If ς_i =1 then the firm is fully efficient and produces the most it can. If ς_i < l then the firm is not fully efficient.

We can let $q_i = f(x_i; \beta)$ be the output that should happen and q_o the observed output where $q_o < q_f$ because of inefficiency and other factors. As $q_o < q_f = q_i = f(x_i ; \beta)$, Aigner and Chu

(1968) suggest the adding of a non-negative random variable to $f(x_i;\beta)$ which would capture the technical inefficiency of firm i : $q_0 = f(x_i;\beta) - u_i$ (3.1.5)

This type of model could be estimated using fixed effect models where u_i is treated as firm fixed effects.

Assume:

$$f = (x_i;\beta) = \beta_0 X_1^{\beta_1} \beta X_2^{\beta_2} \ldots X_k^{\beta_k}$$
$$\ln(x_i;\beta) = \ln\beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \ldots + \beta_k \ln X_k$$
$$\ln q_i = \ln\beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \ldots + \beta_k \ln X_k - u_i$$
$$\ln q_i = \beta X_i - u_i$$

Aigner and Chu (1968) suggested the measure of technical efficiency as

$$\frac{\text{Observed Output}}{\text{Frontier Output}} = \frac{q_i}{\exp(x_i\beta)} = \frac{\exp(x_i\beta - u_i)}{\exp(x_i;\beta)}, \text{ where } 0 < \exp(-u_i) \le 1. \quad (3.1.6)$$

While this is a decent solution to the problem, it does not account for other factors such as rainfall, pests and diseases that could cause deviations from the frontier. Aigner, Lovell and Schmidt (1977) suggested the adding of a two-sided error term to the one sided error term proposed by Aigner and Chu (1968). The likelihood function was derived as follows; the $q_i = f(x_i\beta)\zeta_i \exp(v_i)$ yields $\ln q_i = \ln(f(x_i\beta)) + \ln(\zeta_i) + v_i$. (3.1.7)

Defining $u_i = -\ln(\zeta_i)$ in (6.4) yields, $\ln q_i = \ln(f(x_i\beta)) + v_i - u_i$. (3.1.8)

In a Cobb-Douglas setting, $\ln q_i = \beta_0 + \sum_{i=j}^{k} \beta_j \ln(x_{ji}) + v_i - u_i$ (3.1.9)

where $v_i iid N(0,\sigma_v^2), u_i \ge 0 and \operatorname{cov}(u_i,v_i) = 0$, where v denotes measurement error and other

factors such as weather, among others, and u a one-sided technical inefficiency term. Given this construction, consistent estimates of composite error term cannot be obtained by conventional Ordinary Least Squares (OLS) procedure. Some assumptions about the distribution of u are required first. The most commonly used distributions of u include the Half-Normal, Exponential and Truncated Normal. The Gamma distribution has also been applied in some instances but its application is rare. Take for example firm i: A is deterministic output level such that A' might be the frontier output $q_i = \exp(f(x_i\beta + v_i)$ and A'' might be observed output $q_i = \exp(f(x_i\beta + v_i - u_i)$. For firm j: B is the deterministic output level such that B' might be frontier output; $q_j = \exp(f(x_j\beta + v_j)$ and B'' the observed output $q_j = \exp(f(x_j\beta + v_j - u_j)$. Note that the composite error term $v_i - u_i$ does not cause a problem with OLS as long as v_i and u_i are independent of input x. In that case $\hat{\beta}_{OLS}$ is unbiased, consistent, and efficient amongst linear estimators, except the intercept is not consistent. Nevertheless it becomes impossible to extricate the variances σ_v^2 and σ_u^2. Maximum Likelihood Estimation (MLE) yields more efficient $\hat{\beta}_s$, a consistent intercept and a consistent var *iance* $(v_i - u_i)$.

It is important to note that the model specified assumes a frontier from above. In some instances, frontiers from below might be of interest, for example cost functions. Kumbhakar and Lovell (2000) show that using the dual to production it is possible to derive frontier cost functions:

$\ln(C_i) = \beta_0 + \beta_q \ln(q) + \sum_{j=1}^{k} \beta_l \ln(P_{ji}) + v_i + u_i$ where P_{ji} is the price of input i for firm j. Note that u_i is added to cost frontier as inefficiency is expected to raise cost. Aigner, Lovell and

Schmidt (1977); assume $v \sim iidN(0,\sigma_v^2)$, $u \sim iidN(0,\sigma_u^2)$,[half normal], and define the variance parameters as $\sigma^2 = \sigma_v^2 + \sigma_u^2$, $\lambda = \sigma_u/\sigma_v \geq 0$[If $\lambda = 0$,] then there is no σ_u and hence no technical inefficiency.

Battese and Cora (1977) adopted a different approach, setting the variance parameters as $\sigma^2 = \sigma_v^2 + \sigma_u^2$; $\gamma = \sigma_u^2/\sigma_v^2$ .If $\gamma = 0$ then all deviations from the frontier is attributable to noise. If $\gamma = 1$ then all deviations from the frontier are inefficiencies. In the case of Battese and Cora (1977), they v is normally distributed while u take some form of a one-sided error term;

$$\ln L = \frac{N}{2}\ln\left(\frac{\pi}{2}\right) - \frac{N}{2}\ln\left(\sigma^2\right) + \sum \ln\left(1-\Phi\left(z_i\right)\right) - \frac{1}{2}\sigma^2 \sum \left(\ln y_i - x_i\beta\right)^2$$ where

$z_i = \left[\frac{\ln y_i - x_i\beta}{\sigma}\right]\left(\frac{\gamma}{1-\gamma}\right)^{1/2}$, where x_i are in log form and $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and Φ is the cumulative standard normal distribution. The function $(\ln L)$ is maximised over β, σ^2, γ *for* $k+2$ where k includes the intercept term. In the case where u is assumed to have half-normal distribution, then the function becomes $E[(\exp(-u_i))] = 2\left[1-\Phi\left(\sigma\sqrt{\gamma}\right)\right]\exp\left(-\gamma\sigma^2/2\right)$.

Note that the model specified so far yields average technical efficiency (TE) across the entire sample of firms. In terms of efficiency at the individual firm level, Jondrow et.al., (1982) suggest a measure of $TE_i = \left[1 - \frac{\Phi(\sigma A + \gamma \in_i/\sigma A)}{1-\Phi(\gamma \in_i/\sigma A)}\right] \times \exp\left(\gamma \in_i + \sigma_A^2/2\right)$, (3.17) where $\in_i = \ln y_i - x_i\hat{\beta}, x_i$ are in log form and $\sigma A = \left(\gamma(1-\gamma)\sigma^2\right)^{1/2}$. The maximum likelihood estimates and residuals are substituted in to obtain $\hat{TE}_i$.

3.3 Analytical Framework and Empirical Models

This section presents the analytical approaches and empirical models employed in the analysis of data in this study. The section elaborates in detail measures of the indicators used in analysing evolutions in land rights holdings, land use arrangements and tenure insecurity, as well as the tools used in exploring the relationship between tenure insecurity on the one hand and farm investment and technical efficiency on the other.

3.3.1 Analytical Approach to Measuring Individualisation in Land Rights in Ghana

Land market transactions and use arrangements vary from country to country, usually influenced by the land policy of the particular country, population pressure and land scarcity among other factors. Despite the diversity in land use arrangements, seven forms of land transactions cut across Sub-Saharan African countries. These transactions which mainly take place under informal land market settings include inheritance, gift, purchase, pledge, loan, lease, and share cropping (Lunning, 1965).

Along with succession, land gifts are a traditional, non-commercial and mostly permanent land allocation mechanism (Sjaastad, 2003). Land is described as gift if the new owner acquired the right to own or use free without payment in cash or kind. Even though land gifts are expected to transfer complete rights to the new owner, most gifts in recent times have precluded transfer rights.

Purchase refers to the outright acquisition of complete land rights on a permanent basis usually for cash. Pledge is defined as passing on the right to use the land to another party in exchange for a money loan. Land loaning describes the situation in which land entrusted to a friend/another

user usually for a year when the owner has more land than he requires (should be distinguished from a lease, where there is a defined money payment). Sharecropping is a land tenure system in agricultural production which involves a landowner leasing land to a tenant in return for a percentage of the output yield. The tenant provides labour whereas the landlord provides the land. Other factor inputs may be provided by either party depending on the contract (Cheung 1968).

Lunning (1965) found that there was "to a certain extent, a relationship between density of population and the occurrence of sales but it does not explain all differences. In some ways, acreage of farm land available per head of population should be a more reliable 'yard-stick' (Ibid).

The principal indicator of individualisation in land rights is in the ability to transfer those rights without seeking prior approval (Place and Hazell, 1991). In assessing trends towards individualisation, the study examines modes of land acquisition. It is anticipated that rising trends in individualisation would be characterised by changes in the mode of land acquisition from transactions that grant usufruct rights (e.g. gifts land and shared tenancy arrangements) to modes that confer complete rights such as outright purchases. The specific land rights under consideration are categorised into two:

1. Use rights (rights to grow annual crops, to grow perennial crops, to be buried, to make permanent improvements, and to collect firewood, among others) and
2. Transfer rights (rights to lend, rent, pledge, mortgage, give, bequeath, and sell). Under transfer rights, the following categories are examined;

i. Limited transfer rights: Refers those parcels for which the individual has no permanent transfer or alienation rights, but may have some temporary transfer privileges.

ii. Preferential transfer rights: This category describes parcels that may be permanently transferred but only within the family or lineage (that is, through gift or bequest).

iii. Complete transfer rights: Refer to those lands that may be alienated outside the lineage through the right to sell.

Alongside complete transfer rights, increasing incidence of land titling is also an indication of trends towards individualisation. The privatisation of land rights, other things being equal, is expected to lower disputes and land fragmentation often associated with common pool natural resources. The land fragmentation index (number of plots per land size in acres) is employed to examine fragmentation of land under different land tenure arrangements. Free transferability of land rights is also expected to increase the use of land as collateral and pledges involving land. Pledges are possessory mortgages in which the lender of cash takes possession of the land for a specified period and earns, as interest, the proceeds from the land. Transferability of land rights can only be effective if rights holders can provide proof of ownership. It is therefore expected that a trend towards individualisation would be characterised by documentation of land transactions by way of writing.

3.3.2 Analytical Framework for Assessing Land Tenure Security

The theoretical model for land tenure insecurity is based on the argument that households who hold more land than they are able to cultivate face the risk of losing their plots either through

appropriation by state authorities or through encroachments by other land users. As a theoretical basis for assessing the determinants of tenure insecurity, the study draws from Alemu (1999). In a study of land tenure and soil conservation in Ethiopia, Alemu (1999) hypothesised that relative farm size influences households' perception of their tenure security. Under the Ethiopian land administration (Proclamation 31, 1975, "Public Ownership of Rural Land"), households with relatively large farms risk losing the farms through re-distribution if the households exhibited a lack of capacity to cultivate the farms either by fallowing or renting out land.

The Alemu (1999) framework is to some degree applicable in Ghana even though there are some differences in land policies between Ghana and Ethiopia. While land is vested in the state in Ethiopia, the opposite exists in Ghana where control of land is mostly vested in the stools or skins. Under Ethiopian law households that demonstrate inability to utilise their lands either by not cultivating or renting out land may lose their rights to cultivate the lands through redistribution. In Ghana, households with relatively large farms usually would not fear appropriation by the state but encroachments by relatives within the land owning clan and other land users if land is fallowed. As already reported by Goldstein and Udry (2006), land which is not fallowed is virtually never lost under most indigenous African land tenure systems.

Even though some studies have adopted frameworks that define tenure insecurity as the insecurity associated with losing land if the said land is not cultivated for a given period, these studies have fallen short of directly testing land fallowing as a function of the provenance of land and other socioeconomic factors of the household (Alemu 1999; Holden and Yohannes 2002). Goldstein and Udry (2006) demonstrated that fallow durations varied across the different plots

cultivated by a farmer, depending on the provenance of the land. Ibid (2006) showed that, individuals with local political power fallowed land that they obtained through the political process of matrilineage land allocation significantly longer than they do land obtained through other means.

This study examines directly tenure security (i.e. the assurance of tenure security measured by the number of years households can leave their lands idle without and still maintain ownership) as a function of land ownership and use variables as well as household socioeconomic factors using the Alemu (1999) framework. The relationship between farm size and tenure security associated with the duration households can leave their lands idle is given as:

$$F^P = f(F^r, R(F^r)) \quad (3.2)$$

Where: F^P is the duration of time land could be left unused without loss of title and is a proxy for assurance of tenure security. Households that feel relatively tenure secure are expected to be able to leave their plots and also for longer durations. Households who feel relatively insecure will not be able leave their land unused. F^r denotes relative farm size while R is resource endowment. Resource endowment (R) is expected to have the same effect as in equation (3.1.3).

The study hypothesised that individuals of different social, economic and political status are confronted with different degrees of tenure security which is evidenced by the assurance of tenure security of the durations they leave their land idle without the fear of losing the land.

3.3.3 Land Use Arrangements and Tenure Insecurity: The Empirical Model and Apriori Expectations

The estimable model which controls for household demographic and geographic factors is specified as:

$$F^p = f(F^r, F^s, L^T_i, L^V, L^C_t, S^T, TLU, H^c_i D^L_i) \quad (3.2.1)$$

Where

i. F^P = the duration of land could be left idle without loss of title (dependent variable). The variable is measured in number of years.

ii. F^r = relative farm size. It is expected that households with large tracts of land will be unable to cultivate the land thus increasing the likelihood of encroachment and litigations and therefore tenure insecurity demonstrated in inability to leave land idle.

iii. L^V is the value of land and is expected to exert a negative effect on the duration of tenure.

iv. L^T_i = land ownership and land tenure variables such as land titling and demarcation of boundaries. The expectation is that land ownership with deed will have a positive effect on the period households fallow their plots.

v. Ci^d = Crop dummies. The presence of trees or perennials on land. Like the case with permanent structures, a positive coefficient is expected for perennials and a negative for annual staple crops.

vi. TLU= Livestock holding (excluding oxen) is an indicator of household wealth and a proxy for standing capital. Wealthy households may use their resources to cultivate as

well as police their land. TLU may also be considered as an indicator of social status and therefore the ability of the household to influence power within the community.

TLU is expected to increase durations households are able to leave their lands idle.

vii. H^c_i = Household characteristics including sex of household head, age of household head and education of household head.

i. The sign of the age variable is expected to be positive since older members of community may be able to exert some influence on social and political structure. The square of age (agesq) is added to highlight the assumed nonlinear (quadratic) behaviour of the age variable.

ii. A positive coefficient sign is expected for Sex of the household head variable (Sex). Female-headed households are perceived to be less influential in the community than male-headed households. It is expected that the limited influence in female-headed households would increase their level of insecurity and hence reduce the duration they fallow their plots.

iii. It is expected that household heads with higher the level of education will more informed about land tenure issues and land titling process. This knowledge is expected to improve their ability to document and protect their lands and hence feel less insecure. A negative coefficient sign is expected for household heads that are able to read and those that have completed basic education.

viii. L^{C}_{i} = location dummies. The effect of location is expected to differ depending on factors such resilience of the land tenure system, population and general level of development in the particular location. Dummies for the southern horticultural belt and northern agricultural zone are included while the dummy for affram basin is used as the reference dummy.

ix. S^{T} = Indigene status of the household. The variable takes the value 1 for an indigene and 0 for non-indigene. The number of years household leave land idle is likely to be influenced positively if the household head is an indigene status and negatively if a non-indigene.

3.3.4 Econometric Estimation of Tenure Insecurity Model

The household either feel secure leaving their land or not, and based on their evaluation of their tenure security decide on the duration of time they could leave their lands idle and still maintain ownership or use rights. The number of years land could be left unused without loss of title is given by:

$$F^{P} = \omega_1\beta_1 + \varepsilon_1 \quad (3.2.2)$$

where F^{P} is the number of years land could be left uncultivated which depends on the vector of ω_1 explanatory variables including household socioeconomic characteristics and the provenance of land.

The probability of leaving land without lose of title is given by

$$T^{L} = \Pi_2\Omega_2 + \nu_2 \quad (3.2.3)$$

where *(Tr and T^L)* are observed, whereas F^P is observed only when T^L =1.

Given that the hosuehold first assess their tenure security to decides whether they could leave their land or not, and based on their decision, choose the number years they could leave their lands, the study suspects that the use of a single stage procedure to estimate the factors that influence households tenure security (i.e. whether they can maintain ownership of lands they leave idle) and the duration of time they could leave land raises the issue of sample selection bias. The study will therefore test for the presence of sample selection bias using the Heckman selection model (Heckman, 1979). If we reject the null hypothesis of statistical independence between the probability of losing land in fallow equation and the number of years land could be left, a multistage procedure most be used in the estimation.

3.3.5 Empirical Model for Analysing the Relationship between Land Tenure Insecurity and Household Farm Investment

The model adopted by the study draws from the framework of Feder and Onchan (1987) which has also been applied by several studies including Place and Hazell (1993) in Ghana, Rwanda and Kenya; Hayes and Roth (1997) in Gambia. Unlike Place and Hazell (1993) and Hayes and Roth (1997), this study adds the dimension of investment in the development of irrigation structures. Following the failure to establish strong relationship between individualised land rights and investment or productively, some researchers are encouraged to argue that the basic use rights provided by indigenous land use arrangements are apparently sufficient and able to provide long-term entitlements to users to induce them to make some specific investments in land (Brasselle et. al., 2002). Others also argue that the flexibility of tenure systems allow for enough adjustments to internal developments (Platteau, 1995).

The addition of investment in irrigation development by this study is informed by the fact that soil conservation investment used by some studies as a proxy for long-term investment in land (Hagos and Holden, 2006; Brasselle et. al., 2002) may not involve substantial amount of resources and hence may not significantly influence the farmer's rate of time preference. Secondly, the relative stability of indigenous land use arrangements in most situations may just provide security for periods long enough to allow the household reap returns to soil conservation investment (Brasselle et. al., 2002). The addition of irrigation-related investments such as investment to construct wells, pipes, ponds, canals, drip irrigation facilities, etc, not only increases the value of investment but also the time dimensions required to reap the returns to investment. The study anticipates that farmers would take their land rights or land use arrangements into consideration if the magnitudes in terms costs of investments are high and the time dimension for harvesting the stream of benefits is relatively long.

The theoretical framework for analysing households' long-term investment in soil improvement and irrigation has been discussed in chapter 2 and the theoretical model specified as in (3.1.3) on page 56. Based on the theory and the large body of empirical research undertaken on the subject of land tenure and farm investment across a number of African countries (Clay et.al. 1998; Feder and Feeny, 1993; Hagos and Holding, 2006), the study specifies an estimable empirical model as:

$$\sum I_t = f\,(tenure, wealth_{T=1}, H_T^c{}_{-1}, plot, return, market, crop, Zone)$$

(3.3)

where: ΣI_i measures household conservation and irrigation investment in plot i. The study measured this by the GH¢ value of conservation investment in soil and water and irrigation related investments. The survey solicited household responses on whether they made investment in soil and water conservation and irrigation and if so how much (GH¢ expenditure) was invested. The tenure variable represents factors that influence the farmer's expectation of retaining tenure or his land rights such as whether the plot is owner operated, rented, temporally transferred (loaned). The duration of tenure is also included and is expected to improve farmers perceived tenure security. The $wealth_{T\_1}$ variable denotes household wealth and asset holdings including relative farm size, livestock holdings, labour and other resource endowments. $H^{C}_{T\text{-}1}$ represent household demographic characteristics such as age and education of household head. The variable plot represent farm characteristics such as soil type, drainage, degree of fragmentation (ratio of total number of parcels to total farm size), and access to irrigation. The vector *market* measures market access variables such as borrowing and access to agricultural extension information. The variable *crop* denotes the type of crop cultivated, either short duration crops or annuals or perennials that require land for several seasons. The *Zone* variable controls for location fixed effects such as distance to markets, population density and rainfall.

The study focuses on measuring the effects of land tenure security on household long-term land investment decisions. As indicated in chapter 2, the farmer, base his/her investment decisions on his level of tenure insecurity (assumed to vary with the type of land use arrangement and land documentation) and chooses between investments in capital equipment, which is not lost in the event that he/loses the land and long-term soil improvement and irrigation-related investments, which are completely lost in an eviction. Tenure security in this respect is captured by land use

arrangements variables such as whether the land is purchased, rented, sharecropped or gifted; land titling or rights documentation (i.e. whether land ownership covered with deed or not). Also included is the duration of land contracts, are the number of physical structures on land, years of land ownership and incidence of land disputes.

The household soil conservation and irrigation investment decision making happen at two levels. The household first decides whether to invest or not to invest and upon deciding to do the latter, make decision on the level of investment. Both the decision to invest and the level of investment are influenced by factors including those outlined in the empirical model (equation 3.3). The level of conservation is given by $I^L = X_1\beta_1 + \varepsilon_1$

(3.3.1)

where I^L is the level of household conservation investment which depends on the vector of X_1 explanatory variables outlined in (3.3).

The decision to invest or not is given by $I^D = X_2\Omega_2 + v_2$
(3.3.2)

where *(X and I^D)* are observed, whereas I^L is observed only when I^D =1.

The model assumes that (s_i and v_2) is independent of X with mean zero implying that X is exogenous, and $v_2 \sim N(0, 1)$. Given such a model, if the error terms in Equations (3.3.1) and (3.3.2) are related, they must first be estimated jointly given the premise that the household chooses whether to invest and then, having decided positively chooses the level of conservation investment. This implies there could be problems of selection bias hence requiring that the two equations be estimated jointly. The estimation procedure will therefore involve testing for the presence of selection bias using the Heckman selection model (Heckman, 1979), and examining the likelihood ratio test of independence.

3.3.6 Land Tenure and Household Farm Investments: Testable Hypotheses and Apriori Expectations

The following hypotheses are associated with variables specified in the empirical models.

1. We hypothesise that investments in soil water conservation and irrigation development will increase with the perceived degree of tenure security. The longer the number of years the household has operated a given plot or the duration of contract, the higher will be the incentive to conserve that plot, because we believe that over time, households will develop a strong sense of security over holdings, and this will encourage investment (Alemu, 1999).

2. Owner-operated plots are expected to be more likely to be conserved. Also the expectation is that households would prefer to make irrigation-related investments on their own plots relative to temporarily acquired plots. Plots close to the homestead are more likely to be conserved than far away plots not only owing to the extra costs involved but also because of the relatively stronger degree of security attached to homestead farms. High fragmentation of plots may also involve higher transaction costs rendering investment to be unattractive. Keeping fragmented plots may, however, also be used by households as a risk-spreading strategy. The effect of land fragmentation on conservation and irrigation investment may therefore be ambiguous.

3. Resource or income poverty reduces households' willingness and ability to invest (Holden and Shiferaw, 2002; Pagiola and Holden, 2001). Poverty in assets and cash income lead to high rates of time preference (RTPs), and this may lead to decisions that favour short term or current consumption as against long-term investments in soil

improvement and irrigation. Household wealth variables such as livestock and land holding, non-farm income, higher output or value of output per area, and family labour are expected to reduce households rates of time preference (RTPs) and given secure land tenure/ownership, positively affect both the decision to invest and the level of investment.

4. Location effects such as variations in the levels of commercialisation, distance to major markets and population density will influence the perception of profitability of conservation and irrigation investments. We expect households located in communities near major markets to have greater incentives to invest in land conservation and irrigation. Households in rural areas and far from major markets and commercial centres may also have limited non-farm employment opportunities and hence may invest in land conservation and irrigation to secure perhaps their only source of livelihood. Higher population density may induce intensification and, hence, trigger more investment in conservation. On the other hand it may also lead to higher tenure insecurity because of population pressure and increasing value of land. The distance from major markets is therefore expected to be ambiguous.

Since the study makes use of cross-sectional data, it is plausible to assume that heteroscedasticity might be a problem. Heteroscedasticity is when the variances of the residuals are not the same thus violating the assumption of equal variance of the residuals or homoscedasticity (Gujarati, 2003). Heteroscedascity is largely regarded as a cross-sectional phenomenon. Since there is the suspicion of the problem of heteroscedasticity the robust standard errors are used.

3.3.7 Empirical Model and Econometric Estimation of Technical Efficiency

The prospects of inter-country comparisons of approaches and findings had a significant influence in the choice of approach this study adopted. Kariuki et. al. (2008), Amaza and Maurice (2005), and Ahmed (2002), among others, have used the stochastic frontier approach to assess land tenure and productive efficiency elsewhere in Africa. The study therefore adopts the stochastic frontier approach to estimate technical efficiency not only because of the strengths of the approach but also the opportunity to compare the situation in Ghana with what prevails in other countries. The variables in the frontier model are the traditional variables of a production in a Cobb-Douglas setting namely land, labour and capital while controlling for soil quality factors such as moisture retention and drainage. The use of a single equation model is justified since input allocations and output are observed, implying the general input allocation case where technological relationships can be estimated directly without explicit assumptions that restrict either behaviour or technology (Ahmed, 2002; Just et. al., 1983). In the model, output is defined as a function of land, labour, purchased inputs such as seed, fertilizer and pesticide, farm size and plot soil quality variables:

$$Y = f\,(AREA,\ PINPUT,\ LABOR, Smoist, SoWAT, FRAG,\ CRPD,\ LOCD) \quad (3.4)$$

Where:

Y = Value of farm output.

LAND = Land size in acres

PINPUT = purchased seed, fertiliser and chemicals (value in GH¢)

LABOR = Total labour use (man hours)

Smoist = Moisture retention (Time it takes for land to drain completely)

SoWAT = Dummy variable for source of water used (Irrigated =1 if rain-fed =0)

FRAG = Land fragmentation index (Number of plots per total farm size)

CRPD = Crop dummies

LOCD = Location dummies

Since it is quite conventional to hypothesise that the intercept of the production frontier is influenced by the choice crop (Ahmed, 2002), the selection of crops into the model is an important exercise. Farmers in three ecological areas of the study grow a wide range of crops, the major crops being maize (29%), cassava (10%) and groundnut (10%). All other crops are cultivated by fewer than 5% of farmers.

The scale of production of crops even though important, is not the sole criteria for inclusion in the model. The relative importance or use of crops has implications for household investment and by extension efficiency. Household management of perennial cash crops like cocoa, pineapple, oil palm and mango would most likely differ from the management of non-perennial crops like maize, cassava and yams. Farmers' evaluation of their tenure security is expected to influence their crop choice decision. Farmers with insecure tenure are more likely to plant annual crops than perennial crops.

Dummies for annual crops (including maize, millet, cassava, cowpea, yams, among others); perennial cash crops (comprising cocoa, oil palm and mango); non-perennial cash crops (pineapple, soyabean, melons); and vegetables and spices (including tomato, onions, ginger, tiger nuts etc). The dummy for annual staple crops was naturally excluded from the estimation (used

as the reference crop so that the frontiers for cash/export crops and all other crops are compared to the frontier for annual staple cash crops.

Location specific variables such as variations in altitude, rainfall pattern, soil types, crop and livestock mix and even the level of development in land markets are expected to influence the position or shifting of the frontier. Location dummies are included for the three ecological zones of the study. The dummy for the Southern Horticultural Zone was used as the reference and thus excluded from the estimation.

3.3.8 Evaluating the Determinants of Technical Inefficiency

In examining the influence of land contracts on technical efficiency, the study follows Battese and Ceolli (1995) and models technical inefficiency as a function of other covariates. Given that u, is the technical inefficiency measure obtained by estimating the frontier, the specification

$$u_i = Z_1\delta + E, \qquad (3.4.1)$$

where $Z.$ is a set of variables thought to influence u, enables the testing of effects of household factors including land ownership and tenancy arrangements. The truncated normal distribution is assumed since that allows for a one stage estimation of the frontier model alongside inefficiency modeled as a function of other covariates. The truncated normal distribution means that v maintains a normal, while u takes truncated normal distribution. Therefore we have:

$$\ln L = \sum_{i=1}^{N}\left(-\frac{1}{2}\ln(2\pi) - \ln\sigma + \ln\Phi\left(\frac{\mu}{\sigma\gamma^{1/2}}\right) + \ln\Phi\left(\frac{(1-\gamma)\mu - s\gamma\varepsilon_i}{\left[\sigma^2\gamma(1-\gamma)^{1/2}\right]}\right) - \frac{1}{2}\left(\frac{\varepsilon_i + s\mu}{\sigma}\right)^2\right). \quad \text{The } \beta$$

alongside $,\sigma_u^2, \sigma_v^2, \gamma \text{ and } \delta$ are derived simultaneously via Maximum Likelihood Estimation

alongside , $\delta;^2$, δ^2, λ *and* δ are derived simultaneously via Maximum Likelihood Estimation

(MLE). To test for technical inefficiency, the likelihood ratio (LR) test is employed. Th has its parameters set as: $H_0 : \gamma = \sigma_u^2 / \sigma^2$ or $H_0 : \lambda = \sigma_u / \sigma_v = 0 \quad H_A : \gamma \neq 0$
The test statistic is:
$-2\{\ln LR - \ln L_{UR}\} \sim \chi^2_{(1)}$ where $\ln LR$ is the value of the log-likelihood when $\gamma = 0$.
The value of gamma $\left(\gamma = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2} = 1\right)$ is an indication that all the variations in output as a result of technical inefficiency (Van Velsen, 1964).

In evaluating the influence of land tenure arrangement on productive efficiency, dummy variables for owner-cultivated, sharecropped land, gift land, rented land, and duration of land ownership are included as independent variables. The effects of land documentation on technical inefficiency are also tested with the inclusion of dummies to capture land with deed, land ownership without deed and non-tenancy.

Apart from types of land arrangements, household socioeconomic, demographic and farm characteristics were hypothesised to influence technical inefficiency at the household plot level. Factors like livestock ownership, labour availability, age, sex and education of household head may influence innovation and use of technology and therefore technical efficiency. Land fragmentation index (the ratio of number of plots to total land size), number of livestock owned (total livestock units), the ratio of adult male labour to total labour, age, sex and education of household head, distance to markets, access to extension services are included socioeconomic factors that influence household resource allocation and therefore technical efficiency.

3.3.9 Land Tenure and Technical Efficiency: The Testable Hypotheses and Apriori Expectations

Drawing from theory, the study hypothesises that land transaction and holding arrangements that protect the right of tenants will lead to higher levels of investment and therefore productivity [output per unit input]. Thus, land cultivated by owners and fixed-fee rental land would be technically more efficient compared with alternative land tenure systems such as sharecropped and gifted land due to the restrictions imposed by landowners on the latter. Producers who purchased land outright are expected to invest higher in such land and produce the highest output per unit input. Literature also suggests that efficiency under land ownership with title will be higher compared with land holding without title. Following Marshal (1890) and Mill (1848), the study also hypothesised that share tenancy arrangements will result in inefficient resource allocation. This is because the share tenant receives as marginal revenue only a fraction of the value of his/her marginal product of labour, his [the tenant's] incentive to supply labour or other inputs at the optimum level is limited.

3.4 Study Area

3.4.1 Key Attributes of the Study Regions

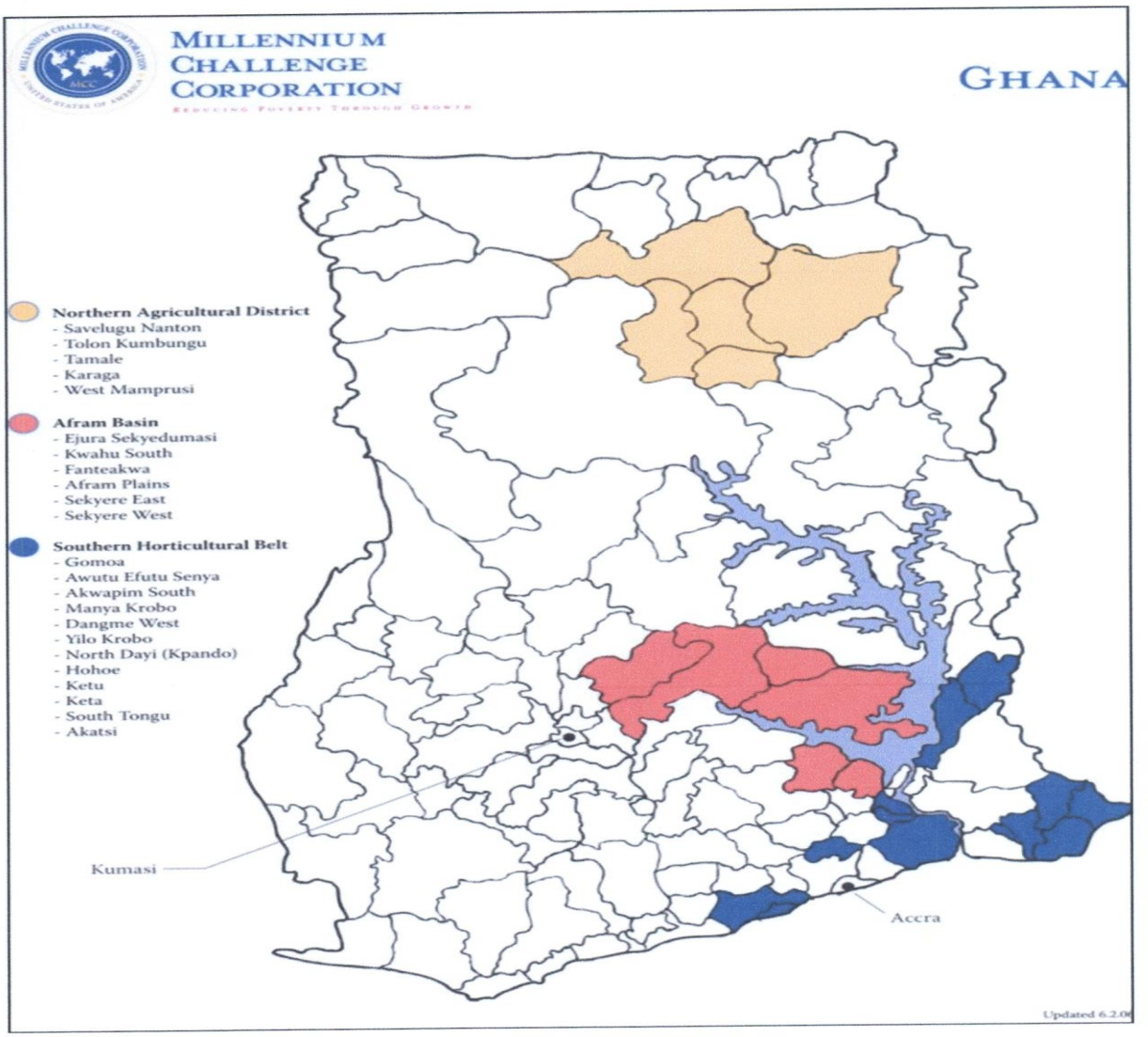
The strength of the data used for this study lies in the geographical spread of the sample. Land tenure systems in Ghana have been largely influenced by ethnicity, population pressures and agriculture, with the land tenure systems in the South differing from tenure systems prevalent in the Northern parts of Ghana. Geographically, the study covered six regions, the Northern, Central, Eastern, Volta, Ashanti and the Greater Accra regions, and over two-thirds of Ghana's land mass (Table 3.1 and Figure 3. 2).

Table 3.1: Population Characteristics of the Study Regions

Region	Land Areas	Population	Population Density (Persons/$_{KM^2}$)
Northern	70, 384	1,820,806	25.9
Ashanti	24, 389	3,612,950	148.1
Eastern	19, 323	2,106,696	109.0
Volta	20, 570	1,635,421	79.5
Central	9, 826	1,593,823	162.2
G. Accra	3, 245	2,905,726	895.4

Source: 2000 Population and Housing Census, Ghana Statistical Services Department

Figure 3.2: The Study Area in Regions and Districts



3.4.2 The Northern Agricultural Zone

The Northern Region, which occupies an area of about 70,383 square kilometres, is the largest region in Ghana in terms of land area and has a population of 1,820,806, representing 9.6 per cent of the country's population. The Northern region shares boundaries with the Upper East and Upper West Regions to the North. The farming systems, population density and even soil characteristics closely resemble the conditions in the two other Northern regions, i.e. the Upper East and Upper West Regions. The land is mostly low lying except in the north-eastern corner with the Gambaga escarpment and along the western corridor. Agriculture in the Northern region is largely subsistence oriented, dominated by the cultivation of arable crops. The climate of the region is relatively dry, with a single rainy season that begins in May and ends in October. The amount of rainfall recorded annually varies between 750 mm and 1050 mm. The dry season starts in November and ends in March or April. These climatic conditions are similar to conditions in the other Northern Regions.

In terms of land tenure systems, the Northern region poses attributes similar to those in the Upper East and Upper West regions. The major ethnic groups of the region are the Mole Dagbon (52.2%) and the Gurma (21.8%). Among the Mole-Dagbon, the largest subgroups are the Dagomba and the Mamprusi, while the Komkomba are the largest of the Gurma, the Chokosi of the Akan and the Gonja of the Guan (figure 3.3). The patrilineage is generally the main authority over lineage land in almost all of Northern Ghana where allodial title is vested in traditional authorities such as the *tendanaa* (Earth priest) and chiefs. When an individual is given a parcel of land by the *tendanaa*, he/she becomes the permanent owner of the land. The land is passed on to male children. Strangers usually cannot buy land but are given to cultivate temporarily even

though weakening traditional land institutions has allowed for the emergence of cash-based land transactions. Given that the Northern Region is the largest in Ghana in terms of land mass and also posses land tenure attributes that represent the diversity in Northern Ghana, the land data from the Northern region would highlight issues of a significantly large component of the diverse and complex land tenure systems and land administration in Ghana.

3.4.3 The Affram Basin

The area of the study referred to as the Affram basin is made up of Districts in the Ashanti and Eastern regions. The Ashanti Region is the third largest of the 10 administrative regions of Ghana, occupying a total land surface of 24,389 square kilometers or 10.2% of the total land area of Ghana. The Ashanti region is the most populated region with a population of 3,612,950 in 2000, accounting for 19.1 per cent of Ghana's total population. The region has a population density of 148.1 per square km making it third, after the Greater Accra (895.5/sq km) and Central (162.2/sq km) regions.

Akans are the predominant ethnic group in the region. About 78.9 % of the Akan population is Asante. Most of the societies in the Affram basin are matrilineal, meaning that, the line of descent is traced through the female. Land rights, inheritance of property, offices and titles are determined by the mother progeny relationship.

The non-Akan population in the region comprises the Mole-Dagbon (9.0%), the Ewe (3.2%), the Grusi (2.4%), the Mande-Busanga (1.8%) and the Ga-Dangme (1.4%). Other smaller ethnic groups form about 1.3% of the population of the region. The population of the Ashanti region is

concentrated in a few Districts. The Kumasi metropolis alone accounts for nearly one-third of the region's population. With the exception of the Kumasi metropolis and the Kwabre District, agriculture and related work is the dominant occupation in all the districts in the region.

The proportion of the population in Agriculture is higher in rural than in urban areas, for all the districts. The Eastern region on the other hand has four major ethnic groupings, namely Akan (52.1%), the Ga-Dangme (18.9%), the Ewes (15.9%) and the Guans (7.2%). Of these, the Ewes are the only non-indigenous ethnic group. The Akan predominate in 11 of the 17 districts. The

Yilo Krobo and Manya Krobo Districts have the largest concentration of the Ga-Dangmes, who constitute 70.0 per cent of the inhabitants of these two districts. About 55% of the economically active population of the Eastern region are employed in agriculture or related work. In terms of land tenure, the Affram basin area of the study represents another important diversity. The area is dominated by the Akan ethnic group and as indicated in chapter one, lineage land in the Akan speaking area is controlled by the matrilineage, where allocated land is only inherited by a man's sister's son unlike in the Northern region where only male children inherit land. The combination of high population density (Ashanti) and low population density (Eastern) region would allow for better comparison of how population plays out on land relations.

3.4.4 The Southern Horticultural Belt

The Greater Accra, Central and Volta regions constitute the Southern horticultural belt of the study. The two most densely populated regions of Ghana, the Greater Accra and Central regions are categorised in the Southern Horticultural Zone. Owing to in-migration and a high population growth rate, the Greater Accra has the highest population density in the country. The major

ethnic groups are the Akan (39.8%), Ga-Dangme (29.7%) and Ewe (18%). The Gas however form the largest single sub-ethnic grouping, accounting for 18.9 percent. The Central region has a population of 1,593,823 and predominantly Akan. About 52.3% of the population engage in agriculture and related activities. The Volta region lies to the east of the Volta Lake and covers an area of 20,570 square kilometres representing 8.6% of Ghana's land mass. The predominant ethnic group in the region, the Ewe, constitutes 68.5 per cent of the total population, followed by the Guan (9.2 %), the Akan (8.5 %) and the Gurma (6.2). A little under three fifths (59.7%) of the population is in agriculture and related occupations. Again, the diversity in terms of population densities, economic activities and ethnicity make the southern horticultural belt an interesting area in terms of land tenure, land markets and evolutions in land rights as well as productive efficiency.

Figure 3.3: Ethnic Map of the Study Area

3.5 Survey Design, Sampling and Data

The data used by the study, the Farmer Based Organization (FBO) Survey, is one of two data sets; the Ghana Living Standards Survey, Round 5 Plus (GLSS5+) and the Farmer Based Organisation survey collected by the Institute of Statistical, Social and Economic Research (ISSER) to facilitate the monitoring and evaluation of the Millennium Challenge Compact signed between the government of Ghana and the Millennium Challenge Corporation (MCC) of the United States of America. Under the compact, $547 million was to be spent over a 5-year period by the Millennium Development Authority (MiDA) of Ghana on poverty reduction programmes with emphasis on promoting economic growth and agricultural transformation. This was to be achieved through two programs. The first was designed to increase the production and productivity of high-value cash and food crops and the second, to enhance the competitiveness of high-valued cash and food crops in local and international markets.

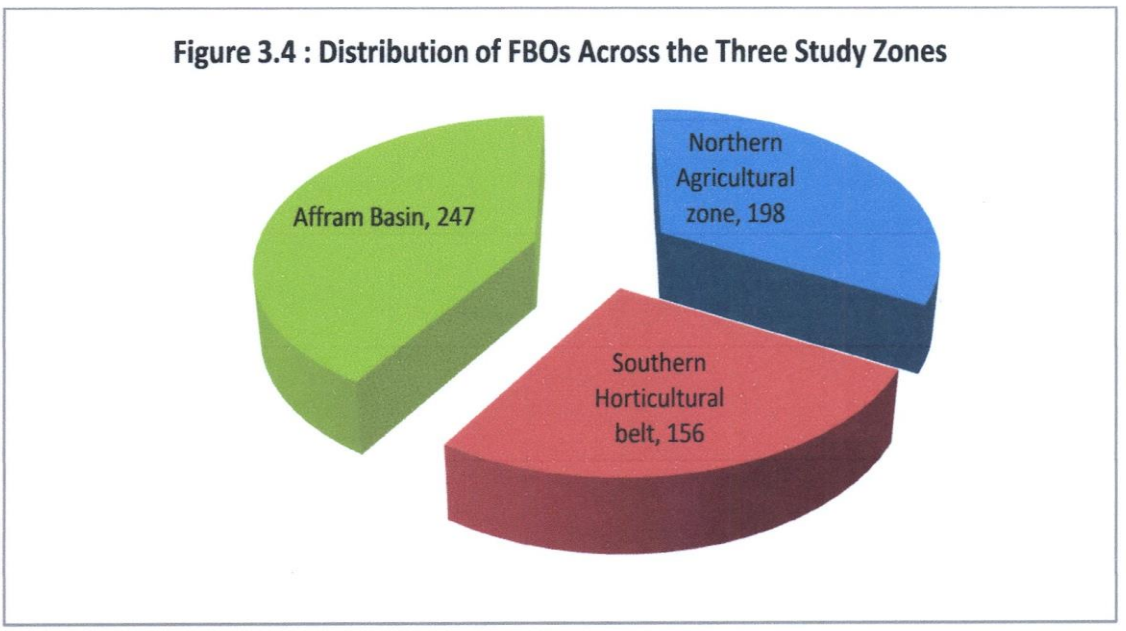
The projects covered 23 districts across Ghana and divided into three zones namely, the Northern Agriculture Zone (Northern Region), the Afram Basin (Ashanti and Eastern Regions), and the Southern Horticultural Belt (South-East Coastal Plains). About 230,000 individuals were expected to benefit directly from the compact interventions while about 1,000,000 are expected to obtain indirect benefits. The 'FBO survey' was designed essentially to facilitate the evaluation of the impact of training to be provided farmers under the agriculture transformation project. Approximately a minimum of 1200 FBOs were expected to benefit from the overall programme intervention.

The Farmer-Based Organisations survey collected information on the overall living circumstances and farming activities of members of FBOs and their respective households. In-depth household data was collected using two sets of questionnaires; a household questionnaire and a community questionnaire: Information was collected on the following household attributes:

i. Demographic Characteristics, Household membership and FBO activities;
ii. Educational characteristics of households;
iii. Household Health;
iv. Activity status of household members;
v. Migration;
vi. Transfers in and out of the households;
vii. Information seeking behaviour of households;
viii. Household assets and participation in financial markets (borrowing, savings and lending behaviour);
ix. Characteristics of household housing;
x. Household agriculture activities including land ownership and transactions and agriculture processing and,
xi. Non-farm enterprises of households

Information was also collected on the location of households, community facilities and farm sizes using geographic position system units (GPS). In addition the community questionnaire was essentially based on a market price survey.

A random sample of farmers was selected from the 601 FBOs. Figure 3.4 shows the distribution of FBOs in the three zones of the study. Based on FBO data received from MiDA five farmers were randomly picked from each FBO to form the basis of the survey.



The distribution of farmers across the MiDA zones is shown in Table 3.2. Out of over 31,000 eligible farmers, 4,791 where sampled with 2,928 of that sample realized. About 25.9% was realised in Southern horticultural belt while 40.9% and 33.2% were realised in the Affram basin and the Northern agricultural zone respectively.

Table 3.2: Distribution of farmers across the MiDA zones

	From MiDA	%	Sampled Farmers	%	Realised Sample	%
Southern Horticultural zone	8,389	26.98	1,248	26.06	758	25.89
Affram Basin	12,764	41.06	1,967	41.06	1,198	40.92
Northern Agricultural Zone	9,937	31.96	1,576	32.90	972	332
All Zones	31,090	100	4,791	100	2,928	100

Source: Descriptive Report: ISSER MIDA FBO Phase I

In order to undertake the levels of analyses proposed by the study, it was important to examine whether available data in Ghana would allow for the use of techniques proposed and also support the testing of hypotheses of the study. The ISSER-MIDA data was of good quality and adequately captured most of the attributes relevant for testing of the study's hypotheses. In addition, the data covered geographical areas that adequately represented Ghana's diversity in the areas of ethnicity, ecology, agriculture, land tenure, population and overall development level differentials. Within the three agro-ecological zones of the MIDA project, almost all forms of land tenure arrangements and land transactions prevalent across Ghana are present.

CHAPTER FOUR_

ANALYSIS OF LAND RIGHTS AND LAND RIGHTS EVOLUTIONS IN GHANA

4.0 INTRODUCTION

In this chapter, the study presents results of explorations of the data in Ghana for evidence of transformations or changes in land rights either in response to population growth, commercialisation in agriculture or both. The analyses was based on tenets of the evolutionary theory of land rights (outlined in chapter three) which predicted that individualisation of land rights would occur in tandem with demographic growth and commercialisation in agriculture. Modes of land acquisition, land rights documentation, land transfer rights, disputes and land fragmentation were examined. Changes in these attributes provide general indications of trends in land rights evolutions.

4.1 Land Rights Evolutions in Ghana

Outright ownership of land and documentation of land rights in Ghana appear to follow prediction of the evolutionary theory of property rights in land. Trends towards privatisation of land rights occur in response to agricultural intensification and commercialisation. Contractual or evidence-based land transactions (land arrangements in which there are agreements to the effect that the transactions have taken place) are becoming a common feature in areas like the Eastern, Volta and Ashanti regions where agriculture is more intensive and relatively more commercialised (see Table 4.1). Farm ownership with deed are highest in the Eastern and Volta regions where farming is increasingly taking a business dimension and lowest in the Northern agricultural zone where farming is largely subsistence oriented. In the Northern agricultural zone

for example, less than 1% of farmland transactions are covered by documentation or agreements, and only about 0.2% of land documentations are written. Written land documentations are highest (over 18%) in the Central region.

Going by the evolutionary theory of property rights, the expectation is that written documentation of farmland rights would be highest in the Greater Accra and Ashanti given that these regions are highly populated. The low levels of farmland rights registration in Accra and Kumasi may however be attributed to a complete restriction of agricultural land markets due to expansions in non-agricultural land transactions. Even though the level of farmland title documentation across Ghana (an average of about 8%) cannot be described as massive, a trend seems to exist and the driving force behind that trend appears to correlate more with intensive agriculture than with population growth.

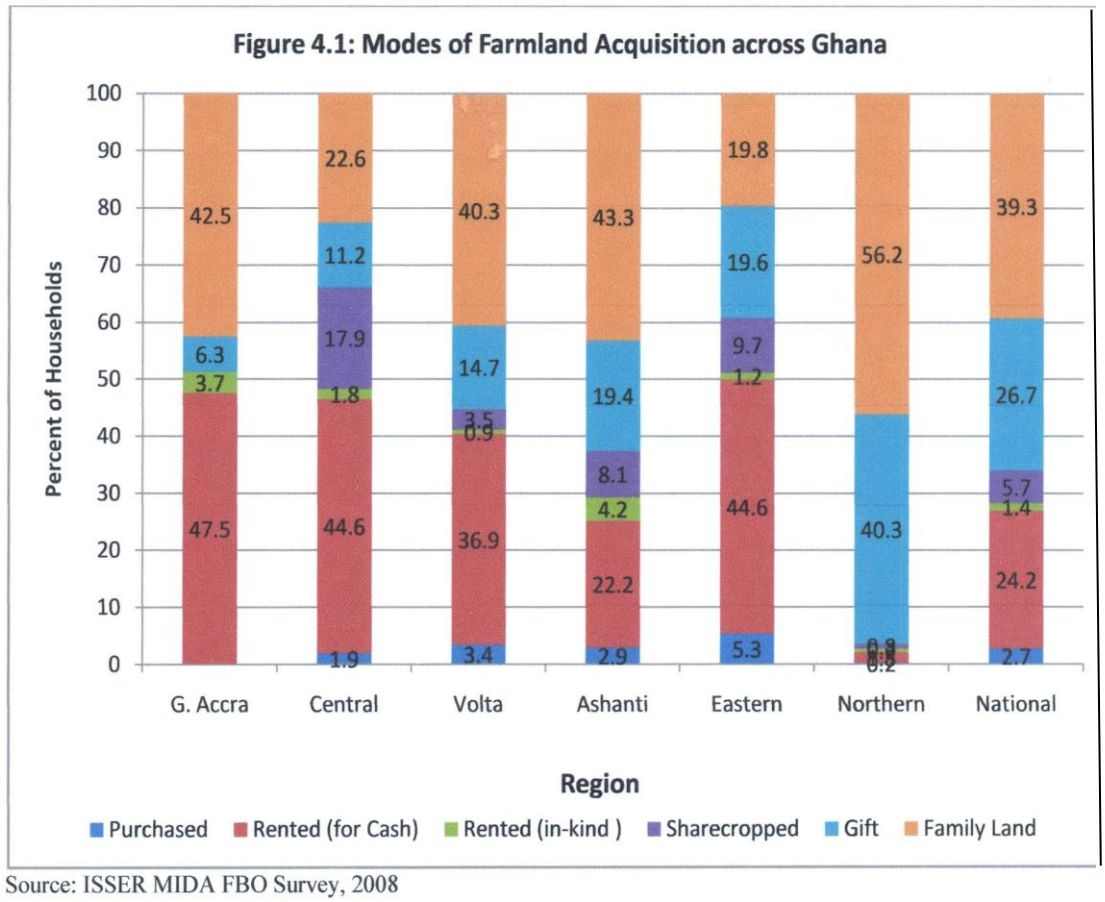
Table 4.1 Farmland rights Documentation in Ghana

	Southern Horticultural Belt			**Afram Basin**		**Northern Agricultural**
	G. Accra	Central	Volta	Ashanti	Eastern	Northern
Documentation						
Ownership with deed	4.9	6.5	11.3	10.5	12.5	0.6
Ownership without deed	38.3	22.6	51.6	51.2	29.5	93.8
Tenure Lands	56.8	70.8	37.0	38.3	58.1	5.5
Nature of documents						
Written	6.1	18.7	9.1	4.5	8.4	0.2
Oral	51.2	60.7	31.6	33.4	53.1	6.6

Source: ISSER MIDA FRO Survey, 2008

Despite the widely held view that farmland rights documentation provides some indications of trends towards individualisation, it is important to note that the extent of land rights documentation depends on the existence of well-functioning markets that allocate private rights in land. The land rights must first be acquired by transactions that adequately define and transfer the rights to the new owner. Once the rights are acquired new owners may decide to register their rights to protect their interest against appropriation by more powerful farmers or land users. Outright purchase of farmland is not widespread in Ghana. On the average, less than 3% of farmlands are acquired by outright purchase. The study by Migot-Adholla et. al. (1991) in Anloga, Wassa and Ejura found an average of 8.4% across the study area. The apparent decline in outright purchase of farmlands may be partly attributed to increasing value of land arising out of non-farm demand for land which drives land owners to hold onto their lands much longer periods in anticipation of higher prices.

Farmland acquisitions by outright purchase are either non-existent or rare in the Greater Accra and Northern regions, averaging at about 0.1% and highest in the Eastern region where over 5% of farmlands are purchased outright (see Figure 4.1). The decline in outright purchases of farmland appears to have given rise to other forms of non-permanent land transactions such as renting and sharecropping. For example, farmland rented for cash averaged 24.2%, an increase of about 11.5% over the 12.7% reported by Migot-Adholla et. al. (1991). The proportion of gift lands in overall land transactions has also declined from an average of 29.4% to about 26.7% between 1991 and 2008.



Source: ISSER MIDA FBO Survey, 2008

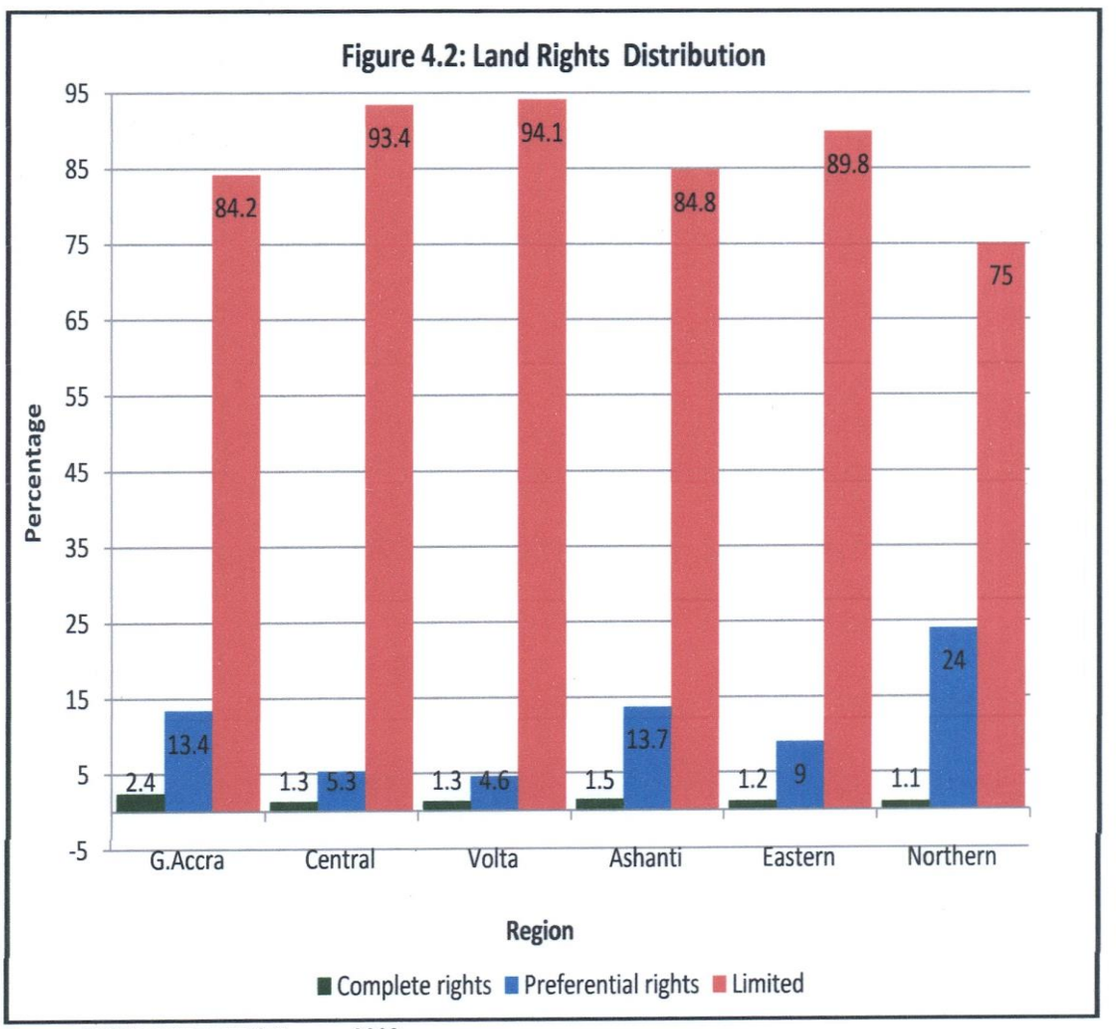
It is quite clear that some form of transformations in land rights holding have occurred over the years but not in directions and at levels to suggest trends towards privatisation of farmland rights. If anything at all, the trends suggest transformations in favour of relatively more stable transactions (in fixed renting). Land rented for cash although usually for short periods of time, provides some form of tenure security for the tenant due to the specificity with regards to the time dimensions involved. The findings made by Migot-Adholla et. al. (1991) and those of this study point to a trend in which land transactions are increasingly becoming monetised (a decline in gifted land in favour of increases in cash rents). It is however also evident that the increasing

monetisation of land has not given rise to widespread transfer of full land rights through outright sale and purchases of farm lands.

Observations from interactions with key stakeholders revealed two principal reasons why land transactions have largely failed to transfer full rights to new tenants. The first is that land renting for example usually occurs between tenants (mostly non-indigenes) and land owners who own land by virtue of belonging to the land owning group and mostly exercised limited transfer rights. The second is the apparent reluctance to sell or buy farmland outright. Prospective farm buyers have observed that the usufruct rights acquired through renting and sharecropping or even squatting have over the years succeeded in providing tenure security to allow for at least short to medium term investments in land. Also, the prices offered for farmlands are usually lower than prices offered by residential developers and lower than the compensation paid in the event lands are acquired by the state. Outright sale of land is therefore more associated with non-farm or non-agricultural related transactions. The one phenomenon that is however clear is that prices are driving land transactions and where the prices are good farmland is sold and bought. For example in the Northern region where mango plantation developers offer competitive prices for land, farmland has been sold and the relevant documentation obtained.

Concerns over tenure insecurity, which some authors suggest is associated with indigenous land tenure arrangements in Africa, usually arise out of perceptions that land relations in Africa constitute static constraints, failing to provide and protect full rights over land. Some argue that tenure arrangements induce insecurity by limiting the control tenants exercise over production decision making. While it may not be contested that the greater percentage of farmland

arrangements and transactions within Ghana provide mostly limited transfer rights, it is also quite clear that such transfer arrangements have not significantly curtailed tenants' control of production processes and decisions. Compared with the findings by Migot-Adholla et. al. (1991), farmland rights appear not to have transformed significantly in terms of the rights farmers exercise over land (Figure 4.2). An average of about 87% of plot owners exercising limited transfer rights. The inability to acquire complete rights over land means that plot holders may not be able to register their rights and therefore cannot mortgage these rights to access finance for farm investments. The other challenge is that land holders may be reluctant to make long-term investments since they do exercise complete rights over their land and could be evicted in the future.



Source: ISSER *MIDA FBO Survey, 2008*

With the exception of the Central, Eastern and Ashanti regions where some significant number of farmers 34.4 %, 32.6% and 19.7%, respectively, (see table 4.2) indicated they did not exercise full control over production decisions, almost all plot holders in the northern region and over 90% in the Greater Accra and Volta regions exercise full control over production decision. The Central, Eastern and Ashanti regions are not only among the high population density regions but also have economies driven by cash crop-agriculture and related activities. The potential for higher returns would most likely heighten the interests of both tenants and landlords in farm production processes. The incidence of land disputes appears to be more correlated with location than with land rights or land titling as land disputes seem to have occurred regardless of whether the farmer had deed or not. What is however striking is the fact that there are more disputes over ownerships than there were between tenants and landlords. Disputes over farmland were highest in the Central and Volta regions occurring in over 20% of plots and lowest in the Northern region at 1.8%.

Despite the apparent failure in transferring full rights to plot holders, land arrangements in Ghana seem not to have affected tenant's control of production processes and decision making and also seem not to have induced widespread disputes between tenants and land owners, This means that in examining the effects of land use arrangements on long term farm investments and productive efficiency, the appropriate hypothesis to test may be the security hypothesis where plot holders fear future appropriation rather than the inability to invest full effort due to interference by land owners.

Table 4.2: Production Decisions Control and Land Disputes

	Southern Horticultural Belt			Afram Basin		Northern Agricultural
	G. Accra	Central	Volta	Ashanti	Eastern	Northern
Land use control						
Full control	90.3	65.6	90.8	80.3	67.4	99.6
Occasional Approval	9.6	19.1	6.3	10.4	10.3	0.3
Regular approval	0.0	15.3	2.9	9.3	22.3	0.2
Incidence of Land Disputes						
Lands with deed	0.0	16.4	4.4	4.0	3.4	0.0
Lands without deed	0.0	9.3	3.9	5.6	0.0	1.8
Tenant	0.0	2.1	4.1	2.7	3.1	0.0

Source: ISSER *MIDA FBO Survey, 2008*

One major criticism often associated with indigenous land tenure systems in Africa is the tendency for plot sizes to continuously decrease due to fragmentation[3]. As family sizes of land owning clans increase the usual practice is for farmland to be distributed among (usually male) family members. Even though the practice of dividing communal lands among members of the community is widespread in Ghana, there seem to be no clear pattern of family lands being smaller or more fragmented than say farms purchased. The data in Table 4.3 lends credence to the fact that general population density may be the main driver of land fragmentation and not necessarily the prevailing land use arrangements. For example in the Northern, Eastern and Ashanti regions, farm sizes are comparatively larger than those in the Central and Greater Accra regions. The Northern region which has the lowest population density in Ghana has an average farm size of 17 acres per household and with the lowest ratio of number of plot to farm size (see Table 4.3)

[3]Land fragmentation is measured by the number of plots per household land holding in acres. The lower the number the less fragmented the household land.

4.3 Farm Size Holding and Land Fragmentation

	Southern Horticultural Zone			Afram Basin		Northern Agricultural Zone	All Zones
	G. Accra	Central	Volta	Ashanti	Eastern	Northern	All Regions
Farm Size							
Purchased land		26.5	7.3	8.5	14.9	16.1	12.9
		(38.2)	(5.9)	(5.4)	(16.2)	(13.6)	(15.7)
Rented (cash)	6.4	7.7	7.2	14.3	9.8	11.2	9.6
	(2.5)	(18.0)	(8.4)	(15.4)	(7.8)	(7.1)	(11.0)
Rented (kind)	3.7	13.9	3.4	15.9	8.2	10.0	13.6
	(0.0)	(3.4)	(4.7)	(12.5)	(5.4)	(11.1)	(11.0)
Sharecrop		6.3	4.0	20.2	11.4	14.2	11.9
		(4.5)	(3.7)	(18.0)	(11.6)	(4.5)	(12.9)
Gift	10.5	5.3	5.4	11.4	11.1	17.0	13.5
	(6.5)	(6.0)	(4.8)	(10.1)	(10.3)	(13.9)	(12.0)
Family land	12.3	7.4	6.9	14.0	11.7	17.4	14.2
	(9.5)	(6.7)	(12.1)	(9.5)	(13.2)	(10.6)	(11.6)
All Parcels	8.9	7.6	6.7	14.0	10.8	17.0	12.7
	(7.2)	(13.9)	(9.5)	(12.2)	(10.7)	(11.7)	(12.0)
Land Fragmentation							
Ownership with	0.3	1.3	1.6	0.3	0.3	0.4	0.4
deed	(0.1)	(1.3)	(2.8)	(0.1)	(0.4)	(0.1)	(0.6)
Rented (cash)	0.4	0.9	1.0	0.3	0.4	0.4	0.6
	(0.2)	(0.7)	(1.5)	(0.2)	(0.5)	(0.2)	(0.9)
Gift	0.4	1.2	0.9	0.3	0.4	0.3	0.4
	(0.4)	(1.2)	(1.1)	(0.2)	(0.8)	(0.2)	(0.5)
Sharecropped		0.6	2.2	0.2	0.4	0.3	0.6
		(1.1)	(3.0)	(0.1)	(0.4)	(0.2)	(1.2)
Family	0.4	0.6	1.2	0.3	0.4	0.3	0.5
	(0.3)	(0.5)	(1.9)	(0.2)	(0.4)	(0.2)	(0.8)
All Parcels	**0.4**	**0.7**	**1.2**	**0.3**	**0.4**	**0.3**	**0.6**
	(0.2)	**(0.8)**	**(1.8)**	**(0.2)**	**(0.5)**	**(0.2)**	**(0.8)**

Source: ISSER *MIDA FBO Survey, 2008;* Figures in parenthesis denote standard deviations

Commercialisation in agriculture and population growth are the most important pillars of the evolutionary theory of property rights with commercialisation in agriculture expected to provide the stimulus for privatisation of land rights. This study measures agricultural commercialisation by category of crops grown. The expectation is that farmers who produce perennial cash crops

would acquire and document complete rights over land while those engaged in the production of staple crops may not have the incentive to acquire full land rights. The data presented in Table 4.4 seems to confirm the hypothesis of the evolutionary theory of land rights that agricultural commercialisation would stimulate the acquisition or complete rights over land.

In all regions, the majority of farmers (19.3%) who have acquired and documented their rights over land belong to the category that produce perennial cash crops like mango, oilpalm, cocoa etc. Given the reality that the production of crops like mango and oilpalm for example would require significant investment and also the fact that the farmer may require relatively longer periods of time to reap returns to investments, it makes a lot of sense that a growing number of perennial cash crop farmers regard the usufruct rights provided by other land tenure arrangements as insufficient. It is also important to point out that majority of perennial cash crop production happens on owner cultivated land even though the owners have not registered their rights.

Table 4.4: Agricultural Commercialisation and Land rights

	Southern Horticultural			Afram Basin		Northern Agricultural	
Crop/ Documentation	G. Accra	Central	Volta	Ashanti	Eastern	Northern	All regions
Annual Staples							
Ownership with deed	7.4	5.8	9.9	10.3	12.4	0.6	7.5
Ownership without deed	40.7	22.5	57.7	51.6	30.5	93.7	58.1
Tenant	51.9	71.6	32.4	38.0	57.1	5.6	34.4
Perennial Cash crops							
Ownership with deed	0.0	16.8	12.5	21.1	21.8	0.0	19.3
Ownership without deed	0.0	30.1	54.2	55.4	44.0	94.7	47.3
Tenant	100	53.0	33.3	23.6	34.2	5.3	33.5
Non-perennial Cash crops							
Ownership with deed	0.0	9.1	12.9	5.8	11.3	0.8	4.0
Ownership without deed	0.0	29.5	58.6	48.2	28.9	90.8	71.6
Tenant	100	61.4	28.6	46.0	59.8	8.3	24.3
Vegetables and Spices							
Ownership with deed	4.0	5.9	13.6	8.2	12.3	1.2	9.2
Ownership without deed	40.0	19.5	43.2	42.1	16.8	94.8	44.4
Tenant	**56.0**	**74.5**	**43.2**	**49.9**	**70.9**	**4.0**	**46.4**

4.2 SUMMARY OF CHAPTER FOUR

It is widely anticipated that indigenous communal land rights systems prevalent in most of Sub-Sahara Africa would gradually give way to more privatised land rights. This chapter examined cross-sectional data from six regions of Ghana for evidence of trends towards individualisation of land rights in Ghana. The theoretical framework for the analyses was based on the evolutionary theory of property rights with population growth and agricultural intensification and commercialisation expected to stimulate and sustain the transformation of land rights. Various indicators of privatised land rights including, transfer rights, modes of land acquisition, land rights documentation, disputes and land fragmentation were examined.

The study identified a trend in which privatisation of land rights appear to be correlated with intensification and commercialisation of agriculture, even though the rate of the change over the last two decades has been relatively slow. Less than 14% of farmland owners exercise complete rights (the right to transfer land without seeking prior approval) over their land. There is also a significantly higher percentage of ownership without deed. Some holders of communal land who under normal circumstances exercise only usufruct rights are claiming full rights, including the right to transfer such lands without prior approval. This is perhaps an indication that customary institutions are increasingly being weakened to the extent that a growing number of people, even in rural areas, are beginning not to regard traditional land tenure structures as overriding interest.

Despite the fact that over 90% of farmland is still communally owned, it was found that farmland use arrangements have become more monetised. Fixed and cash-based land renting have

increased significantly over the 12.7% average reported by Migot-Adholla et. al. (1991). Like several other studies across Sub-Saharan Africa, the study found that indigenous land use arrangements were still stable and provided relative tenure security to facilitate short to medium term investment in land. Insecurity and inefficiency inducing attributes like disputes, limited control of production decision making and land fragmentation varied largely by location and not by land rights documentation or the mode of land acquisition. Commercialisation in agriculture is perhaps the strongest driver of privatisation of land rights. Perennial cash crop farmers were more likely to acquire and register land rights than farmers who cultivate annual staple crops or even non-perennial cash crops. Based on these findings, it is expected that land tenure arrangements in Ghana would most likely affect only long-term soil conservation and farm infrastructure investment and not short-term input use. In the next chapter, the study examines the determinants of land tenure insecurity and how land tenure insecurity, inherent in indigenous land use arrangement, influence investment in irrigation development, soil and water conservation practices.

CHAPTER FIVE

LAND OWNERSHIP, TENURE SECURITY AND FARM INVESTMENT

5.0 INTRODUCTION

This chapter discusses results of econometric models specified to analyse the determinants of tenure security and the relationships between tenure security and household soil conservation and irrigation investments. Three econometric models were specified to examine farmer, farm and land tenure factors that influenced tenure insecurity (equation 3.41), the decisions to invest in soil conservation and irrigation (equation 3.41) and the intensity (money value) of household investment in soil conservation and irrigation (equation 3.46). Equation 3.41 was estimated using the binomial probit and maximum likelihood procedure. Robust estimation procedure (White/ Sandwich) was employed as a means of addressing or correcting for heteroskedasticity. Twenty four (24) variables were included in the tenure insecurity model. The determinants of tenure security model was run for 1,352 observations.

5.1 Definition and Measurement of Key Variables of the Investment Model

Table 5.1 presents the description, measurement and field means of variables used in the various models (i.e. equations 3.41 and 3.46). The data shows that 13% of households think they will lose their land if it was left unused for a given period. The period of time households can leave their lands without the fear of losing the land averages at about 1.8 years. The median period households could leave their lands without losing ownership or use rights was 1 year, an indication that half of the households are tenure insecure and fear losing their lands if they left it for more than a year.

About 19% of the households made investments (averaging about GH¢ 37 per acre) in soil and water conservation and the development of irrigation facilities. About 14% of household have access to other sources of water for irrigation other than being rain dependent. Close to 34% of households have adopted or at least have tried improved technology. As expected, the greater majority (88%) of households were male-headed. On the average, households have been cultivating their plots for about 10 years. The average household farm size was estimated at about 12.7 acres.

About 14% of farmland holders included in the analyses have had disputes in relation to ownership and use of their plots. Only 5% of plot owners included had deeds covering their rights over plots they cultivated. About 32% of plot owners did not have documentation covering their rights over the plots they own. Close to 39% of plots holders included in the analyses were cultivating land owned by the extended family or clan. About 23% were cultivating plots they received as gifts. The result in table 5.1 shows that the necessary conditions for relatively high tenure insecurity (i.e. incidence of disputes, limited documentation of land rights and communal ownership rather than individual ownership) existed and therefore provided a unique opportunity for testing of the study's hypotheses.

Table 5.1: Overview and Description of Variables in the models

Variable	Description	Mean	Std. Dev.
Decision to invest	1= invested, 0 = did not invest	0.1887	
Sex	1= Male, 2= Female	0.8811	
Age of Household Head	In number of years	46.8298	12.9539
Age of household head square	In number of years	2360.827	1332.992
Household size	Number of people	6.1778	3.0634
Dependency ratio	(Members below 15 and above 64(/ (members above 15 years and below 65 years)	1.0715	0.9240
Basic education	Number that attained basic education	0.6603	0.9405
No basic education	Number with no basic education	0.3328	0.4712
Major occupation of household head	(1= farm employment 0= non-farm employment)	0.8682	0.3382
Reads proficiently	Number able to read a sentence in English well	0.2	0.4
Read fairly	Number unable to read well in English	0.1	0.3
Livestock Holding	Number of all livestock (in TLU)	2.4521	7.8814
Land Holding	Number of acres of land owned by household	12.6839	11.9410
Non-farm income (per capita)	Amount in Ghana Cedis	351.7471	2142.446
Value of household assets	Amount in Ghana Cedis	5150.017	13232.29
Value of output per area	Amount in Ghana Cedis	53.757	364.0098
Gift land	Dummy (1=gift land, 0= not gift land)	0.2637	
Sharecropped land	Dummy (1=sharecropped, 0= not sharecropped)	0.0566	
Family land	Dummy (1= family land, 0= not family land)	0.3884	
Ownership with deed	Dummy (1= yes, 0 = No)	0.0524	
Ownership without deed	Dummy (1= yes, 0=No)	0.3173	
Duration of tenancy contract	Number of years	9.9470	8.4967
Ratio of zonal to household farm size	In acres	0.9531	0.9795
Land Fragmentation Index	Number of parcels/farm size in acres		
Number of physical structures on plot	Number	0.1415	0.4818
Incidence of disputes	Dummy (1= Had disputes, 0= Had no disputes)	1.9704	
Duration of land ownership	Number of years	8.9251	6.5223
Southern horticultural belt	Dummy (1=southern, 0=otherwise)	0.2367	
Northern agric. Zone	Dummy (1=northern, 0=otherwise)	0.3733	

Table 5.1 Continued.

Variable	Description	Mean	Std. Dev.
Perennial cash crops	Dummy (1= perennial cash crop, 0=otherwise)	0.0346	
Non-tree cash crop	Dummy (1=non-tree cash crop, 0= otherwise)	0.2050	
Vegetables and Spices	Dummy (1=vegetables and spices, 0=otherwise)	0.1442	
Soil depth	Soil depth in feet	3.3605	1.7208
Sandy soil	Dummy (1= sandy, 0=otherwise)	0.1623	
Loamy soil	Dummy (1=loamy, 0= otherwise)	0.2991	
Light clay	Dummy (1= light clay, 0=otherwise)	0.0859	
Heavy clay	Dummy (1=heavy clay, 0=otherwise)	0.0327	
Gravelly	Dummy (1=gravelly, 0=otherwise)	0.0557	-
Drainage	Numbers of hours it takes for plot to drain	21.5838	72.484
Receive extension visits	Dummy (1=receive extension visits, 0=No)	0.5346	-
Distance to markets	In Kilometers	2.1684	15.343
Adoption of improved technology	Dummy (1= adopted, 0=have not adopted)	0.3419	
Borrowing	Dummy (1=borrowed, 0= Did not borrow)	0.1928	-
Output	In kilograms per area	1637.495	14865.89
Purchased input	In value of Ghana Cedis	37.9331	209.8388
Total labour used	In man hours per farm size	265.9244	572.6855
Irrigation	Dummy (1= irrigated, 0= land rain-fed)	0.1378	-
Perception of tenure insecurity	Dummy (1= feels insecure, 0= Does not)	0.0073	-
Investment (soil-water and irrigation)	Amount of Ghana Cedis invested	36.7863	980.2843
Probability of losing unused land (probability of insecurity)	Dummy (1= Insecure i.e. will lose land if left unused for a given period 0= secure and can leave land unused for a period of time)	0.1262	0.3431
Duration of tenure security	Number of years	1.7915	1.1954

Field Means computed from ISSER-MIDA FBO Survey Data, 2008

5.2 Determinants of Tenure Security

Because the household either feel secure leaving their land or not, and based on their evaluation of their tenure security decide on the duration of time they could leave their lands idle and still maintain ownership or use rights, the study suspected that the use of a single stage procedure to estimate the factors that influence households tenure security (i.e. whether they can maintain ownership of lands they leave idle) and the duration of time they could leave land raises the issue of sample selection bias. The study therefore tested for the presence of sample selection bias using the Heckman selection model (Heckman, 1979). Using standard tests procedures and the likelihood Ratio Test (LRT) of the independence of the two equations, the study failed to reject the hypothesis of statistical independence (see appendix). This implied that there was no sample selection bias and the two equations could be estimated separately.

Maximum likelihood estimates of the determinants of the probability of land tenure insecurity are presented in Table 5.2. Relative household land holding had an unexpected negative sign. It was expected apriori (i.e. the Alemu hypothesis) that, households with large farms relative to their resource endowments and available family will be more tenure insecure due to their inability to manage or protect the lands. The inverse relationship between tenure insecurity and farm size is an indication that the Alemu, (1999) farm size effect on tenure security varied significantly in the context of Ghana. Two reasons may likely explain the inverse farm size-tenure security relationship. First of all, households that own large tracts of land are usually big and influential households who are able to exert significant influence on traditional authority and structures that govern ownership of land. Secondly, the apparent feeling of tenure security among households that hold large tracts of land may also be as a result of the abundance of land which may result in the households not being too concerned about losing some plots.

The age and age square of household head had the expected positive and negative signs respectively even though only the age variable was significant at 1%. The signs of age and age square mean that younger people are more likely to lose land they leave idle compared with older people. The result underscores the Goldstein and Udry (2006) assertion that people who held political authority or those able to influence the local political structure were more tenure secure.

The value of household land was significant at 10% and had the expected positive sign. The results of the study seem to suggest that the source of insecurity in Ghana is not a direct function of farm land size (i.e. Alemu, 1999 relative farm size effect) but rather the value of farmland. This contrasts with the findings by Holden and Yohannes (2002) which established a direct relationship between relative farm size and tenure insecurity in Ethiopia. While households with large farm holdings in Ghana may not fear redistribution by the state as is the case in Ethiopia, rising value of land may lead to land grabbing by more powerful farmers or developers.

The cultivation of own farms (with deed) was found to be inversely related to tenure insecurity and statistically significant at 1%. Households that obtained their lands through the political processes of matrilineage and patrilineage (family land) were less likely to lose land that they leave idle for a specified period. Indigenes were also found to be less likely to lose land they fallow compared with non-indigenes. These results are consistent with findings by Goldstein and Udry (2006).

Land fragmentation was found to be inversely related to the tenure insecurity but was not significant. The division of farm plots into

Table 5.2: Determinants of the Probability of Tenure Insecurity

Variable	Coefficient.	Robust Std. Err.	Z
Native status of household head	-0.3270	0.0610	-5.35***
Sex of Household Head	-0.0867	0.0788	-1.10
Age of household head	0.0216	0.0058	3.70***
Age of household head square	-0.0090	0.0000	-1.40
Major occupation of household head	-0.3159	0.0751	-4.20***
Household size	-0.0073	0.0090	-0.81
Read proficiently	-0.0256	0.0652	-0.39
Years of education	-0.0638	0.0075	-8.49***
Livestock holding (TLSU)	0.0424	0.0360	1.18
Duration of land ownership	2.1202	0.2314	9.16***
Owner-cultivated (with deed)	-0.7643	0.0745	-10.26***
Sharecropped land	0.0451	0.0647	0.70
Family Land	-1.1654	0.0586	-19.88***
Gift Land	0.1271	0.0508	2.50*
Preferential rights	0.1678	0.0783	2.14*
Full rights	0.4491	0.0709	6.33***
Number of physical structures	-0.1621	0.0357	-4.54***
Existence of clear boundaries	0.0785	0.0562	1.39
Southern Horticultural Belt	-0.0565	0.0656	-0.86
Northern agric. Zone	-0.0285	0.0877	-0.33
Land fragmentation index	-0.0270	0.0360	-0.75
Farm Size	-0.0130	0.0039	-3.33**
Value of land	0.0091	0.0053	1.70*
Distance to markets	0.0012	0.0012	1.00
Constant	-1.9664	0.2132	-9.22***
	Log pseudo likelihood		-1575.68
	Wald X^2 (24)		819.12
	Prob > X^2		0.0000
	Pseudo R^2		0.42

Dependent Variable: Probability of losing left unused (takes value 1 if farmer indicates he cannot leave land for long without loss of rights and 0 otherwise) n= 1352

*, ** and *** are levels of significance at 10%, 5% and1%, respectively

several smaller crop fields has often been described as risk spreading strategy that farm households employ to minimise loses.

Even though probability of losing idle land is a good measure of the tenure security, the period of time that households can leave their land without loss of rights is a relatively more accurate indicator of tenure security as it gives a better indication of the assurance dimension of tenure security.

Table 5.3 provides estimates of the determinants of the number of years household could leave their lands and still maintain ownership (equation 3.2.2). Equation (3.2.2) was estimated with a censored regression model (Tobit Model) to take into account issues of sample selection or the expectation that some households will report zero duration of leaving their lands idle (Hagos and Holden, 2006). The results show that native males are more secure leaving their farms uncultivated for extended periods than non-indigenes and females. The native status and sex of household head variables were significant at 1% and 5% respectively.

Unlike with the determinants of the probability of losing idle land model, most of the household assets and wealth variables had the expected signs. Livestock holing in tropical livestock units, family labour in man hours exerted a significant positive effect on the duration households could leave their lands idle and still maintain ownership. Non-farm income was significant at 1% but exhibited an inverse relationship with the assurance of tenure security. The value of farmland exhibited the expected negative effect on the duration of tenure security and was significant at 1%. Unlike with the probability of losing idle land model, the farm size variable in the duration of tenure security exhibited a negative effect (i.e. consistent with Alemu, 1999) but was not significant.

With regards to the modes of acquisition of land, family land, ownership (with deed) and sharecropped land maintained their effects with the family land and ownership (with deed)

exerting a positive effect on the duration of tenure security and sharecropped land exerting a negative effect. The sharecropped land variable was however not significant.

The effects of the modes of land acquisition on the assurance of tenure security offer useful policy options for promoting tenure security. The fact that ownership with deed reduces the probability of losing land not in use and also increases the assurance of tenure security means that land titling programmes are useful tools for improving tenure security even on farm lands.

Table 5.3: Determinants of Assurance of Tenure Security

Variable	Coefficient	Robust Std. Err.	t-statistic
Household Characteristics			
Native status of household head	0.7128	0.1872	3.81***
Sex of household head	0.7239	0.2351	3.08**
Age of household head	0.0091	0.0125	0.72
Age of household head square	0.7380	0.0001	0.06
Dependency ratio	-0.0095	0.1029	-0.09
Major occupation of household head	-0.1006	0.2140	-0.47
Ability to read	-0.2137	0.1798	-1.19
Household Assets and Wealth variables			
Livestock holding (in TLU)	0.4022	0.0596	6.74***
Land holding	-0.0113	0.0176	-0.64
Value of land	-0.0021	0.0005	-3.93***
Non-farm income (per capita)	-0.2477	0.0892	-2.78**
Family labour	0.6253	0.1036	6.03***
Land Tenure and Security Variables			
Family land	1.2372	0.1967	6.29***
Gift land	0.8943	0.2200	4.06***
Sharecropped land	-0.1797	0.3063	-0.59
Incidence of land dispute	-0.1966	0.3782	-0.52
Well demarcated boundaries	0.2488	0.1747	1.42
Ownership with deed	1.5194	0.2403	6.32***
Preferential rights	0.2200	0.2184	1.01
Complete rights	0.6006	0.1873	3.21**
Years owning land	-0.0306	0.0127	-2.40*
Number of physical structures	0.5523	0.0700	7.88***

Table 5.3: continued.

Variable	Coefficient	Robust Std. Err.	t-statistic
Crop and Location Variables			
Southern horticultural belt	-0.1696	0.2079	-0.82
Northern agricultural zone	-0.5566	0.2567	-2.17*
Perennial cash crops	0.0778	0.2769	0.28
Non-perennial cash crops	0.0259	0.2034	0.13
Vegetables and spices	0.0375	0.2196	0.17
Distance to major market	-0.0050	0.0040	-1.25
Plot Characteristics			
Index of land fragmentation	0.2548	0.1125	2.26*
Sandy soil	0.1409	0.3371	0.42
Loamy soil	0.3181	0.3258	0.98
Light clay	-0.1634	0.3798	-0.43
Heavy clay	0.5751	0.4891	1.18
Mix soil	-0.4674	0.3673	-1.27
Market Access and Participation			
Receive extension visits	0.1633	0.1827	0.89
Adopted improved technology	-0.1607	0.1649	-0.97
Apply fertiliser	0.1345	0.1676	0.80
Constant	-2.5103	0.6770	-3.71***
Log pseudo likelihood	-1472.57		
F(37,1339)	11.71		
Prob >F	0.0000		
Pseudo R-Squared	0.0900		
left-censored observations at fallow period <=1	862		
uncensored observations	477		

Dependent variable: Number of years households can leave land uncultivated
Source: Author's computation from ISSER-MIDA FBO Survey 2008 *, ** and *** are levels of significance at 10%, 5% and1%, respectively

5.2 Land Tenure Security and Household Farm Investment

It is widely believed that a major development challenge for emerging economies has to do with their land markets and how land relations influence long-term farm investments. Two dimensions are relevant in the analysis of the relationship between land tenure and farm investment. The first is the magnitude of the costs and returns associated with the investment

under consideration as well as time dimensions involved. The second has to do with how land ownership and land use arrangements which influence the farmer's expectations of their tenure security and hence their investment decisions. Costs of investments, the time horizon of expected stream of benefits and land ownership/tenancy arrangement combine to influence farmers' investment decisions.

While farmers may use complementary inputs such as fertiliser, chemicals or improved seed without worrying much about the rights gamut they hold over their land, the scenario is expected to vary significantly with investments in long-term soil and water conservation and irrigation which is more costly and the returns harvested over longer periods of time. With long term investments in land, it is expected that farmers would evaluate the time dimensions involved in reaping the stream of future returns to investments as well as the risk factors including the probability of losing rights to land and only make long-term investments if their evaluation of inherent risks are favourable.

In this section, the study analyses the linkages between land tenure arrangements and farm investment decision making using data from six regions of Ghana. The data is explored for differences in the decisions to invest and levels of investment in soil conservation and irrigation development under different land holding arrangements and household endowment.

Table 5.4 provides regional average investment in soil water conservation and irrigation-related investments in the study regions. It is quite clear from the table that levels (average Ghana Cedi value) of investments in documented plots are relatively higher than investments in undocumented farms in the Central, Volta, Eastern and Northern regions. Investments in

undocumented plots are however higher than investment in documented plots in the Greater Accra and Ashanti regions. Tests of significance showed that differences in levels of investment in documented and undocumented plots are only statistically significant in the Eastern and Northern regions.

The information in table 5.4 does not however provide enough basis for concluding that land documentation is a priority for farmers in investment decision making processes. In order to make meaningful conclusions, it is important to take into account other factors that such resource endowments, location and crop characteristics that could possibly influence households' investment decision.

Table 5.4: Land Conservation and Irrigation Investment in Documented and Undocumented Plots

Documents	Plots with Written Documents	Plots with no Written Documents	t-Value
Southern Horticultural Belt			
Central Region	28.5 (10.5)	22.9 (5.7)	-0.41
Greater Accra Region			
Volta Region	64.1 (11.8)	119.4 (68.8)	0.25
Affram Basin			
Ashanti Region	16.1 (7.2)	21.9 (9.3)	0.49
Eastern Region	126.8 (66.1)	19.4 (2.3)	- 0.49***
Northern Agric. Zone			
Northern Region	48.0 (30.9)	1.9 (0.3)	-9.72***

Source: ISSER MIDA-FBO SURVEY, 2008. *** Significant at 1% level

The study's analytical model for analysing the relationship between land tenure arrangements and household farm investments demonstrated that the intensity (value of investments) of

investments function (equation 3.8) and the decision to invest function (equation 3.9) could be statistically dependent and may require estimation by a Heckman process if indeed tests confirmed some form of sample selection bias (Heckman 1990). The study tested for sample selection bias using a Heckman two-step model (Deaton, 1997).

The Heckman test for sample selection bias tests the null hypothesis of $H_0: p\varepsilon_1 v_2 = 0$ and the alternative hypothesis $H_A: p\varepsilon_1 v_2 \neq 0$. The measure of correlation between e_1 *and* v_2 is the correlation coefficient *p*. If study rejects the null hypothesis of $pe_1v_2 = 0$ then the decision to invest equation (the sample selection equation) and the level of investment (outcome equation) cannot be said to be independent and thus must be estimated jointly by the Heckman technique. Table 5.5 presents the result of the Heckman sample selection test. The Wald's test of independence indicates that pe_1v_2 is not significantly different from zero hence failure to reject the null hypothesis $H_0 : pe_1v_2 = 0$ i.e. the models revealed no significant selection bias. As indicated, the significance of this result is that the sample selection (decision to invest) and outcome equations (money value of investments) could be treated as two independent equations and estimated separately.

Table 5.5: Test for Sample Selection Bias

Heckman Sample selection model	Statistics	P-Value
Rho	-0.0502	
Wald test of independence of equations (rho = 0): $x^2 = 0.42$		Prob $>x^2 = 0.5194$

Source: Author's computations using MIDA FBO Survey, 2008

The binomial probit and censored regression (Tobit) models were used to estimate the decision to invest and level of conservation and irrigation investments, respectively. The standard Probit and Tobit models may be formulated as

$$y_t^* = x`_i \beta + \varepsilon_i$$

$$y_t^* = 1 \; if \; y_i* = 1$$

$$= 0 \; otherwise$$

$$y_i^* = x`_i \beta + \varepsilon_i$$

$$y_i = yi^* \; if \; y_t^* > 0$$

$$= 0 \; if \; y_i^* \leq 0 \qquad (5.1)$$

where I = 1, 2, . . . ,N, and ε_i is assumed to be NID (0, δ^2) and independent of x_i . This model is a censored regression model where observations may be censored from below. To correct for possible heteroskedasticity, robust standard errors are estimated.

The probit model of the decision to invest in soil and water conservation and irrigation is presented in Table 5.6. Endogenous variable such the number of physical structures established on the land by the household were excluded from the model because of lack of appropriate instruments that would enable us predict the variable.

Land tenancy arrangements such as renting and sharecropping were found to have significant influence on households' decision to invest and had the expected negative signs. While land ownership (without deed) did not exert a significant influence on the probability of households deciding to invest, land documentation (ownership with deed) was found to have a positive significant influence on the decision to invest.

Households were also found to be less willing to invest in farm land they received as gifts (gifted land) and which they had not formally documented as well as on sharecropped plots. The assurance of tenure security as expected exerted a positive significant effect on the probability of investing in soil and water conservation and irrigation. The fact that land documentation and duration of tenure security positively influenced households' decision to invest is an indication that land titling programmes and policies can facilitate households' farm investment by enhancing tenure security.

The distance to major markets was found to exert a negative effect on the decision to invest and was significant at the 1%. Access to irrigation as well as the ratio of household to zonal land size also had the expected and significant positive effects on the decision of households to invest. Household land relative to zonal farm size was included to test for farm size effects.

The effect of household resource endowment on the decision to invest was found to be mixed. While household livestock (in TLU) holding was not significant, labour availability (family labour) and value of output per area (or crop income) significantly increased the probability of households deciding to invest in land conservation and irrigation. Location and crop characteristics were also found to have significant effects on the decision to invest. Compared with the Southern horticultural belt, Households located in the Affram basin and the Northern agricultural zone had higher propensities to invest contrary to apriori expectations. Since the Southern horticultural belt dummy was set as the reference category and therefore not included in the estimation, negative coefficient signs were expected for both the Affram basin and the

Table 5.6: Maximum Likelihood Estimates of the Determinants of the Decision to Invest

Variable	Coefficient	Robust Std. Errors	
Household Characteristics			
Sex of household head	0.4065	0.0971	4.19***
Age of household head	-0.0240	0.0091	-2.62**
Age square of household head	0.1754	0.0862	2.03*
Dependency ratio	0.0101	0.0309	0.33
Basic education	0.2133	0.0382	5.58***
No education	0.2884	0.0856	3.37**
Household Assets and Wealth variables			
Livestock Holding (in TLU)	-0.0343	0.0386	-0.89
Household land holding	-0.0156	0.0075	-2.08*
Value of output per area	0.4721	0.0886	5.33***
Family labour	0.0733	0.0342	2.14*
Land Tenure and Security Variables			
Gift land	-0.3087	0.06015	-5.13***
Sharecropped land	-0.2323	0.0676	-344**
Rented land	-0.1173	0.0654	-1.79*
Ownership with deed	0.1633	0.0676	2.42*
Ownership without deed	-0.0136	0.0944	-0.14
Assurance of tenure security	0.1389	0.0554	2.50*
Years of land ownership	-4.3728	3.9281	-1.11
Crop and Location Variables			
Affram Basin	0.4404	0.0796	5.53***
Northern agricultural zone	0.7883	0.1149	6.86***
Distance to major market	-0.0140	0.0038	-3.65***
Perennial cash crops	0.0198	0.1002	0.20
Non-perennial cash crops	-0.1275	0.0625	-2.04*
Vegetables and spices	0.2350	0.0624	3.77***
Plot Characteristics			
Ratio of zonal to household farm size	0.1805	0.0877	2.06*
Index of land fragmentation	0.1829	0.0510	3.58***
Access to irrigation	0.9210	0.0710	12.96***
Drainage	-0.1371	0.3398	-0.40
Soil depth	25.8536	14.5829	1.77*
Market Access and Participation			
Receive extension visits	-0.0130	0.0539	-0.24
Adoption of improved technology	0.0771	0.0498	1.55
Constant	-1.5085	0.2811	-5.37***

Table 5.6 continued.

Log likelihood	-1866.34
Wald x^2 (30)	365.43
Prob > x^2	0.0000
Pseudo R^2	0.1009

Dependent Variable is Decision to invest soil conservation and irrigation (1= if the household invested and 0= if household did not invest)
Source: Author's computations from *MIDA FBO Survey, 2008**, ** and *** are levels of significance at 10%, 5% and 1%, respectively.

Northern agricultural zone. This expectation was based on the Boserup (1965) population pressure hypothesis which posits that high population density (land scarcity) would stimulate investment and use of improved technology. It was expected that the high population density of the southern horticultural belt will lead higher propensities to invest. The absence of population pressure effect could however be due to the fact that agriculture intensification is less in the southern horticultural belt and also the abundance non-farm employment opportunities which significantly increases the opportunity cost of labour and other resources.

The cultivation of vegetables and spices was found to positively influence the decision to invest in soil and water conservation and irrigation. This was expected since the production of vegetables and spices in many instances is done in the dry or minor seasons and would usually involve significant investment in irrigation. The cultivation of perennial cash crops and non-perennial cash crops had the expected positive and negative coefficient signs respectively but only the coefficient for non-perennial cash crops was statistically significant.

Land fragmentation had a positive effect on the probability of investing and was significant at 1%. This is contrary to apriori expectation that highly fragmented plots, usually common with communal or family held land, would have a negative effect on the probability of investing. One

possible explanation for this observation is that households may be using land fragmentation as some sort of risk spreading activity. The ratio of zonal to household farm size was significant at 10% and had a positive coefficient sign. Soil depth was significant at 10% and positively correlated with the probability of investing. Drainage (an indicator of water retention) had a negative coefficient but was not significant. Access to agricultural extension as well as the adoption of improved technology did not significantly affect households' probability of investing.

The level of soil conservation and irrigation investment was measured by the amount (GH¢) spent by the household to improve and conserve soil water or fertility and to facilitate irrigation. Households' level of investment in soil conservation and irrigation was hypothesised to be influenced by a number of household socioeconomic and farm characteristics as well as the provenance of land (Table 5.7). Compared to the results of the probability of investment, differences in the amounts spent by households in soil conservation and irrigation were to a great extent explained by differences in types of land use and ownership arrangements as well as the duration of land ownership.

Land ownership (both with deed and without deed) had significant positive effects on households' investment expenditure. Consistent with apriori expectations, family owned, rented, gifted and sharecropped lands had negative coefficient signs but were however not statistically significant. The negative coefficient signs especially in the case of share tenancy could be indicative of some degree of Marshallian inefficiency (Marshal, 1890) transmitting to households' willingness to invest and levels of investment expenditure on long-term soil improvement and irrigation.

Table 5.7: Determinants of Soil and Water Conservation and Irrigation Investment expenditure

Variable	Coefficient	Robust Std. Err.	t-statistic
Household Characteristics			
Sex of household head	-102.1851	36.4605	-2.80**
Age of household head	11.6229	6.0322	1.93*
Age of household head square	-146.8364	58.7225	-2.50*
Household size	28.5339	3.9584	7.21***
Dependency ratio	-90.2414	17.4334	-5.18***
Attained basic education	-32.1379	19.5568	-1.64
No formal education	-121.8411	40.1405	-3.04**
Household Assets and Wealth variables			
Livestock holding (in TLU)	-23.8377	21.5921	-1.10
Land holding	-7.8167	4.12557	-1.89*
Non-farm income (per capita)	17.5791	10.2533	1.71*
Value of output per area	0.1187	.018828	6.31***
Family labour	19.6628	21.6363	0.91
Land Tenure and Security Variables			
Family land	-39.4991	44.0785	-0.90
Gift land	-47.0821	45.5502	-1.03
Sharecropped land	6.1550	39.7833	0.15
Rented land	93.5805	43.5905	2.15*
Ownership with deed	150.3289	44.5321	3.38**
Ownership without deed	67.4012	37.4213	1.80*
Duration of land contract	17.4348	4.15372	4.20***
Years owning land	-7.1505	4.26031	-1.68*
Duration of tenure security	281.6785	26.7354	10.54***
Crop and Location Variables			
Affram Basin	138.6426	39.2577	3.53***
Northern agricultural zone	326.5296	63.9384	5.11***
Perennial cash crops	61.9845	58.6894	1.06
Non-perennial cash crops	-83.3227	29.2898	-2.84**
Vegetables and spices	39.7842	34.7841	1.14
Distance to major market	-1.9830	1.54175	-1.29
Plot Characteristics			
Ratio of zonal to household farm size	51.8104	50.2338	1.03
Index of land fragmentation	-36.7666	16.1320	-2.28*
Access to irrigation	258.0953	33.1152	7.79***
Drainage	213.7851	108.114	1.98*
Sandy soil	82.3615	49.0453	1.68*
Loamy soil	11.8678	45.8229	0.26
Light clay	-74.6241	59.2080	-1.26
Heavy clay	-121.0221	71.1975	-1.70*
Mix soil	18.5464	49.9998	0.37
Market Access and Participation			
Receive extension visits	88.5725	27.2893	3.25**
Adopted improved technology	35.7479	24.5838	1.45
Constant	-1062.186	206.2269	-5.15***

Table 5.7 Continued

Log pseudo likelihood	-4034.3159
F(38,1352)	11.30
Prob>F	0.0000
Pseudo R^2	0.0596
left-censored observations at INVSWCON_IRR <=1	893
uncensored observations	459
Observations	

Dependent variable: GI-10 Invested in soil and water conservation and irrigation.

Source: Author's computation from ISSER-MIDA FBO **Survey 2008 *, ** and *** are levels of significance at 10%, 5% and1%, respectively**

The signs of household wealth variables were mixed in terms of their consistency with apriori expectations. Livestock holing (in TLU) did not have the expected positive sign even though the coefficient was not significant. Non-farm income and value of output had the expected signs and was significant at 10% and 1% respectively. Location dummies which were included to capture site specific effects in investment indicate that autonomous investment in soil conservation and irrigation was relatively higher in the affram basin and the northern agricultural zone. The dummies for these two locations were significant at 1%.

With respect to plot characteristics, the degree of land fragmentation and drainage were found to be significant in explaining the amounts households invested in soil and water conservation and irrigation. Households invested less on highly fragmented plots and more on irrigable plots and well drained plots. With regards to market and information access, farmers who received extension visits found to invest higher amounts than those who did not. Adoption of improved technology had the expected positive sign but did not significantly influence household investment expenditure.

Some household and demographic factors seem to significantly influence the levels of soil conservation and irrigation investments. The study expected ambiguous signs for younger household heads. Younger household heads may invest more in soil and water conservation and in irrigation because they perhaps have the strength to work and also may earn income from other non-farm activities to support their on-farm investment. It was possible that access to nonfarm employment and possible out-migration for work by younger household heads would reduce their incentive to invest. It was also expected that elderly household heads would invest less in soil conservation and irrigation perhaps due to their declining role in household farming activities or may invest more because they could no longer engage in other non-farm employment. Both age and age-squared of household head had significant effects on the amounts invested. Both exerted positive effects on the amounts households invested in soil conservation and irrigation.

Household size was found to have a significant positive effect on the amounts invested. Higher dependency ratio appears to have discouraged the amount of investment in soil conservation and irrigation and was significant at 1%. Large households with lower number of dependents as opposed to workers are expected to invest more since they are less likely to be constrained in terms of access to family labour. Although not significant, formal education was inversely related to the amounts households invested in soil conservation and irrigation although the formal education variable was not significant. As expected however, not having formal education significantly reduced the amounts households invested in soil and irrigation.

5.3 SUMMARY OF CHAPTER FIVE

Chapter five examined the factors that explain households' tenure insecurity as well as how different land use arrangements influenced households' investment decisions and choices. In analysing the determinants of tenure security, the study tested Alemu (1999) hypothesis which stipulated that farm size was positively correlated with tenure insecurity.

The study augmented the Alemu (1999) model which was first used by Ibid to test the effect farm size effect on tenure insecurity in Ethiopia. The modification of the Alemu (1999) model involved the addition of land value as a source of tenure insecurity. This modification was informed by the underlying land tenure systems in Ghana where traditional custodians like chiefs and Tendambas manage land on behalf of their people. The Ghanaian context implied that tenure insecurity was associated with litigations or appropriation by more powerful land users as the land value increases in response to population growth and not the fear of losing land to state redistribution programmes as entails in the Ethiopian context under which the Alemu (1999) hypothesis was first tested.

With respect to analysing the determinants of households' long-term investment in soil improvement and irrigation, the study adopted the framework used by Feder (1987) which sets the household as a utility maximizing entity that chooses between short-term complementary inputs use and long-term land investments based on the household's rate of time preference. The study distinguished the decision to invest which was analysed with a Probit model from the intensity of investment (investment expenditure) in soil improvement and irrigation which was estimated with the Tobit model. The Probit and Tobit models tested the effects of land tenancy and

land ownership arrangements on households' investment behaviour while controlling for household demographic and wealth characteristics, market and information access conditions, crop choice, as well as plot and location level factors.

Contrary to the finding by Holden and Yohannes (2002), the study found that marginal farm size was inversely related with tenure insecurity. Tenure insecurity was rather found to correlate positively with value of farm land and not farm size as Alemu (1999) posited. The study found that individual ownership and documentation of land significantly reduce the probability of the households losing uncultivated lands.

Individual ownership of land increased both the probability of investing and the level of investments made in land improvement and irrigation. This evidence probably points to the increasing importance households place on land ownership and also underscores the importance of tenure security in facilitating or land titling programmes. Until more recently several studies, especially those conducted in the mid-late twentieth century, could not plausibly establish strong links between land ownership and investment. There are two possible explanations for this particular finding of the study. First, there is the possibility that land markets and land relations have changed significantly over the last two decades with increasing money transaction and fixed agreements propelled by population growth and increasing value of land. Second, the inclusion of irrigation investment as a long term investment in land raises the value of household investment and also the time period required to reap the returns on the investments. The finding seems to conform to Boserup (1965) and Ault and Rutman (1979) predictions that land tenure in Africa evolved in tandem with principles of economic efficiency and that households would

acquire full rights (i.e. take full rights into consideration) when the need for such rights arose, propelled either by population growth and land scarcity or by emerging market opportunities. The findings of the study point to a scenario in which households take land ownership and tenancy arrangements into consideration if the resource implications of land investments are relatively huge and the time dimensions for harvesting returns to investments is relatively long.

CHAPTER SIX

TECHNICAL EFFICIENCY UNDER ALTERNATIVE LAND HOLDING ARRANGEMENTS IN GHANA

6.0 INTRODUCTION

The levels and sources of inefficiency in Sub-Saharan Africa agriculture have been a central issue in economic development discussions for over half a century. While some contend that the poverty of the agricultural sector in sub-Saharan Africa is due to resource poverty that limits households' ability to invest in agriculture (Ip and Stahl, 1978), others believe that land ownership and tenancy arrangement are largely responsible for the low investment and high inefficiency that characterise agriculture in the sub-continent (Georgescu-Roegen, 1960; Issawi, 1957; Heady, 1947). This debate is an age-old one and has shaped not only research but also land and development policies in several African countries. In this chapter the study uses stochastic frontier modelling to test the hypothesis that land held under varying ownership and tenancy arrangements will be cultivated at different levels of technical efficiency due to variations in the levels of tenure security farmers associate with the arrangements. The study tests for differences in technical efficiency among owner-operated, tenant-cultivated, documented and undocumented land, as well as gifted and communally held lands.

6.1 Technical Efficiency under Different Land Holding Arrangement in Ghana

Maximum likelihood estimates of parameters in the stochastic frontier model (specified in equation 3.4) are presented in Table 6.1. The frontier model was run for 259 observations for which complete information was available.

The coefficients of farm size, purchased inputs, labour and index of land fragmentation represent elasticities of inputs with respect to the value of output since the value of output and these variables entered the model in the natural logarithm form. Labour and access to extension exerted positive effects on output and were statistically significant at the 5% and 1% respectively. The index of land fragmentation also had a significant negative effect on the value of farm output, implying that productivity is lower on highly fragmented land.

Agro-ecological zone appears to have profound influence on the intercept of the frontiers. As indicated, the study area was divided into three agro-ecological zones namely the southern horticultural belt, the Affram basin and the northern agricultural zone. The dummy of the southern horticultural belt was used as the reference. The intercept of the frontier for the northern agricultural zone and the Affram basin had negative coefficients. This implies that the intercept of the frontier for the southern horticultural belt is above the intercepts of the basin and the northern agricultural zone.

The dummies for vegetables and spices as well as that for non-perennial cash crops had negative coefficient signs even though both were not statistically significant. The negative signs however indicate that the production frontiers of perennial cash crops and vegetables and spices lie below the frontier of staple annual food crops.

Table 6.1: Maximum Likelihood Estimates of the Stochastic Frontier Model

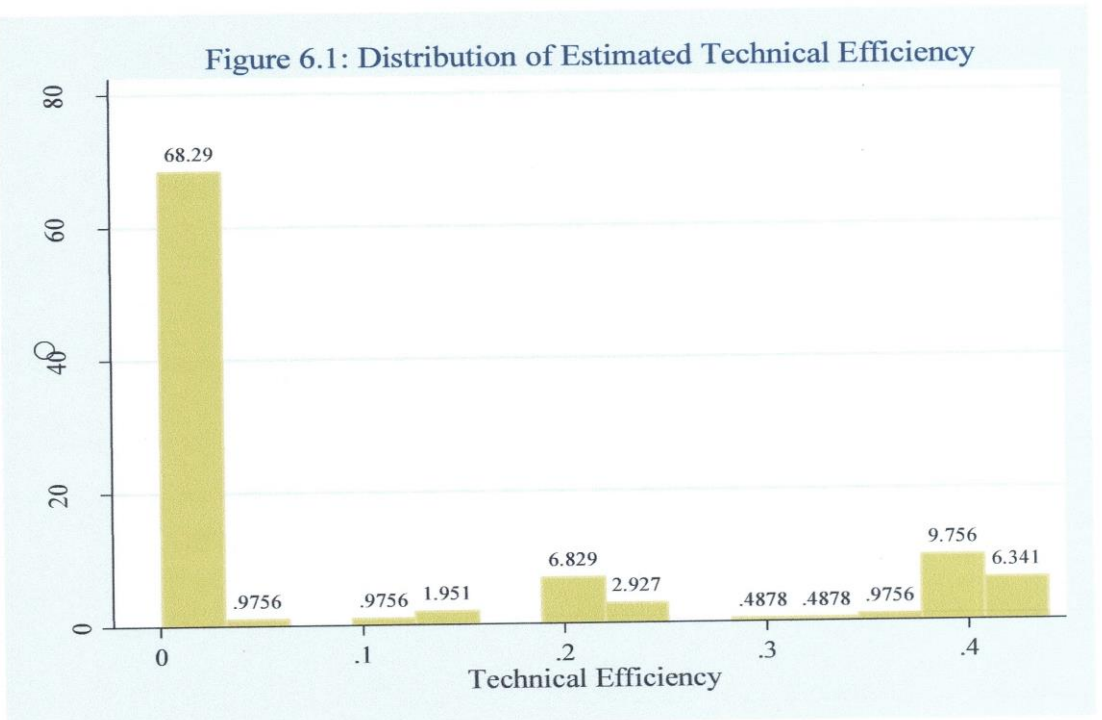
Variable	Coefficient	Std. Err.	Z
Farm size	-0.0018	0.0021	-0.87
Purchased Inputs	0.0003	0.0005	0.70
Labour	0.0021	0.0007	2.98**
Vegetables and spics	0.0011	0.0028	0.41
Perennial cash crops	-0.0031	0.0043	-0.88
Affram Basin	-0.2486	0.0276	-8.99***
Northern Agricultural zone	-0.4399	0.0259	-16.97***
Access to Extension	0.0042	0.0010	4.07***
Drainage	-0.0025	0.0006	-4.02***
Index of land fragmentation	-0.0155	0.0029	-5.18***
Constant	0.42249	0.0265	15.90***
Log likelihood	571.58		
Wald x^2 (11)	1218.26		
Prob > X^2	0.0000		

Dependent Variable: Log of Value of Output

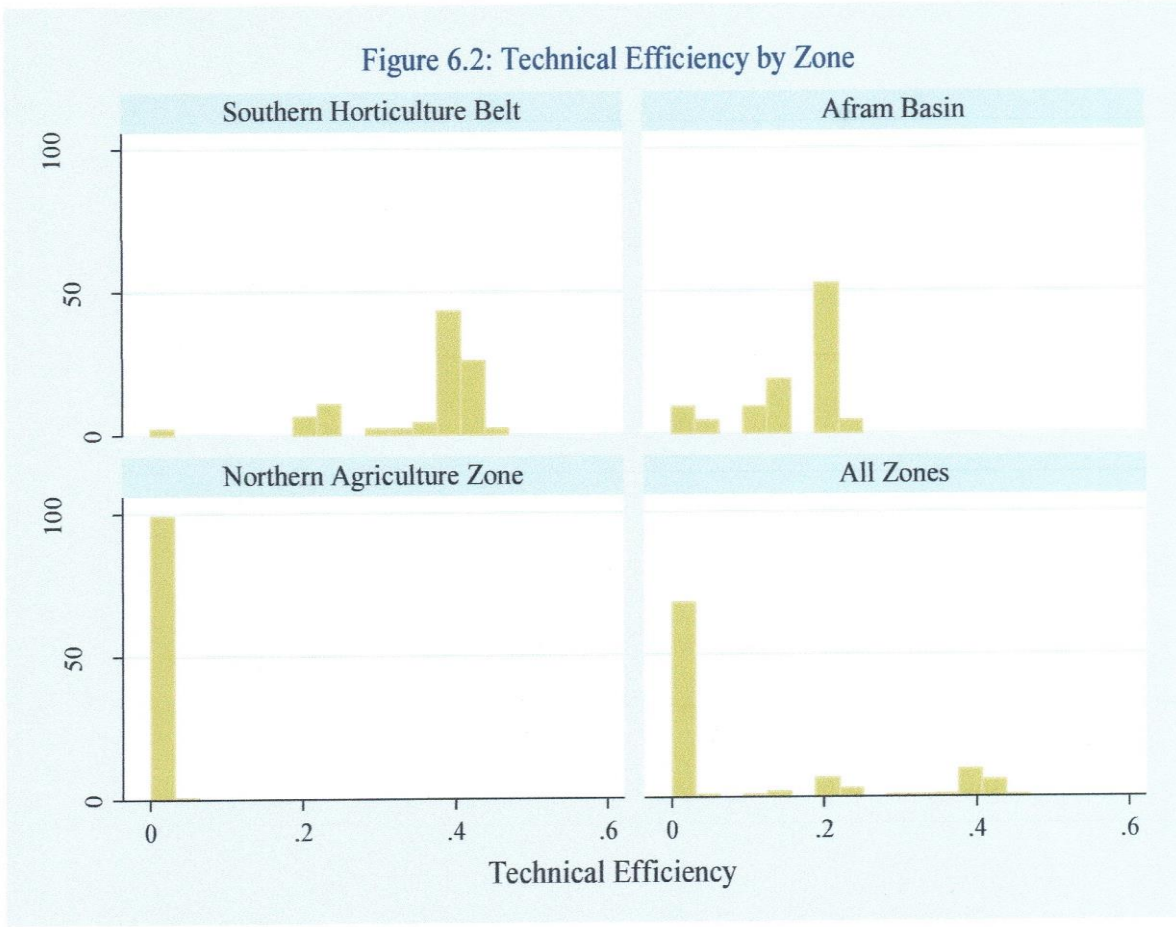
Author's computation from ISSER-MIDA FBO Survey 2008: *, ** and *** are levels of significance at 10%, 5% and 1%, respectively

The distribution of farmers across the study area in terms of technical efficiency is skewed to the right (Figure 6.1). The data shows the existence of extremely high levels of technical inefficiency in most farming systems across the study area. Only about 6 % of farmers in the study area are able to produce up to 50% of the potential. The greater majority (about 78%) operate between 010% technical efficiency, implying that the potential of improving productivity by about 90% exists if the sources of the technical inefficiency are identified and the right policies and production choices are made. Analysis of technical inefficiency by agro-ecological zone indicates technical inefficiency is highest and most skewed to the right in the northern

agricultural zone. The distribution in the southern horticultural belt is more even, even though not normally distributed (Figure 6.2).

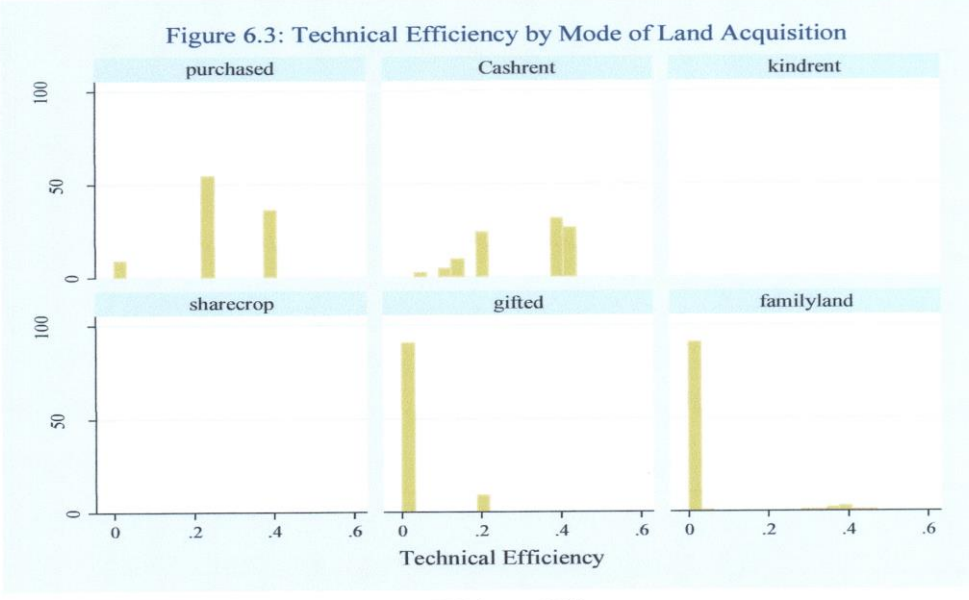


Source: Authors computation from ISSER-*MIDA FBO Survey, 2008*

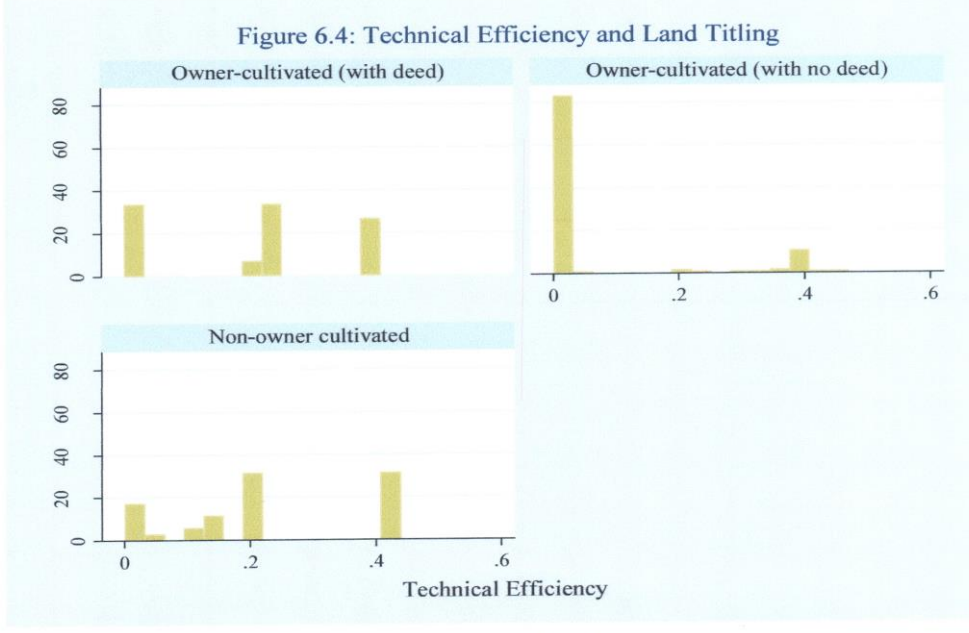


Source: Authors computation from ISSER-*MIDA FBO Survey, 2008*

Figures 6.3 and 6.4 highlight relative technical efficiency under alternative land holding arrangements. The figures indicate that technical efficiency was not only higher among farmers who either purchased or rented their land for cash. Land documentation also appeared to have profoundly influenced technical efficiency as the distribution of technical efficiency was more even among owner-cultivated plots relative to tenured land (Figure 6.4).



Source: Authors computation from ISSER-*MIDA FBO Survey, 2008*



Source: Authors computation from ISSER-*MIDA FBO Survey, 2008*

On the average technical efficiency is estimated to range from 0.0009 to 0.4393 with mean of 0.0997. The most efficient producers are farmers with complete rights over their land. Farmers with complete rights over their plots produce at an estimated average technical efficiency of 24%, with farmers holding preferential rights and limited rights producing at about 9% and 1% technical efficiency respectively.

The performance of farmers under different land tenure arrangement can be compared using a computed relative technical efficiency. For example, maximum estimated technical efficiency of alternative land tenure arrangements can be compared to determine the levels of improvement in productivity that can be achieve or lose by switching to different land arrangements. If RTE is the relative technical efficiency, the relationship can be specified as: $RTE = \left(1 - \frac{X_i}{X_R}\right) * 100$

where X is the maximum estimated technical efficiency for a particular attribute (i.e. land tenure arrangement or location), and X_R maximum estimated technical efficiency of a reference category.

In this analysis, average technical efficiency in titled plots is compared to non-titled plots. Also, technical efficiency in plots for which the holders have complete rights is compared with efficiency in those plots that the holders have preferential and limited rights. The average technical efficiency for plots in which the holders have complete rights, preferential and limited rights is about 24%, 9% and 1.1%, respectively. This implies that on the average, parcel holders with preferential and limited farm rights can achieve up to 59.8% and 96% improvements in output respectively if they acquired complete rights, other things being equal.

Using the same relationship and the data in Table 6.2, the study finds that plot holders with title produce up to 79.3% more output than plot holders with no title. The most profound relationship between land holding arrangements and productivity is in the mode of land acquisition. While technical efficiency on purchased land averages at about 30%, efficiency in rented, family owned and sharecropped land averages at about 29%, 3.5% and 27%, respectively. This suggests that, other things being equal, producers under cultivating clan or family controlled land could improve their output by up to 89% if they purchased their land. Plots on which the plot holder exercised full control over production decisions were also found to be more cultivated efficiently than plots on which the landlord has partial or full control of production decisions.

Table 6.2: Comparative Technical Efficiency in Different Land Ownership and Holding Arrangements

	Mean technical Efficiency	Standard Deviation	Minimum	Maximum
Land Rights Characteristics				
Complete rights	0. 2457	0. 1708	0.0013	0. 4393
Preferential rights	0.0998	O. 1512	0.0012	0. 3362
Limited rights	0.0109	0.0353	0. 0020	0. 1889
Control of Production Decisions				
Plot Holder has full control	0.0245	0.0362	0.0002	0.1804
Landlord has partial control	0.0094	0.0145	0.0006	0.0566
Landlord has full control	0.0140	0.0126	0.0057	0.0285
Mode of Land Acquisition				
Rented land (for cash)	0. 2859	0. 1284	0.0532	0.4179
Family land	0. 0350	0. 1033	0. 0009	0. 4393
Sharecropped Land	0. 2745	0. 1233	0. 0075	0. 4061
Own land (purchased)	0. 3076	0. 1259	0. 0532	0. 4330
Land Documentation				
Written documents	0.2982	0. 0938	0. 1907	0. 4061
No written documentation	0.0617	0. 1359	0. .0009	0. 4393
Location Characteristics				
Southern horticultural zone	0.3607	0.0907	0.01670	0.4393
Affram Basin	0.1551	0.0676	0.0067	0.2203
Northern agricultural zone	0.0043	0.0048	0.0009	0.0334
All Plots	**0.0997**	**0.1553**	**0.0009**	**0.4393**

Source: Author's computation from ISSER-MIDA FBO Survey 2008:

Another innovative way of doing a comparative analysis of technical efficiency in alternative land holding arrangements is to rank the estimated technical efficiency by some household or plot manager attributes including the relevant land holding arrangements. By undertaking this ranking, one is asking among others the following questions:

i. Who are the most efficient producers?
ii. Under what arrangements and conditions have they acquired their land?
iii. What crops do they cultivate?
iv. Where are they located?

The results that follow are based on sub-sample of 259 households for which complete information required for the frontier model was available. Table 6.3 presents a ranking of the top ten most efficient producers and the bottom or ten least efficient producers. Six of the top seven most efficient producers purchased their land outright and also hold deeds or title of their rights. They are also mango farmers and located in the southern horticultural belt, indicating that cash crop production and population density may be strongly correlated with the acquisition of private rights over land.

The second most efficient farmer however is located in the northern agricultural zone, cultivates yam and acquired his land for free. Inspection of the data showed that this yam farmer (second most efficient farmer) is a commercially oriented farmer who cultivates over 100 acres of land and sold most of his produce outside the northern region. The commercial orientation is perhaps explains the level of efficiency. Comparatively, the least efficient farmers either cultivate family land or land they received as gifts; who have no documentation of their rights over the land and are all located in Northern agricultural zone. Efficiency in seven of the top ten most efficient producers is between 32% - 44%. The ten least efficient households have technical efficiency of

about 1% or less and are all located in the Northern agricultural zone. About 90% least efficient farmers cultivate land held by the extended family or community for which they have formal documentation. The data seem to support the "land reformists' school" arguments that land relations have profound influence on resource allocation and factor productivity. The probable reason why the trend is not widespread may be due to the dominance of subsistence agriculture across the study area and Africa in general. The data at least points to a trend where commercialisation or business orientation in agriculture characterised by the cultivation of cash crops (mango) is associated with significant levels of privatisation in land rights (outright purchase and documentation of land) and increased productivity or efficiency.

Table 6.3: Ranking of Technical Efficiency by land tenure arrangement, crop and zone

Rank	Land Documentation	Incidence Disputes	Type of contract	Mode of acquisition	Zone	Crop	Technical efficiency
1st	Holds a deed	No	Own land	Purchased	Southern	Mango	0.4393
2nd	Oral agreement	No	Own land	Gift	Northern	Yam	0.4392
3rd	Holds a deed	No	Own land	Purchased	Southern	Mango	0.4387
4th	Holds a deed	No	Own land	Purchased	Southern	Mango	0.4220
5th	Holds a deed	No	Own land	Purchased	Southern	Mango	0.4136
6th	Holds a deed	No	Own land	Purchased	Southern	Mango	0.4134
7th	Holds a deed	No	Own land	Purchased	Southern	Mango	0.3257
8th	No document	No	Own land	Gift	Southern	Mango	0.2533
9th	No document	No	Own land	Gift	Southern	Mango	0.2013
10th	Oral agreement	No	Tenant	Rented (cash)	Affram	Maize	0.1722
250th	No document	No	Own land	Gift	Northern	Rice	0.0119
251st	No document	No	Own land	Family land	Northern	Pepper	0.0113
252nd	No document	No	Own land	Family land	Northern	Maize	O. 0111
253rd	No document	No	Own land	Family land	Northern	Okro	0.0108
254th	No document	No	Own land	Family land	Northern	Beans/peas	0.0105
255th	No document	No	Own land	Family land	Northern	Okro	0.0029
256th	No document	No	Own land	Family land	Northern	Okro	0.0026
257th	No document	No	Own land	Family land	Northern	Okro	0.0018
258th	No document	No	Own land	Family land	Northern	Pepper	0.0015
259th	No document	No	Own land	Family land	Northern	Okro	0.0011

Source: Author's computations from *ISEER-MIDA Data* 2008

Even though the data in Table 6.3 points to gains in technical efficiency associated with privatisation of land rights, it is important to carry out similar analysis but in this case investigating whether non-privatisation of land rights is associated with technical inefficiency. Maximum likelihood estimates of factors that explain technical inefficiency are presented in Table 6.4. The overall measure of technical inefficiency (Gamma) is equal to 0.96 indicating almost all of the deviations from the frontier are as a result of inefficiency and not due to random error in the data. The results in Table 6.4 also suggests that technical inefficiency exists in

Table 6.4: Maximum Likelihood Estimates of Parameters of technical Inefficiency

Variable	Coefficient	Std. Err.	Z
No formal education	-0.4042	0.1770	-2.28*
Reads fairly	0.7298	0.1811	4.03***
Cannot read	-0.0192	0.1698	-0.11
Sharecropped land	0.0924	0.0651	1.42
Rented land (cash)	0.3622	0.0493	7.34***
Family land	0.0711	0.0224	3.17**
Purchased land	-0.2573	0.0692	-3.72***
Owner cultivated plots deeds	-0.0282	0.0164	-1.72*
Rented in-kind	0.6672	0.0972	6.86***
Duration of land contracts	0.0039	0.0303	0.13
Age	0.4114	0.0720	5.71***
Age square	0.0325	0.1526	0.21
Dependency ratio	0.5391	0.1091	4.94***
Livestock holding (TLU)	-0.0236	0.0330	-0.72
Value of farm implements/tools	-0.0623	0.0265	-2.35*
Number of cattle owned	-0.1499	0.0337	4.44***
Total male labour	-0.0214	0.0450	-0.48
Value of household assets	0.1440	0.0431	3.34**
Per capita non-farm income	0.2837	0.0411	6.90***
Credit market participation	-0.1561	0.0829	-1.88*
Distance to major market	0.0037	0.0013	2.81**
Adoption of improved technology	-0.1657	0.0548	-3.02**
Ratio of zonal to household farm size	0.0417	0.0085	4.90***
Constant	-4.1692	0.6590	-6.33***

Table 6.4 continued.

Sigma-square	0.0016
Gamma	0.9647
Log likelihood	571.58

Author's computation from ISSER-MIDA FBO Survey 2008:
Dependent variable: Dependent variable is technical inefficiency measure determined in a single stage procedure together with the frontier function and estimated using STATA 11. Continuous variables are in natural logarithms.

*, ** and *** are levels of significance at 10%, 5% and1%, respectively

production across the study area. The study finds that the mode of land acquisition had some degree of influence on technical inefficiency. Outright purchase of land was found to be negatively correlated with technical inefficiency and was significant at the 1% levels. Production on family held and rented land had the expected positive relationship with technical inefficiency and was statistically significant at the 5% and 1% levels respectively. Technical inefficiency was found to be negatively correlated with privately owned (owner cultivated with deed) plots and positively related to sharecropping even the sharecropped land-technical inefficiency relationship was not statistically significant.

The literacy variable was somewhat ambiguous and did not display the expected effect on technical inefficiency. Plot managers with no formal education had an unexpected significant negative effect on technical inefficiency. The ability to read fairly had a significant positive effect on technical inefficiency indicating plot managers with the ability to read fairly did not necessarily have a lower propensity of being technically inefficient when compared to those who are able to read proficiently.

Most of the variables controlling for household wealth and market participation were largely significant and had the expected signs. The value of farm implements and number of cattle owned, and had the expected negative correlation with technical inefficiency and were significant at the 10% and 1% levels respectively. Total livestock holding (in tropical livestock units) had the expected sign but was not significant. The value of household assets and non-farm income had unexpected positive correlation with technical inefficiency.

The distance to major markets and participation in credit markets exerted a significant influence on technical inefficiency and had the expected signs. Distance to major markets had positive coefficient sign indicating that technical inefficiency increased with increasing distance between households and major markets. The significant negative effect of borrowing (participation in credit markets) on technical inefficiency is consistent with the credit hypothesis or the credit effect hypothesis which states that participation in credit markets, other things being equal, would improve farm investment and therefore technical efficiency. As expected, adoption of improved technology exerted a significant negative effect on technical inefficiency.

6.2 SUMMARY OF CHAPTER SIX

This chapter examined the relationship between land use arrangements and technical efficiency in Ghana. The analyses were informed by neo-classical theories of share tenancy pioneered by Alfred Marshall and J. S. Mill as well as the "equal efficiency school" hypothesis. A background to the analyses was provided by highlighting the lack of consensus both on the research and policy fronts in terms of the relationship between land holding arrangements and productive efficiency.

The findings of the study were largely consistent with some of the most recent surveys (Ahmed, 2002; Kariuki, 2008) conducted on the subject elsewhere in Africa. First, the study found that technical inefficiency was high in the study area. Land transactions that transferred permanent rights to the holder such as outright purchase and land renting for cash were found to be negatively correlated with technical inefficiency, an indication that monetisation of land transaction has helped to improve technical efficiency in crop production. This study also finds technical inefficiency to be positively associated with production on family or sharecropped land, and possibly pointing to the presence of Marshallian inefficiency.

Household wealth factors such as value of farm implements and number of cattle owned were found to be negatively associated with technical inefficiency. This significant influence of household resource endowment on technical inefficiency is in tandem with the "equal efficiency school" hypothesis. The significant effect of market access variables such as distance to major markets and participation in credit markets was also in tandem with the credit hypothesis that access to financial markets enabled households to make significant investments in land which in turn improved technical efficiency.

A ranking of the top 10 most efficient producers and bottom 10 least efficient farmers revealed that the most efficient farmers were located in the Southern horticultural belt, were mostly mango farmers who had acquired their land through outright purchase and had written documentation covering their interests in their land. On the other hand, all the least efficient farmers were located in the Northern agricultural zone, cultivated family owned or received the

plots as gifts with technical efficiency scores close to zero. Farmers with complete rights over their plots registered technical efficiency score of 8%; with plots on which the holders exercised preferential rights averaging at about 2% of technical efficiency. Technical efficiency was about 1.7% on plots with limited rights. This trend strongly suggests that privatisation of land rights would significantly improve productivity, other things being equal.

CHAPTER SEVEN

SUMMARY, CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

7.0 INTRODUCTION

The study examined land relations in Ghana and the implications for land tenure security, farm investments and technical efficiency. The study's hypotheses were based on the neo-classical theory of land tenure which suggests that both demand-side (incentives to farmers) and supply-side (incentives to lenders) influence productive efficiency through investment. The study first examined evolutions in land rights in Ghana, guided by posits of the evolutionary theory of land rights that sets individualisation in land rights as a function of population growth, commercialisation and agricultural intensification. The objective was to explore trends in farm land rights evolutions in Ghana and if trends were observed, analyse the drivers of the transformations based on the theory. The study also explored the data, analysing for possible links between land use arrangements in Ghana and the incidence of perceived land tenure insecurity. This chapter presents a summary of the study's key findings, the policy implications and recommendations.

7.1 SUMMARY OF FINDINGS

7.1.1 Alternative Land Rights Arrangements in Ghana

Land rights in Ghana appear to evolve in tandem with posits of the evolutionary theory of land rights, with the intensification and commercialisation of agriculture appearing to drive the privatisation of land rights. The study found that the greater majority of farmers held only limited

transfer rights even though there was evidence to the effect that contractual or evidence-based land transaction (land arrangements in which there are agreements to the effect that the transactions have taken place) had indeed increased. The study observed over 5% decline in outright purchase of land in favour of other non-permanent forms of land transaction such as fixed rate renting. The decline in outright sale and purchase of land means that people are not acquiring complete rights over land and therefore not be able to document their interests in land.

7.1.2 Determinants of Land Tenure Security

The study found that relative farm size did not increase but rather decreased tenure insecurity. The results seem to suggest that the source of insecurity in Ghana is not a direct function of farm land size (i.e. Alemu, relative farm size effect) but rather the value of farmland. The cultivation of own farms (with deed) was found to be inversely related to tenure insecurity. Households that obtained their lands through the political processes of matrilineage and patrilineage (family land) were less likely to lose land that they leave idle for a specified period.

7.1.3 Land Tenure Arrangements and Farm Investments

Even though the study found that private ownership of land and land documentation exerted significant effects on both the decision to invest in land and the level of investment, the influence was stronger in the case of the amounts households invested in long-term soil improvements and irrigation. While land title documentation for example did not exert a significant effect on the decision to invest, both individual ownership and documentation of rights exerted significant positive effects on the levels households invested.

7.1.4 Technical Efficiency in Alternative Land Holding Arrangements

On the average, technical efficiency ranged from 0.0009 to 0.4393. The study found that the most efficient producers were farmers with complete rights over their land. Farmers who held complete rights over their land produced at an estimated average technical efficiency of 24% while those who held preferential rights and limited rights producing at about 9% and 1% technical efficiency respectively. The results implied that land holders with preferential and limited farm rights could achieve up to 59.8% and 96% improvements in output respectively if they acquired complete rights, other things being equal. The most efficient farmers were found to be mango farmers located in the Southern horticultural zone who had acquired their land through purchase and also had land title deeds.

7.1.5 Determinants of Technical Inefficiency in Ghana

The study examined the relationship between land use arrangements and technical efficiency in Ghana. The overall measure of technical inefficiency (Gamma) was 0.96, an indication that most of the deviations from the frontier are as a result of inefficiency and not due to random error in the data. In general, the study found that technical inefficiency was high in the study area. Land transactions that transferred permanent rights to the holder such as outright purchase and fixed fee renting were found to be positively correlated with technical efficiency, an indication that monetisation of land transaction has helped to improve technical efficiency in crop production. Household wealth factors such as value of farm implements and number of cattle owned were also found to be positively associated with technical efficiency. This significant influence of household resource endowment on technical inefficiency is in tandem with the “equal efficiency school” hypothesis.

7.2 CONCLUSIONS

Even though land rights arrangements in Ghana appears to evolve in tandem with the predictions of the evolutionary theory of land rights, the emerging land markets and forms of land transactions suggests either a truncation of the evolutionary track at some stage or a rather extremely slow rate of land rights transformations. For example, a reduction in non-cash modes of land acquisition such as land gifts and cultivation of family land did not result in a corresponding increase in outright land purchases but rather a growth in land renting. Land owners appear to be speculative, preferring to hold land for longer periods in anticipation of higher payoffs as land values appreciate in the course of urbanisation and commercialisation of agriculture. Even though fixed-fee renting can provide some level of security over a period of time to facilitate land-related investments, the fact that rights acquired through renting are mainly usufructory limits or eliminates the use of land to secure credit for farm investment.

Contrary to the hypothesis of the "Equal Efficiency School" that land rights or tenure security had no correlation with the willingness of farmers to make long-term land improvement investment and productive efficiency, it is clear that land rights are emerging as a strong factor in explaining both the willingness to invest and the levels of land-related investments in Ghana. Policy initiatives to streamline land transactions in Ghana through land administration reforms are therefore not only consistent with theory but also with empirical data.

There is a relatively strong link between privatised land rights, cash crop production and technical efficiency. Even though it is plausible to argue that mango farmers were efficient because they cultivated a high value crop with relatively higher returns to investment, the fact

that the most efficient farmers were associated privatised land rights confirms the "land reformist school hypothesis" that secure land rights were a pre-condition for achieving technical efficiency.

7.3 POLICY IMPLICATIONS AND RECOMMENDATIONS OF THE STUDY

Even though the findings of the study on the transformations of land rights in Ghana are in tandem with the predictions of the evolutionary theory of land rights, there is still the need for some form of regulation by government and designated agencies to counter imperfections in land relations. While some may argue that governments should not intervene in land markets with the view that these markets would evolve over time, the time dimension (i.e. the length of time it would take for land relations to evolve into efficient land markets) could have serious implications for short to medium-term economic growth in the country. This study agrees with arguments that options exist for governments to intervene in land relations without necessarily interfering with the evolution process. An appropriate approach for Ghana would be to use market-based inducements where government offer incentives to induce the restructuring of existing property rights or the creation of new ones, for example through the distribution of public lands; state expenditure on land reclamation and subsequent allotment as private property; state sponsored credits channelled through land banks and cooperatives; and support to institutions to administer the necessary land acquisition and distribution mechanisms.

The study found that land owners were mostly speculative, preferring to either engage in short-term land renting or hold unto land for longer periods in anticipation of higher payoffs as land value appreciates overtime. What policy can do is to facilitate the transfer of complete rights as

well as discourage speculative behaviours in land transactions. The taxing of unproductive or idle land is one way of discouraging speculative demand for land. On the grounds of promoting efficiency in land use, some economists have long argued for the application of land tax on improved land. Such policies can improve efficiency in the land market by compelling land holders to improve or put their land to productive use. Land markets are efficient if they transfer land to producers who have the ability to put land to optimum use. The imposition of taxes on unimproved land can also help to drive down land prices by discouraging speculative demand for land. The adoption of idle land tax policies could however introduce some distortions in land markets. While idle land taxes may discourage the possession of idle land, the policy could lead to distress land sales if not carefully applied.

The finding by the study that, private ownership of land significantly influenced household farm investment decisions underscores the importance of facilitating the privatisation of land rights. In seeking to improve land markets and transactions in Ghana, policy needs to pursue the duel objective of promoting equity in access to land and efficiency land rights management. The land administration reform programme and other forms of interventions in land relations should focus on putting in place legal provisions and land rights management mechanisms for specific groups of people in society. There is also the need for institutional reform and capacity development for land agencies to develop:

i. clear, flexible and secure forms of contract with protection of rights for all parties
ii. efficient procedures for registering transactions, and
iii. systems that would significantly reduce the time and cost of registering land transactions.

The findings of this study which links privatisation of land rights to technical efficiency adds to the growing number of studies that have empirically established links between land rights and productivity efficiency. While the findings seem to confirm posits of the "land reformist" school which associated efficiency with individualised land rights, it could not reject one aspect of the "equal efficiency" school which associated technical inefficiency in African agriculture with resource poverty. The fact that most household wealth variables were found to be positively correlated with technical efficiency attests to this fact. For policy, the result means that privatisation of land rights would not necessarily lead to higher productivity if such efforts are not complemented by efforts to enhance the resource endowments of households or producers. Land rights reform should therefore be pursued as part of a broader programme to improve land rights as well as the access of farm households to complementary resources.

Interaction with stakeholders including chiefs, farmers and land registration agencies revealed that land lease periods have become a source of concern in the Ghanaian land market. Even with non-agricultural land transactions, the gradual departure from the conventional ninety-nine year lease period has further worsened the volatility in the largely informal Ghanaian land markets. In the case of agricultural land, this study found that duration of land contracts was positively correlated with technical efficiency. This finding implies that, lease period review programmes targeting the imposition of minimum lease period for contractual farm land transactions could be employed as a means of reducing uncertainties associated with land use arrangements such as loaning, renting, share tenancy and even with outright purchase.

7.4 SUGGESTIONS FOR FUTURE RESEARCH

The unavailability of panel data in Ghana capturing the issues addressed by this study is a limitation. The use of cross-sectional data meant that only differences between households or individuals could be explored. For example, the analysis of efficiency within one household or of one individual over time, as land rights and resource endowment changes is an important aspect this study could not address due to data constraints. The use of panel data and Difference- In-Difference (DID) or multi-staged mixed equations analyses can help shed further light on the land tenure-productivity relationship in Ghana in particular and Sub-Saharan African in general. The Institute of Statistical Social and Economic Research (ISSER) in collaboration with Yale University has begun compiling panel data on a wide range of issues including land which could be used in the future to test the neo-classical economic theory of land tenure.

REFERENCES

Adegboye, R. (1974). Land Tenure Problems and Improved Practices. The Economics of Cocoa Production and Marketing,. R. A. e. a. Kotey. Legon, University of Ghana, Institute of Statistical, Social and Economic Research.: 159-164.

Adams, M., Cousins, B. amd Manona, S. (1999). Land Tenure and Economic Development in Rural South Africa: Constraints and Opportunities. ODI, Working Paper 125. London.

Agbosu, L., Awumbila, M., Dowuona, H., and Tsikata, D. (2007). Customary and Statutory Land Tenure Policy in Ghana. ISSER Technical Publication No. 70. Accra, Ghana, Institute of Statistical, Social and Economic Research.

Agbosu, L. K. (2000). Ghana Land Law: Contradiction Between Anglo-American and Customary Conceptions of Tenure Practices. Working Paper, Land Tenure Centre, An Institute for Research and Education on Social Structure, Rural Institution, Resource Use and Development, University of Wisconsin, Madison, USA: 32.

Ahmed, M. M., B. Gebremedhin, S. Benin, and S. Ehui, (2002). "Measurement and sources of technical efficiency of land tenure contracts in Ethiopia." Environment and Development Economics 7: 507-527

Aigner, D. J., Lovell, C. A. K., and Schmidt, P. (1977). "Formulation and estimation of stochastic frontier production function models." Journal of Econometrics **6:** 21-37.

Aigner, D. J. and S. Chu (1968). "On Estimating the Industry Production Function." American Economic Review **58:** 826-839.

Alemu, T. (1999). Land Tenure and Soil Conservation: Evidence from Ethiopia. Ekonomiska Studier, Goteborgs Universitet

Amaza, P. and D. Maurice (2005). Identification of Factors That Influence Technical Efficiency in Rice-Based Production Systems in Nigeria. Workshop on Policies and Strategies for Promoting Rice Production and Food Security in Sub-Saharan Africa. Cotonou (Benin).

Anderson, J. N. D. (1954). Islamic Law in Africa. London, Her Majesty's Stationery Office.

Atwood, D. A. (1990). "Land Registration in Africa: The Impact on Agricultural Production." World Development, Vol. 18(No. 5): 659-671.

AU/NEPAD (2003). In ariuki, D. K., C. N. Ritho, et al. (2008). Analysis of the Effect of Land Tenure on Technical Efficiency in Smallholder Crop. Conference on International Research on Food Security, Natural Resource Management and Rural Development, Tropentag 2008, University of Hohenheim,.

Ault, D. E. and Rutman G. L. (1979). "The Development of Individual Rights to Property in Tribal Africa." Journal of Law & Economics **vol. 22** (issue 1): pages 163-182.

Aryeetey, E. And Udry, C. (2009) "Towards Efficient and Equitable Land Tenure Reforms in Ghana-ISSER, November 2009.

Aryeetey, E. (2009) " Domestic Resource Mobilisation for Inclusive Development: How has this been affected by the Financial Crisis?" Conference to commemorate the 40th anniversary of ISSER. M-Plaza Hotel. Accra Ghana.

Banerjee, A. V. and A. F. Newman (1993). "Occupational Choice and the Process of Development." Journal of Political Economy 2(101): 274-298.

Barnes, J. A. (1954). Politics in a Changing Society. A Political History of the Fort Jameson Ngoni. London, Oxford University Press for the Rhodes Livingston Institute.

Baron, D. (1978). Land Reform in Sub-Saharan Africa: An Annotated Bibliography. Washington D. C., U.S. Agency for International Development, Office of Rural Development.

Barrows, R., M. Roth, et al. (1989). Land Tenure and Investment in African Agriculture: Theory and Evidence, Land Tenure Center, LTC Paper No. 136, University of Wisconsin-Madison.

Barrows R. and M. Roth (1990). "Land Tenure and Investment in African Agriculture: Theory and Evidence." The Journal of Modern African Studies **28:** 265-297.

Bassett, T. J. (1993a). Introduction: The Land Question and Agricultural Transformation in Sub-Saharan Africa. Land in African Agrarian Systems. T. J. Bassett and D. E. Crummey. Madison, Wisconsin, The University of Wisconsin Press: 3-31.

Battese, G. E. and Coelli, T. J. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empirical Economics, 20, 2, 325-32.

Battese, G. E. and G. S. Cora (1997). " Estimation of a production frontier model with application to the pastoral zone of eastern Australia." Journal of Agricultural Economics.

Bauer, P. W. (1990). "Recent Development in the Econometric Estimation of Frontiers." Journal of Econometrics **46(1-2):** 39-56.

Bentsi-Enchill, K. (1964). Ghana Land Law. London, Sweet and Maxwell.

Benneh, G. (1975). "The Impact of Cocoa Cultivation on the Traditional Land Tenure System of the Akan of Ghana." Ghana Journal of Sociology **Vol.** 6(No. 1): pp. 43-61.

Besley, T. (1995). "Property Rights and Investment Incentives: Theory and Evidence from Ghana." The Journal of Political Economy **Vol. 103, No. 5:** 903-937.

Berry, S. (1993). No Condition is Permanent - The Social Dynamics of Agrarian Change in Sub-Saharan Africa. Madison, University of Wisconsin Press.

Biebuyck, D., Ed. (1963). African Agrarian Systems. London, Oxford University Press for the International African Institute.

Binswanger, H. P., K. Deininger, et. al. (1995). Power, Distortions, Revolt and Reform in Agricultural Land Relations in Behrman, J. and T. N. Srinivasan Amsterdam; New York and Oxford, Elsevier Science, North Holland.

Boserup, E. (1981). Population and Technological Change. Chicago, Chicago University Press. Boserup, E. (1965). Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure. New York, Aldine Publishing Co.

Brasselle, A.-S., Gosport, F. and Platteau, J.-P. 2002. "Land Tenure Security and Investment Incentives: Puzzling Evidence from Burkina Faso." *J. Development Econ.* 68 (2): 373418.

Bruce, J. W. and S. E. Migot-Adholla (1994). Searching for Land Tenure Security in Africa. Dubuque IA, Kendall-Hunt Publishing Company.

Bruce, J. (1988). Indigenous Tenure a Development Constraint? memo, University of Wisconsin-Madison, Land Tenure Centre.

Bruce, J. W. (1986). Land Tenure Issues in Project Design and Strategies for Agricultural Development in Sub-Saharan Africa, Land Tenure Center (LTC) Paper University of Wisconsin-Madison. No. 128.

Burgess, R. (2001). Land and Welfare: Theory and Evidence from China. Working Paper, London School of Economics.

Chanock, M. (1985). Law, Custom and Social Order - The Colonial Experience in Malawi and Zambia. Cambridge, Cambridge University Press.

Charnes, A., Cooper,W.W. and Rhodes, E. (1978) "Measuring the Inefficiency of Decision Making Units." European Journal of Operational Research 2**(6):** 429 - 444.

Chauveau, J.-P. (2006). How does an institution evolve? Land, politics, intra-households relations and the institution of the tutorat between autochthons and migrant farmers in the Gban region (Ivory Coast). Land rights and the politics of belonging in West Africa. R. Kuba and C. Lentz. Leiden, Brill Academic Publishers: 213-240.

Cheung, S. N. S. (1969). The Theory of Share Tenancy. Chicago, University of Chicago Press. Cheung, S. N. S. (1968). "Private Property Rights and Sharecropping." J. Polit. Econ. **76:** 11071122.

Clay, D., Reardon, T., and Kanganiemi, J., (1998). "Sustainable intensification in the highland tropics: Rwandan farmers' in land conservation and soil fertility." Economic Development and Cultural Change **46(2):** 351-377.

Clark, R. J. (1969). Problems and Conflicts over Land Ownership in Bolivia. Inter- American Affairs **22.**

Coelli, T. J. (1995). "Recent developments in frontier estimation and efficiency measurement." Australian Journal of Agricultural Economics **39:** 219-245.

Cohen, J. (1980). "Land Tenure and Rural Development in Africa," in R Bates and M Lofchie Colin, J.-P. (2005). "Le developpement d'un marche foncier ? Une perspective ivoirienne." Afrique contemporaine **213:** 179-196.

Colin, J.-P. and M. Ayouz (2006). "The Development of a Land Market? Insights from Cote d'Ivoire." Land Economics **82(3):** 404-423.

Collier, P. (1983). "Malfunctioning of African Rural Factor Markets: Theory and a Kenyan Example." Oxford Bulletin of Economics and Statistics Vol. 45(No. 2): 141-172

Cotula L. (ed). Changes in "Customary" Land Tenure Systems in Africa. ISBN: 978-1-84369-

657-5 (March, 2007).

Cotula, L., Ed. (2006). Land and Water Rights in the Sahel - Tenure Challenges of Improving Access to Water for Agriculture. IIED, Issue Paper 139. London.

Dabire, B. and M. Zongo (2005). L'impact de la crise ivoirienne sur acces a la terre dans la province de la Comod. Note de synthese CLAIMS, UERD. Ouagadougou, CLAIMS, UERD. 9.

Deaton, A. (1997). The Analysis of Household Surveys. A Microeconometric Approach to Development Policy. Baltimore, The Johns Hopkins University Press (for the World Bank).

Deininger, K. and Feder. G. (1998). Land Institutions and Land Markets., Washington, D.C.: The World Bank.

Djire, M. (2004). Reformes legislatives et dynamiques foncieres- acces a la terre et la gestion des ressources naturelles dans les communes rurales de Sanankoroba et de Dialakoroba. Bamako, CLAIMS IIED.

Dorner, P. (1972). Land Reform and Economic Development, Kinsport Kingsport Press

Dravi, M. M. (1984). The Alleviation of Rural Poverty in Cameroon. Rome, Food and Agriculture Organization.

Dzanku, F. M. (2007). Land Rights, Sustainable Natural Resource Use and Agricultural Productivity in Ghana, Institute of Statistical, Social and Economic Research (ISSER) University of Ghana.

Elias, T. (1956). The Nature of African Customary Law. Manchester, Manchester University Press.

Farrell, M. J. (1957). "The measurement of production efficiency." Journal of the Royal Statistical Society **120:** 253-290.

Feder, G. (1987). "Land Ownership Security and Farm Productivity: Evidence from Thailand." J. Develop. Stud. **24:** 16-30.

Feder, G. and R. Noronha (1987). "Land Rights Systems and Agricultural Development in Sub-Saharan Africa." The World Bank Research Observer **Vol. 2, No. 2 (Jul., 1987):** 143169.

Feder, G. and Feeny (1993). The theory of land tenure and property rights. In: Hoff, K.,

Feder, G. and R. Noronha (1987). "Land Rights Systems and Agricultural Development in Sub-Saharan Africa.

Feder, G., Onchan, T., Chlamwong, Y., and Hongladorom, C. (1987). Land Policies and Farm Productivity in Thailand. Baltimore MD, John Hopkins University Press, 1988.

Feeny, D. (1982). The Political Economy of Productivity: Thai Agricultural Development 18801975., Vancouver: University of British Columbia Press.

Fitsum H, F., et al. (2006). "Tenure security, resource poverty, public programs, and household plot-level conservation investments in the highlands of northern Ethiopia" Agricultural Economics.

Galor, O**.** and J. Zeira (1993). "Income Distribution and Macroeconomics", Review of Economic Studies,. **60 (1),:** 35-52.

Gavian, S. and M. Fafchamps (1996). "Land Tenure and Allocative Efficiency in Niger." American Journal of Agricultural Economics **78 (No**. 2): 460-471.

Gavian, S. and S. Ehui (1998). "The relative efficiency of alternative land contracts in a mixed crop-livestock system in Ethiopia." Agricultural Economics **20:** 37-49.

The World Bank Research Observer **Vol. 2, No. 2:** 143-169.

Gebremedhin, B., J. Pender, J., Ehui, S., and Mtiku, H. (2002). Policies For Sustainable Land Management In The Highlands Of Tigray, Northern Ethiopia. EPTD Workshop Summary Paper No.14.

Georgescu-Roegen, N. (1960). "Economic Theory and Agrarian Reform." Oxford Econ. Papers (12): pp. 1-6.

Goldstein, M. Udry, C. (2008). "The Profits of Power: Land Rights and Agricultural Investment in Ghana" *Journal of Political Economy*, 2008, vol. 116, no. 6. The University of Chicago.

Glazier, J. (1984). "Mbeere Ancestors and the Domestication of Death." Man **19:** 133-148. Gluckman, M. (1941). Economy of the Central Barotse Plains. RLI Paper 7. Livingstone, Rhodes-Livingstone Institute.

Green, J. K. and. (1987). "Evaluating the Impact of Consolidating Holdings, Individualization of Tenure, and Registration of Title: Lessons from Kenya." Tenure Center Paper No. 129. University of Wisconsin Madison, 1987.

Geertz, C. (1963). Agricultural Involution: The Process of Ecological Change in Indonesia. Berkeley, University of California Press.

Grier, B. (1981). "Underdevelopment, Modes of Production and the State in Colonial Ghana." African Studies Review. **24:** 21-47.

Hagos, F. and S. Holden (2006). "Tenure security, resource poverty, public programs, and household plot-level conservation investments in the highlands of northern Ethiopia." Agricultural Economics 34: 183-196.

Harrisson, P. (1987). The Greening of Africa., London Paladin Grafton Books, .

Hayami, Y. and K. Otsuka. (1993). The Economics of Contract Choice: An Agrarian Perspective. Oxford, U.K., Clarendon Press.

Hailey, M. (1957). An African Survey Revised 1956. London, Oxford University Press.

Haswell, M. R. (1963). The Changing Pattern of Economic Activity in a Gambia Village. London, Her Majesty's Stationery Office.

Hayes, J., M. Roth, M., and Zepeda, L (1997). "Tenure Security, Investment and Productivity in Gambian Agriculture A Generalized Probit Analysis." American Journal of Agricultural Economics Vol. 79 (No. 2): pp. 369-382.

Heady, E. (1947) "Economics of Farm Leasing Systems " Journal Farm Economics Vol. 29: pp. 659-678.

Hecht, R. M. (1982). Cocoa and the Dynamics of Socio-economic Change in Southern Ivory Coast. Cambridge, Cambridge University. Ph.D dissertation.

Heckman, J. J. (1990). "Varieties of Selection Bias" American Economic Review 80: 313-318. Heckman, J. (1979). "Sample selection bias as a specification error." Econometrica 47: 153-161. Hill, L., and P. Kau (1973) "Application of Multivariate Probit to a Threshold Model of Grain Dryer Purchasing Decisions". American Journal of Agricultural Economics 55: 19-27.

Holden, S. and B. Shiferaw (2002). Poverty and land degradation: Peasants' willingness to pay to sustain land productivity. In: Barrett, C. B., Place, F., Aboud, A. A. (Eds.),Natural

resources management in African agriculture- understanding and improving current practices, CABI publishing.

Holden, S. and H. Yohannes (2002). Land Redistribution, Tenure Insecurity, and Intensity of Production: "A Study of Farm Households in Southern Ethiopia" Land Economics, University of Wisconsin Press.

Ibik, J. (1971). "Restatement of African Law, 4." In Malawi II. London, Sweet and Maxwell. IFAD (2002). International Fund for Agricultural Development Annual Report.

Ip, P. C. and C. W. Stahl (1978). "Systems of Land Tenure, Allocative Efficiency, and Economic Development." American Journal of Agricultural Economics **Vol. 60** (No. 1): pp. 19-28.

Issawi, C. (1957). "Farm Output Under Fixed Rents and Share Tenancy." Land Economics **Vol. 38:** pp. 74-77.

Johnson, E. G. Omotunde. 1972. "Economic Analysis, Legal Framework and Land Tenure Systems". *Journal of Law and Economics*, 15 (1): 259-276.

Johnson, D. G. (1950). "Resource allocation under share contracts." Journal of Political Economy **58:** 111-123.

Jondrow, J. C., Lovell, A. K. Meterov, I. S., and Schmidt, P. (1982). "On estimation of technical inefficiency in stochastic frontier production function model." Journal of Econometrics **19:** 233-238.

Just, R., Zilberman, D. and Hochman, E. (1983). "Estimation of multi-crop production functions." American Journal of Agricultural Economics **65:** 770-780.

Kariuki, D. K., Ritho, C. N. and Munei, K. (2008). Analysis of the Effect of Land Tenure on Technical Efficiency in Smallholder Crop. Conference on International Research on Food

Security, Natural Resource Management and Rural Development,Tropentag 2008, University of Hohenheim,.

Kasanga, K. (2002). Land Tenure Resource Access and Decentralisation in Ghana The Dynamics of Resource Tenure in West Africa. C. e. a. e. Toulmin. London, International Institute for Environment and Development: 25-36.

Kasanga, K. (1988). Land Tenure and Development Dialogue: The Myth Concerning Communal Land Holding in Ghana. Occasional Paper No. 19., Department of Land Economy. Cambridge University.

Kemp, J. (1981). "Legal and Informal Land Tenures in Thailand." Modern Asian Studies **15 (** no. 1): 1-23.

Kidanu, A. and T. Alemu (1994). Rapid Population Growth and Access to Farm Land: Coping Strategies in Two Peasant Associations in North Shoa.

Kille, G. S. and M. C. Lyne (1993). Property Rights to Land, On-Farm Investment and Farm Productivity: A Study of KwaZulu, South Africa. Pietermaritzberg, South Africa, Mimeo University of Natal.

Knox, M., Anna, M.-D. R. and Hazell. P. (1998). Property Rights, Collective Action and Technologies for Natural Resource Management: A Conceptual Frame-work. CAPRI Working Paper No.l., IFPRI. Washington, D.C.

Kumbhakar, S. C. and C. A. K. Lovell (2002). Stochastic Frontier Analysis. Cambridge (2000), Cambridge University Press.

Kone, M., G. J. Ibo, et al. (2005). Le tutorat en Cote d'Ivoire, analyseur pertinent des dynamiques socio-foncieres locales en milieu rural ivoirien, GIDIS-CI.

Laffont , J. J. and M. S. Matoussi (1995). "Moral hazard, Financial Constraints and Sharecropping in El Oulja." Review of Economic Studies 62: 381-399.

Lawry, S. W. (1994). "Structural Adjustment and Natural Resources in Sub-Saharan Africa: The Role of Tenure Reform." Society and Natural Resources (7(4)): 383-387.

Lavigne-Delville, P., C. Toulmin, Colin, J., Chauveau, J. (2001). Negotiating Access to Land in West Africa: A Synthesis of Findings from Research on Derived Rights to Land. London: IIED.

Levin, M. D. (1976). Family Structure in Bakosi: Social Change in an African Society. Princeton, N.J., Princeton University. **Ph.D. dissertation.**

Lewis, J. V. (1979). Descendants and Crops: Two Poles of Production in a Malian Peasant Village, Yale University, New Haven, Conn. **Ph.D. dissertation.**

Lipton, M. and R. Longhurst (1989). New Seeds and Poor People. London: Unwin Hyman. Oxford, Oxford University Press.

Lipton, M. (1968). "The Theory of the Optimizing Peasant." Journal of Development Studies **4 (3):** 327-351.

Li, G., S. Rozelle, et. al. (1998). "Tenure, Land Rights, and Farmer Investment Incentives in China." American Journal of Agricultural Economics **19:** 63-71.

Lunning, H. A. (1965). "The Impact of Socio-Economic Factors on the Land Tenure Pattern in Northern Nigeria." Journal of Administration Overseas **4 (** no. 3): 173-182.

Maddala, G. S. (1983). Limited-Dependent and Qualitative Variables in Econometrics, Cambridge University Press.

Magnant, J. P. (1993). Les normes foncieres traditionnelles en Afrique noire, University of Perpignan.

Maini, K. M. (1967). Land Law in East Africa. London, Oxford University Press.

Malcolm, D. M. (1953). Sukumaland: An African People and Their Country. London, Oxford University Press.

Marshall, A. (1930). Principles of Economics. London, Macmillan & Co.

Marshal, A. (1890). Principles of Economics, London: Macmillan.

Maxwell, D. and K. Wiebe (1999). Land Tenure and Food Security: Exploring Dynamic Linkages. Development and Change. **30 (4):** 825-849.

Matchaya, G. (2009) "Land ownership security in Malawi" African Journal of Agricultural Research Vol. 4 (1), pp. 001-013, January 2009.

Mathieu, P., Lavigne Delville, Ph. Ouedraogo, H. Zongo, M. and Pare, L. (2003). Making Land Transactions More Secure in the West of Burkina Faso. London, IIED/GRET.

McPhee, A. (1926). The Economic Revolution in British West Africa. London, Routledge.

Meek, C. K. (1949). Land Law and Custom in the Colonies. 2d. London, Oxford University Press.

Meeusen, W. and Broeck, J. V. D. (1977). Efficiency estimation from Cobb-Douglas production functions with composed error, International Economic Review **18::** 435-444.

Millennium Development Authority (2010) "Maize, Soya and Rice Production and Processing"

Investment Opportunity Ghana. Millennium Development Authority, Accra, Ghana

Middleton, J. (1961). Land Tenure in Zanzibar. London, Her Majesty's Stationery Office.

Migot-Adholla, S. E., G. Benneh, Place, F., and Atsu, S. (1994). Land, Security of Tenure and Productivity in Ghana. Searching for Land Tenure Security. B. A. Migot-Adholla. Iowa, Kendall Hunt Publishing Company.

Migot-Adholla, S. E., Hazell, P. B., and Place, F. (1991). Indigenous Land Rights Systems in Sub-Saharan Africa: A Constraint on Productivity?, World Bank Econ. Rev. 5 (January 1991): 155-75.

Mill, J. S. (1848). Principles of Political Economy. London, Longmans.

Morduch, J. (1995). "Income Smoothing and Consumption Smoothing." Journal of Economic Perspectives 9(3): 103-114.

Nettng, R. (1968). Hill Farmers of Nigeria: Cultural Ecology of the Kofyar of Jos Plateau. Seattle, University of Washington Press.

Newbery , D. M. G. (1987). "Agricultural Taxation: The Main Issues. The Theory of Taxation for Developing Countries. D. Newbery and N. Stern. Oxford, England, Oxford University Press.

Nkamleu, G.B. and Adesina, A. (1999). "Modelling Farmers Decision on Integrated Soil Nutrient Management in Sub-Saharan Africa: A Multinomial Logit Analysis in Cameroon." Agricultural Economics (in review).

Noronha, R. A. (1985). Review of the Literature on Land Tenure Systems in Sub-Saharan Africa. Report No. ARU 43, Agriculture and Rural Development. Washington, DC, The World Bank.

Okoth-Ogendo, H. W. O. (1976). "African Land Tenure Reform". Agricultural Development in Kenya: An Economic Assessment, Nairobi. J. Hayer, J. K. Maitha and W. M. Senga, Oxford University Press: 124-142.

Otsuka, K., H. Chuma, Chuma, H., Hayami, Y. (1992). "Land and labor contracts in agrarian economies: theories and facts." Journal of Economic Literature **30.**

Otsuka, K. and Y. Hayami (1988). "Theories of share tenancy: a critical survey." Economic Development and Cultural Change 37(1): 32-68.

Pagiola, S. and S. Holden (2001). Farm household intensification decisions and the environment., CABI Publishing, New York.

Place, F. and P. Hazell (1993). "Productivity effects of indigenous land tenure systems in sub-Saharan Africa." American Journal of Agricultural Economics 74(3): 360-373.

Place, F., M. Roth, et al. (1994). Land Tenure Security and Agricultural Performance in Africa: Overview of the Methodology. Searching for Land Tenure Security in Africa. J. Bruce and S. Migot-Adholla. Iowa, Kendall/Hunt Publishing Company.

Platteau, J. P. (2000). "Does Africa need land reform. In :C. Toulmin, and Quan, J. (Eds) Evolving land rights, policy and tenure in Africa. DFID/IED/NRI, London.

Platteau, J.-P. (1995). Reforming Land Rights in Sub-Saharan Africa: Issues of Efficiency and Equity. UNRISD Discussion Paper No. 60. Geneva.

Pingali, P., Binswanger, H. P., and Bigot, Y. (1987). Agricultural Mechanization and the Evolution of Farming Systems in Sub-Saharan Africa. Baltimore, Md, John Hopkins University Press.

Quan, J. (2000). Land tenure, economic growth and poverty in sub- Saharan Africa. Evolving Land Rights, Policy and Tenure in Africa. In C. Toulmin and J. Quan.(Eds) London, DFID/IIED/NRI.

Quisumbing, A. R., Aidoo, Payongayong, J.B. E. and Otsuka, K. (2001), "Agroforestry Management in Ghana", in *Land Tenure and Natural Resource Management: A Comparative Study of Agrarian Communities in Asia and Africa*

Roth, M. and D. Haase (1998). Land Tenure Security and Agricultural Performance in Southern Africa. Madison, BASIS-CRSP Program, Land Tenure Center.

Rowling, C. W. (1946). Land Tenure in Kano. Kaduna, Government Printer.

Sadoulet, E. and A. de Janvery (1995). Quantitative Development Policy Analysis, The John Hopkins University Press.

Seiford, L. M. and R. M. Thrall (1990). " Recent Developments in DEA: The Mathematical Programming Approach to Frontier Analysis." Journal of Econometrics 46(1-2): 7-38.

Shaban, R. A. (1987). "Testing between competing models of sharecropping." Journal of Political Economy 95(5): 893-920.

Schickele, R. (1941). "Effects of Tenure Systems on Agricultural Efficiency." Journal Farm Economics: pp.185-207.

Sjaastad, E. (2003). "Trends in the Emergence of Agricultural Land Markets in Sub-Saharan Africa." Forum for Development Studies(1-203).

Sjaastad, E. and W. D. Bromley (1997). "Indigenous Land Rights in Sub-Saharan Africa: Appropriation, Security and Investment Demand." World Development 25(4): 549-562. Snyder, F. G. (1981). Capitalism and Legal Change. New York, Academic Press.

Sorrenson, M. P. K. (1967). Land Reform in the Kikuyu Country. A Study in Government Policy. Nairobi, Oxford University Press.

Swynnerton, R. J. M. (1954). A Plan to Intensify the Development of African Agriculture in Kenya, Nairobi, Government Printer.

Tanabe, S. (1978). Land Reclamation in the Chao Phraya Delta. Honolulu, University Press of Hawaii.

Thebaud, B. (2002). Foncier Pastoral et Gestion de l'Espace au Sahel. Peuls du Niger Oriental et du Yagha Burkinabe. Paris, Karthala.

Thomson, J. T. (1976). Law, Legal Process and Development at the Local Level in Hausa-Speaking Niger: A Trouble Case Analysis of Rural Institutional Inertia. Bloomington, University of Indiana. Ph.D. dissertation.

Tikabo, M. O. and S. T. Holden (2004). Land Tenancy and Efficiency of Land Use in the Highlands of Eritrea, As**,** Department of Economics and Resource Management, Norwegian University of Life Sciences.

Tsikata, D. 2003. "Securing Women's Interests within Land Tenure Reforms: Recent Debates in Tanzania", *Journal of Agrarian Change* 3: 1 and 2: 149-183. January and April.

Twerefou, D. K, Osei-Assibey, E. and Agyire-Tettey, F. (2011) "Land tenure security, investments and the environment in Ghana" Journal of Development and Agricultural Economics Vol. 3(6), pp. 261-273, June 2011.

Van Velsen, J. (1964). The Politics of Kinship. A Study of Social Manipulation among the Lakeside Tonga. Manchester, Manchester University Press for the Rhodes-Livingstone Institute.

Varian, H. R. (1993). Intermediate Microeconomics, New York: W.W. Norton & Co. 526

Waddell, E. (1972). The Mound Builders: Agricultural Practices, Environment, and Society in the Central Highlands of New Guinea. Seattle, University of Washington Press.

Walker, T. and N. Jodha (1986). How Small Farmers Adapt to Risk. Baltimore, Johns Hopkins University Press.

Watts, M. (1983). "Good Try, Mr. Paul: Populism and the Politics of African Land Use." African Studies Review. **26, No. 2:** 73-83.

Wilson, R. J. A. (1971). "Land Tenure and Economic Development - A Study of the Economic Consequences of Land Registration in Kenya's Smallholder Areas." Journal of the Statistical and Social Inquiry Society of Ireland Vol. XXII, Part. III: 124-151.

Wooldridge, M. J. (2002). Econometric analysis of cross section and panel data. Cambridge, MA, MIT. 752 .

LIST OF APPENDICES

APPENDIX 1: REGRESSION OUTPUT OF THE FRONTIER MODEL STOCHASTIC FRONTIER MODEL

Stoc. frontier normal/truncated-normal model Number of obs = 259
Wald chi2(11) = 1218.26
Log likelihood= 571.58382 Prob > chi2 = 0.0000

Dependent Variable: Log of value of output
:Technical inefficiency estimated from stochastic frontier model

vput_area	Coef.	Std. Err. z	z	P>z	[95% Conf	Interval]
Farm size	-.001809	.0021249	-0.85	0.395	-.0059737	.0023557
Purchased Inputs	.0003929	.0005426	0.72	0.469	-.0006707	.0014564
Labour	.0020683	.0007066	2.93	0.003	.0006834	.0034532
Access to Agricultural Extension	.0042137	.0010449	4.03	0.000	.0021658	.0062616
Non-tree cash crops	.0002431	.0017268	0.14	0.888	-.0031414	.0036275
Vegetables and spices	.0012336	.0030085	0.41	0.682	-.0046629	.0071301
Perennial cash crops	-.0050519	.004048	-1.25	0.212	-.0129858	.002882
Affram Basin	-.2497668	.0265783	-9.40	0.000	-.3018593	-.1976744
Northern Agricultural zone	-.4396819	.0247801	-17.74	0.000	-.48825	-.3911137
Access to irrigation	.0146138	.0060382	2.42	0.016	.0027791	.0264485
Drainage	-.0024513	.0006945	-3.53	0.000	-.0038124	-.0010901
Land Fragmentation	-.0160012	.0029765	-5.38	0.000	-.0218351	-.0101673
Constant	.4215884	.0254572	16.56	0.000	.3716933	.4714835

Mu						
No formal education	-.4042769	.1770717	-2.28	0.022	-.751331	-.0572227

Reads fairly	.7298193	.1811767	4.03	0.000	.3747195	1.084919
Cannot read	-.0192218	.1698366	-0.11	0.910	-.3520955	.3136519
Sharecropped land	.0924747	.065107	1.42	0.156	-.0604178	.0039759
Rented land (cash)	.3622432	.0493649	7.34	0.000	.2654898	.4589965
Family land	.0711219	.0224241	3.17	0.002	.0271714	.1150723
Purchased land	-.2573251	.0692658	-3.72	0.000	.2701474	.5527178
Owner cultivated plots deeds	-.028221	.0164273	-1.72	0.086	.4766117	.8578911
Rented in-kind	.6672514	.0972669	6.86	0.000	-.0351328	.2200822
Duration of land contracts	.0039701	.0303518	0.13	0.896	-.0555183	.0634586
Age	.4114326	.0720856	5.71	0.000	-.2665146	.3316794
Age square	.0325824	.1526033	0.21	0.831	-.3930836	-.1215666
Dependency ratio	.53911	.1091928	4.94	0.000	-.0883053	.0410591
Livestock holding (TLU)	-.0236231	.0330017	-0.72	0.474	-.114365	-.0104138
Value of farm implements/tools	-.0623894	.0265187	-2.35	0.019	.0837805	.2160456
Number of cattle owned	-.149913	.0337417	-4.44	0.000	-.1098495	.0669232
Total male labour	-.0214631	.0450959	-0.48	0.634	.0595053	.2285718
Value of household assets	.1440386	.04313	3.34	0.001	.0250576	.0584234
Per capita non-farm income	.2837589	.041143	6.90	0.000	.20312	.3643977
Credit market participation	-.1561086	.0829273	-1.88	0.060	-.318643	.0064259
Distance to major market	.003751	.0013336	2.81	0.005	.0011372	.0063647
Adoption of improved technology	-.1657147	.0548024	-3.02	0.002	.3250961	.7531238
Ratio of zonal to household farm size	.0417405	.0085118	4.90	0.000	-.2731255	-.0583039
Constant	-4.169218	.659089	-6.33	0.000	-5.461008	-2.877427

/lnsigma2	-6.380899	.165971	-38.45	0.000	-6.706196	-6.055602
/ilgtgamma	3.30922	.2436048	13.58	0.000	2.831763	3.786676
sigma2	.0016936	.0002811			.0012233	.0023447
Gamma	.9647438	.0082858			.9443683	.9778317
sigma_u2	.0016339	.000282			.0010812	.0021866
sigma_v2	.0000597	9.14e-06			.0000418	.0000776

APPENDIX 2: HECKMAN SELECTION MODEL FOR THE PROBABILITY OF TENURE INSECURITY AND THE DURATION OF TENURE SECURITY

Heckman selection model	Number of obs = 1352
(regression model with sample selection)	Censored obs = 1177
Uncensored obs=	175
Wald chi2(37) =	90.28
Log likelihood = -910.7074	Prob > chi2 = 0.0000
Dependent variable: Number of years household can leave uncultivated without losing rights	
Selection:	The probability of the household leaving land uncultivated.

	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
falperiod1						
indigene	-.0912613	.2145584	-0.43	0.671	-.5117881	.3292654
dispute	.3744863	.1741699	2.15	0.032	.0331195	.7158531
TLSU1	.2422814	.0815292	2.97	0.003	.0824871	.4020758
Sex_tenure	.0938562	.2011619	0.47	0.641	-.3004138	.4881262
age	.0145582	.0114924	1.27	0.205	-.0079666	.037083
agesq	.0000176	.0001253	0.14	0.888	-.0002279	.0002632
yrsown	.0030996	.0111177	0.28	0.780	-.0186906	.0248899
South	-.0205769	.1860944	-0.11	0.912	-.3853152	.3441614
North	-.1368272	.2417768	-0.57	0.571	-.6107009	.3370465
deed	-.0560645	.2280568	-0.25	0.806	-.5030477	.3909187

sharecrop	.3423507	.2915395	1.17	0.240	-.2290562	.9137576
familand	.3591895	.2041655	1.76	0.079	-.0409675	.7593465
freeland	-.0962792	.2020986	-0.48	0.634	-.4923852	.2998268
lfrag2	.0244789	.1537797	0.16	0.874	-.2769237	.3258815
perecas	-.1683742	.2369039	-0.71	0.477	-.6326973	.2959489
vegspi	-.2120959	.1921526	-1.10	0.270	-.5887081	.1645164
nontrecas	-.0219216	.1813987	-0.12	0.904	-.3774565	.3336133
sfms2	-.002744	.0085465	-0.32	0.748	-.0194948	.0140068
job	.2026509	.2241536	0.90	0.366	-.236682	.6419839
mktdist	.0067428	.0040007	1.69	0.092	-.0010984	.0145839
Nostrucl	.2312364	.0916396	2.52	0.012	.051626	.4108467
nofulrite	-.2762255	.199115	-1.39	0.165	-.6664837	.1140326
fulrigth	.042913	.1830798	0.23	0.815	-.3159168	.4017427
boundry	.3547861	.155148	2.29	0.022	.0507017	.6588705
pincol	-.0928505	.0939636	-0.99	0.323	-.2770158	.0913149
ab_read	-.2482221	.1695735	-1.46	0.143	-.5805801	.0841359
lvalue2	-.0000115	.000021	-0.55	0.585	-.0000526	.0000297
techinv	.095145	.1504384	0.63	0.527	-.1997089	.3899988
AEA	.2649666	.1416841	1.87	0.061	-.0127291	.5426622
dratio	.2690759	.0867004	3.10	0.002	.0991462	.4390055
tlabor l	.2815704	.3357542	0.84	0.402	-.3764957	.9396365
sand	-.8004681	.3022498	-2.65	0.008	-1.392867	-.2080694
loam	-.7687884	.3075406	-2.50	0.012	-1.371557	-.1660199
liteclay	-.7849351	.347875	-2.26	0.024	-1.466758	-.1031126
haviclay	-.670088	.5744411	-1.17	0.243	-1.795972	.4557959

mixsoil	-.6638429	.338678	-1.96	0.050	-1.32764	-.0000462
fert	.3530171	.1489216	2.37	0.018	.0611362	.644898
_cons	1.734277	.7754455	2.24	0.025	.2144316	3.254122

indigene	.4007381	.0934641	4.29	0.000	.2175518	.5839244
TLSU1	.0311722	.0278116	1.12	0.262	-.0233375	.0856818
Sex tenure	.0655023	.105394	0.62	0.534	-.1410661	.2720707
age	-.0046933	.0060866	-0.77	0.441	-.0166229	.0072363
agesq	.0000167	.0000659	0.25	0.800	-.0001124	.0001458
yrsown2	.0040479	.0047956	0.84	0.399	-.0053512	.013447
South	-.0079113	.089792	-0.09	0.930	-.1839004	.1680778
North	-.0472628	.1168359	-0.40	0.686	-.276257	.1817313
hhsize	-.0409698	.0139401	-2.94	0.003	-.0682919	-.0136477
deedl	.6518711	.0950236	6.86	0.000	.4656283	.8381138
sharecropl	-.5149728	.1172255	-4.39	0.000	-.7447305	-.285215
familandl	-.1090335	.088092	-1.24	0.216	-.2816907	.0636236
freelandl	-.1507382	.0839183	-1.80	0.072	-.315215	.0137386
lfrag2	-.0518161	.0661273	-0.78	0.433	-.1814234	.0777911
sfms2	.0042616	.0059325	0.72	0.473	-.0073659	.0158891
job	.0550643	.1032532	0.53	0.594	-.1473081	.2574368
mktdist	.0014045	.0016978	0.83	0.408	-.0019231	.0047322
Nostrucl	.0410217	.045718	0.90	0.370	-.048584	.1306274
nofulrite	.1773354	.1009469	1.76	0.079	-.0205168	.3751876
fulrigth	.0378129	.0901967	0.42	0.675	-.1389695	.2145952

boundry	-.0778303	.0788941	-0.99	0.324	-.2324598	.0767992
ab_read	.107108	.086654	1.24	0.216	-.0627307	.2769467
yrseduc	.039399	.0090425	4.36	0.000	.021676	.0571221
_ cons	-2.161574	.2562176	-8.44	0.000	-2.663751	-1.659397

/athrho	-.8092126	.2269576	-3.57	0.000	-1.254041	-.364384
/lnsigma	-.0270537	.1300325	-0.21	0.835	-.2819127	.2278053
rho	-.6691557	.1253329			-.849413	-.3490697
sigma	.973309	.1265618			.7543395	1.255841
lambda	-.6512952	.2023247			-1.047844	-.2547462

LR test of indep. eqns. (rho = 0): chi2(1) = 9.45 Prob > chi2 = 0.2021

APPENDIX 3: REGRESSION OUTPUT OF THE DETERMINANTS OF THE PROBABILITY OF TENURE SECURITY AND THE DURATION OF TENURE SECURITY

Probit regression			Number of obs	=	1339
			Wald chi2(24)	=	819.12
			Prob > chi2	=	0.0000
Log pseudolikelihood	=	-1575.6817	Pseudo R2	=	0.4288
Dependent variable: The probability that the household can leave land uncultivated					

can_falowl	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
indigene	-.3270708	.0610996	-5.35	0.000	-.4468238	-.2073178
TLSU1	.0424453	.0360442	1.18	0.239	-.0282001	.1130906
Sex tenure	-.0867762	.0788738	-1.10	0.271	-.2413661	.0678137
age	.0216808	.0058612	3.70	0.000	.010193	.0331685
agesq	-.00903	.0000644	-1.40	0.161	-.0002164	.0000359
yrsown3	-2.120246	.2314415	-9.16	0.000	-2.573863	-1.666629
South	-.0565952	.065657	-0.86	0.389	-.1852805	.0720901
North	-.0285275	.0877652	-0.33	0.745	-.2005441	.1434892
hhsize	-.0073607	.0090891	-0.81	0.418	-.025175	.0104537
deedl	-.7643384	.0745318	-10.26	0.000	-.9104181	-.6182587
sharecropl	.0451943	.0647868	0.70	0.485	-.0817856	.1721742
familand3	-1.165486	.0586301	-19.88	0.000	-1.280399	-1.050573
freeland3	.127112	.0508998	2.50	0.013	.0273503	.2268738

lfrag2	-.0270039	.0360578	-0.75	0.454	-.0976758	.043668
sfms2	-.0130871	.0039293	-3.33	0.001	-.0207884	-.0053858
job	-.3159983	.075167	-4.20	0.000	-.4633228	-.1686738
mktdist	-.0012956	.0012907	-1.00	0.315	-.0038254	.0012341
Nostrucl	-.1621983	.0357352	-4.54	0.000	-.2322379	-.0921586
nofulrite	.167871	.0783862	2.14	0.032	.0142369	.3215051
fulrigth	.4491641	.0709896	6.33	0.000	.310027	.5883011
boundry	.078509	.0562977	1.39	0.163	-.0318326	.1888505
ab_read	-.0256813	.0652751	-0.39	0.694	-.1536181	.1022556
lvaluel	.0091054	.0053678	1.70	0.090	-.0014153	.019626
yrseduc	-.0638959	.0075258	-8.49	0.000	-.0786462	-.0491456
_cons	1.966464	.2132147	9.22	0.000	1.548571	2.384357

Tobit regression			Number of	obs	=	1352
			F(37,	1302)	=	11.71
			Prob > F		=	0.0000
Log pseudolikelihood	=	-1472.5779	Pseudo R2		=	0.0900
Dependent variable: Number of years households can leave land uncultivated without losing rights						

falperiodl	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
indigene	.7128092	.1872268	3.81	0.000	.34551	1.080108
dispute	-.1966418	.3782318	-0.52	0.603	-.9386522	.5453686

TLSU1	.402202	.0596373	6.74	0.000	.2852064	.5191977
Sex tenure	.7239328	.2351959	3.08	0.002	.2625283	1.185337
age	.0091016	.0125693	0.72	0.469	-.0155567	.03376
agesq	.73806	.0001255	0.06	0.953	-.0002388	.0002536
yrsown	-.0306766	.0127622	-2.40	0.016	-.0557133	-.0056399
South	-.1696943	.2079774	-0.82	0.415	-.5777019	.2383133
North	-.5566004	.2567205	-2.17	0.030	-1.060232	-.0529692
deed	1.519453	.240371	6.32	0.000	1.047897	1.99101
sharecrop	-.1797877	.3063462	-0.59	0.557	-.7807739	.4211986
familand	1.237203	.1967925	6.29	0.000	.8511378	1.623268
freeland	.8943238	.2200117	4.06	0.000	.4627076	1.32594
lfrag2	.2548402	.1125899	2.26	0.024	.0339627	.4757176
perecas	.0778902	.2769782	0.28	0.779	-.4654823	.6212626
vegspi	.0375981	.2196274	0.17	0.864	-.3932642	.4684605
nontrecas	.0259195	.2034958	0.13	0.899	-.373296	.425135
sfms2	-.0113967	.0176884	-0.64	0.519	-.0460975	.0233041
job	-.1006438	.2140813	-0.47	0.638	-.5206258	.3193383
mktdist	-.0050285	.0040169	-1.25	0.211	-.0129089	.0028519
Nostrucl	.5523309	.0700852	7.88	0.000	.4148385	.6898232
nofulrite	.2200912	.2184062	1.01	0.314	-.2083754	.6485578
fulrigth	.6006792	.1873051	3.21	0.001	.2332264	.968132
boundry	.248874	.1747259	1.42	0.155	-.0939012	.5916492
pincol	-.247719	.0892332	-2.78	0.006	-.4227755	-.0726624

ab_read	-.2137913	.1798978	-1.19	0.235	-.5667127	.1391301
lvalue2	-.0021075	.0005367	-3.93	0.000	-.0031605	-.0010546
techinv	-.1607247	.1649713	-0.97	0.330	-.4843633	.1629139
AEA	.1633935	.1827254	0.89	0.371	-.1950749	.521862
dratio	-.0095234	.1029471	-0.09	0.926	-.2114838	.1924369
tlaborl	.6253692	.10368	6.03	0.000	.4219711	.8287673
sand	.1409944	.3371945	0.42	0.676	-.5205097	.8024985
loam	.3181292	.3258913	0.98	0.329	-.3212004	.9574588
liteclay	-.1634846	.3798014	-0.43	0.667	-.9085743	.581605
haviclay	.5751639	.4891396	1.18	0.240	-.3844242	1.534752
mixsoil	-.4674867	.3673682	-1.27	0.203	-1.188185	.2532117
fert	.1345388	.1676624	0.80	0.422	-.1943791	.4634568
_ cons	-2.510323	.6770552	-3.71	0.000	-3.838561	-1.182084
/sigma	2.204844	.0699819			2.067555	2.342134

Obs. summary: 862 left-censored observations at falperiodl<=1
477 uncensored
observations 0 right-
censored observations

APPENDIX 4: HECKMAN SELECTION MODEL FOR THE DETERMINANTS OF THE PROBABILITY AND LEVEL OF INVESTMENT

Heckman selection model		Number of obs =	1352			
(regression model with sample selection)		Censored obs =	640			
Uncensored obs=	712					
Wald chi2(38) =	225.35					
Log pseudolikelihood = -6272.969		Prob > chi2 =	0.0000			
Dependent variable: Expenditure (GH0) on soil and water and irrigation investment						
Selection:	Decision to invest in soil and water conservation and irrigation					

	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
SEXeff	-23.34909	32.95793	-0.71	0.479	-87.94545	41.24727
age	10.83964	3.110885	3.48	0.000	4.742416	16.93686
agesql	-103.5772	28.47542	-3.64	0.000	-159.388	-47.76637
hhsize	-6.996159	2.236658	-3.13	0.002	-11.37993	-2.612389
dratio	-10.58259	7.555271	-1.40	0.161	-25.39065	4.225472
tlaborl	-31.68539	28.59363	-1.11	0.268	-87.72788	24.35711
TLSU1	1.598141	6.871616	0.23	0.816	-11.86998	15.06626
AEA	-18.31311	13.96602	-1.31	0.190	-45.68601	9.059776
basedu	-25.7322	18.94791	-1.36	0.174	-62.86941	11.40502
noedu	-74.5736	32.31231	-2.31	0.021	-137.9046	-11.24264
totArea	.0744123	1.445752	0.05	0.959	-2.75921	2.908035

_ IMIDAZONE_2	2.056199	27.6973	0.07	0.941	-52.22951	56.34191
_ IMIDAZONE_3	41.75958	34.61074	1.21	0.228	-26.07622	109.5954
freeland	-70.57588	28.8303	-2.45	0.014	-127.0822	-14.06953
familand	-33.88455	23.61325	-1.43	0.151	-80.16568	12.39658
sharecrop	9.263624	26.50094	0.35	0.727	-42.67726	61.20451
rentland	9.793231	29.75	0.33	0.742	-48.5157	68.10216
pinco	.0266743	.0059778	4.46	0.000	.0149581	.0383905
vput_area	-25.00521	12.79508	-1.95	0.051	-50.0831	.0726863
duracont	.5915349	1.680729	0.35	0.725	-2.702633	3.885702
mktdist	-1.34206	.8209596	-1.63	0.102	-2.951111	.2669914
shh_zfs2	3.35694	19.5194	0.17	0.863	-34.90039	41.61427
lfrag2	-38.52272	9.790615	-3.93	0.000	-57.71197	-19.33347
deed	58.19217	30.24789	1.92	0.054	-1.092604	117.4769
nodeed	87.98958	17.23569	5.11	0.000	54.20825	121.7709
yrsownl	6654.175	2391.082	2.78	0.005	1967.74	11340.61
ALTWASORS	-46.20875	32.82423	-1.41	0.159	-110.5431	18.12556
drainl	23.51226	83.44245	0.28	0.778	-140.0319	187.0565
techinv	44.75083	15.80268	2.83	0.005	13.77814	75.72351
cmktpart	-3.500507	18.89249	-0.19	0.853	-40.5291	33.52809
perecas	8.374242	20.12236	0.42	0.677	-31.06487	47.81335
nontrecas	5.329816	11.26849	0.47	0.636	-16.75603	27.41566
vegspi	49.64566	20.59834	2.41	0.016	9.273654	90.01767
sand	19.63263	21.32797	0.92	0.357	-22.16942	61.43468
loam	12.35428	15.40626	0.80	0.423	-17.84144	42.54999
liteclay	6.928656	33.6892	0.21	0.837	-59.10096	72.95827

haviclay	15.55444	20.88761	0.74	0.456	-25.38451	56.4934
mixsoil	48.94159	22.58015	2.17	0.030	4.68531	93.19788
_ cons	-160.6817	85.72241	-1.87	0.061	-328.6946	7.331132

inv						
SEXeff	.3642781	.099375	3.67	0.000	.1695066	.5590495
age	-.0216957	.0052558	-4.13	0.000	-.0319968	-.0113946
agesq	.0001639	.0000512	3.20	0.001	.0000636	.0002642
dratio	-.0833881	.035035	-2.38	0.017	-.1520555	-.0147208
tlabor	-.0001795	.0000603	-2.98	0.003	-.0002976	-.0000613
TLSU	-.0071037	.0036262	-1.96	0.050	-.0142109	3.56e-06
AEA	-.0301136	.0556933	-0.54	0.589	-.1392706	.0790433
basedu	.2240508	.0404449	5.54	0.000	.1447802	.3033213
noedu	.2243459	.0909848	2.47	0.014	.0460191	.4026728
totArea	-.0190236	.0076924	-2.47	0.013	-.0341004	-.0039467
IMIDAZONE_2	.4420198	.0825642	5.35	0.000	.2801971	.6038426
_IMIDAZONE_3	.8691896	.1201953	7.23	0.000	.633611	1.104768
freeland	-.2755932	.0627691	-4.39	0.000	-.3986185	-.152568
sharecrop	-.3900771	.074497	-5.24	0.000	-.5360886	-.2440655
mktdist	-.0159166	.0049445	-3.22	0.001	-.0256077	-.0062255
shhzfs2	.2734449	.0869573	3.14	0.002	.1030117	.4438782
lfrag2	.204148	.0502917	4.06	0.000	.1055781	.3027179
deed	.0818554	.09758	0.84	0.402	-.1093979	.2731087
nodeed	.1950119	.0707253	2.76	0.006	.056393	.3336309
rentland	-.1485367	.0700016	-2.12	0.034	-.2857373	-.0113362

yrsown	-.0142554	.0041861	-3.41	0.001	-.0224601	-.0060508
ALTWASORS	.7884752	.0762843	10.34	0.000	.6389606	.9379897
fence	-4.857173	.1209709	-40.15	0.000	-5.094271	-4.620074
perecas	.012831	.1026399	0.13	0.901	-.1883394	.2140014
nontrecas	-.1001902	.0669697	-1.50	0.135	-.2314483	.031068
vegspi	.2100391	.0661302	3.18	0.001	.0804263	.3396518
soil_depth	.0030902	.0155904	0.20	0.843	-.0274664	.0336468
VputArea	.000448	.0000924	4.85	0.000	.0002668	.0006291
techinv	.0600756	.0520618	1.15	0.249	-.0419635	.1621148
drain	.000133	.0003099	0.43	0.668	-.0004744	.0007405
_ cons	-1.297058	.2207614	-5.88	0.000	-1.729742	-.8643732
/athrho	-.0354104	.0887237	-0.40	0.69	-.2093056	.1384848
/lnsigma	5.040624	.0676007	74.56	0.000	4.908129	5.173119
rho	-.0353956	.0886125			-.2063017	.1376062
sigma	154.5665	10.4488			135.3859	176.4644
lambda	-5.470977	13.74113			-32.40309	21.46113

Wald test of indep. eqns. (rho = 0 chi2(1) = 0.16 Prob > chi2 = 0.6898

APPENDIX 5: REGRESSION OUTPUT OF DETERMINANTS OF THE DECISION TO INVEST AND LEVEL OF INVESTMENT

inv	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
SEXeff	.4065857	.097128	4.19	0.000	.2162183	.5969531
age	-.0240942	.0091842	-2.62	0.009	-.0420949	-.0060935
agesql	.1754661	.0862719	2.03	0.042	.0063764	.3445558
dratio	.0101008	.0309886	0.33	0.744	-.0506357	.0708373
tlaborl	.0733738	.0342369	2.14	0.032	.0062708	.1404769
TLSUI	-.0343038	.0386134	-0.89	0.374	-.1099848	.0413771
AEA	-.0130555	.0539128	-0.24	0.809	-.1187227	.0926117
basedu	.2133212	.0382249	5.58	0.000	.1384017	.2882407
noedu	.2884209	.0856576	3.37	0.001	.1205351	.4563068
totArea	-.0156289	.007532	-2.08	0.038	-.0303913	-.0008666
_ IMIDAZONE_2	.4404409	.0796301	5.53	0.000	.2843687	.5965131
_IMIDAZONE_3	.7883721	.1149534	6.86	0.000	.5630675	1.013677
freeland	-.3087409	.0601905	-5.13	0.000	-.4267121	-.1907697
sharecrop	-.23232	.0676239	-3.44	0.001	-.3648605	-.0997795
mktdist	-.0140734	.0038505	-3.65	0.000	-.0216202	-.0065266
shh_zfs2	.1805529	.0877939	2.06	0.040	.00848	.3526257
lfrag2	.1829602	.0510487	3.58	0.000	.0829065	.2830138
Dura_ten	.1389064	.0554979	2.50	0.012	.0301326	.2476802
nodeed	-.0136872	.0944759	-0.14	0.885	-.1988565	.1714822

deed	.1633521	.0676184	2.42	0.016	.0308225	.2958817
rentland	-.1173967	.0654875	-1.79	0.073	-.2457499	.0109565
yrsownl	-4.372857	3.928187	-1.11	0.266	-12.07196	3.326249
ALTWASORS	.9210136	.0710472	12.96	0.000	.7817637	1.060264
perecas	.0198256	.100206	0.20	0.843	-.1765746	.2162258
nontrecas	-.1275008	.0625564	-2.04	0.042	-.2501091	-.0048924
vegspi	.235007	.062406	3.77	0.000	.1126935	.3573204
soil_depthl	25.8536	14.58295	1.77	0.076	-2.728447	54.43565
vput_area	.4721831	.0886083	5.33	0.000	.298514	.6458523
techinv	.077145	.0498203	L55	0.122	-.020501	.174791
drainl	-.1371378	.3398898	-0.40	0.687	-.8033095	.5290338
_ cons	-1.50854	.2811718	-5.37	0.000	-2.059627	-.9574536

Dependent variable: Decision to invest in soil and water conservation and irrigation

Tobit regression			Number of	obs	=	1352
			F(38,	1352	=	11.30
			Prob > F		=	0.0000
Log pseudolikelihood	=	-4034.3159	Pseudo R2		=	0.0596

Dependent variable: Expenditure (GM on soil and water and irrigation investment

invexp	Coef.	Std. Err.	T	P>t	[95% Conf.	Interval]

SEXeff	-102.1851	36.46054	-2.80	0.005	-173.6708	-30.69944
Age	11.62299	6.032271	1.93	0.054	-.2040689	23.45005
agesql	-146.8364	58.72257	-2.50	0.012	-261.9697	-31.70312
Hhsize	28.53395	3.9584	7.21	0.000	20.77299	36.29492
Dratio	-90.24145	17.4334	-5.18	0.000	-124.4219	-56.06097
tlaborl	19.66289	21.63633	0.91	0.364	-22.75798	62.08376
TLSU1	-23.8377	21.5921	-1.10	0.270	-66.17184	18.49644
AEA	88.5725	27.28931	3.25	0.001	35.06823	142.0768
Basedu	-32.13798	19.5568	-1.64	0.100	-70.48165	6.205684
Noedu	-121.8411	40.14054	-3.04	0.002	-200.542	-43.14033
totArea	-7.816778	4.125577	-1.89	0.058	-15.90551	.2719578
_ IMIDAZONE_2	138.6426	39.25777	3.53	0.000	61.6726	215.6126
_ IMIDAZONE_3	326.5296	63.93848	5.11	0.000	201.1698	451.8893
freeland	-47.08218	45.55029	-1.03	0.301	-136.3895	42.22515
familand	-39.49917	44.07852	-0.90	0.370	-125.9209	46.92256
sharecrop	6.155027	39.78337	0.15	0.877	-71.84549	84.15555
pincol	17.57917	10.25334	1.71	0.087	-2.523848	37.68219
VputArea	.1187927	.0188284	6.31	0.000	.0818771	.1557083
duracont	17.43486	4.153729	4.20	0.000	9.290929	25.57879
Mktdist	-1.98307	1.541759	-1.29	0.198	-5.00589	1.03975
shhzfs2	51.81045	50.23385	1.03	0.302	-46.67962	150.3005
lfrag2	-36.76662	16.13203	-2.28	0.023	-68.39558	-5.137652
Dura ten	281.6785	26.73547	10.54	0.000	229.2601	334.0969
deed	150.3289	44.53211	3.38	0.001	63.01788	237.64
nodeed	67.40127	37.42133	1.80	0.072	-5.968167	140.7707

rentland	93.58058	43.59053	2.15	0.032	8.115617	179.0455
yrsown	-7.150562	4.260318	-1.68	0.093	-15.50348	1.202352
ALTWASORS	258.0953	33.1152	7.79	0.000	193.1686	323.022
drainl	213.7851	108.114	1.98	0.048	1.813342	425.7568
techinv	35.74799	24.58388	1.45	0.146	-12.45194	83.94791
perecas	61.98451	58.68949	1.06	0.291	-53.08395	177.053
nontrecas	-83.32273	29.28989	-2.84	0.004	-140.7494	-25.89605
vegspi	39.78426	34.78415	1.14	0.253	-28.41463	107.9832
sand	82.36154	49.04539	1.68	0.093	-13.7984	178.5215
loam	11.86783	45.82293	0.26	0.796	-77.97403	101.7097
liteclay	-74.62418	59.20809	-1.26	0.208	-190.7094	41.46106
haviclay	-121.0221	71.19755	-1.70	0.089	-260.6143	18.57001
mixsoil	18.54648	49.99985	0.37	0.711	-79.48479	116.5778
cons	-1062.186	206.2269	-5.15	0.000	-1466.521	-657.8508

APPENDIX 6: FIELD MEANS OF VARIABLES CONTAINED IN THE EMPIRICAL MODELS

Variable	Obs	Mean	Std. Dev.	Min	Max
SEXeff	13415	.8811778	.3235913	0	1
Age	13480	46.82985	12.95395	18	99
Agesq	13480	2360.827	1332.992	324	9801
TLU	9905	2.452188	7.881467	.009	161.7945
AEA	10431	.5346563	.4988214	0	1
Basedu	17521	.6603504	.9405789	0	2
Noedu	17521	.3328006	.4712293	0	1
TotArea	13480	12.68399	11.94108	.0024711	150.66
South	13480	.2367211	.4250854	0	1
North	13480	.373368	.4837165	0	1
Freeland	13480	.2637982	.4407075	0	1
Sharecrop	13480	.0566766	.2312321	0	1
Familand	13480	.3884273	.4874107	0	1
Deed	13480	.0524481	.2229371	0	1
Nodeed	13480	.3173591	.4654657	0	1

Pinco	12162	351.7471	2142.446	.0939335	82512.33
VputArea	12483	53.75702	364.0098	0	21590.69
Duracont	12085	9.947042	8.496763	1	46
Mktdist	11559	2.168449	15.34306	0	500
shh_zfs2	13480	.9531962	.9795919	.0001409	19.52118
lfrag2	14443	.5631554	.7995787	.0107527	9.875785
Nostruc	13480	.141543	.48188	0	9
Dispute	14443	1.970436	.1693884	1	2
Yrsown	10801	8.925192	6.522366	1	28
Drain	12008	21.58386	72.48455	1	2880
Techinv	11403	.3419276	.4743763	0	1
Cmktpart	13480	.1928042	.3945152	0	1
Perecas	14443	.0346188	.1828188	0	1
Nontrecas	14443	.2050128	.403725	0	1
Vegspi	14443	.1442914	.3513971	0	1
Asval	13418	5150.017	13232.29	0	255850
Fmlabor	10640	51.46852	149.7681	0	3651
Fflabor	10640	34.85273	147.0398	0	3200
soil_depth	15606	3.360502	1.720819	1	6

Sand	17521	.1623195	.3687542	0	1
Loam	17521	.2991268	.4578885	0	1
Liteclay	17521	.085954	.2803041	0	1
Haviclay	17521	.0327036	.1778648	0	1
Gravel	17521	.0557046	.2293569	0	1

Variable	Obs	Mean	Std. Dev.	Min	Max
Dratio	13480	1.071587	.9240318	0	10
Hhsize	13480	6.177819	3.063499	1	18

Variable	Obs	Mean	Std.	Dev.	Min	Max
Educat	5785	2		0	2	2

Variable	Obs	Mean	Std. Dev.	Min	Max
ab_read	17521	.2293819	.4204473	0	1
Variable	Obs	Mean	Std. Dev.	Min	Max
Qkg	9411	1637.495	14865.89	.55	787500
TotArea	13480	12.68399	11.94108	.0024711	150.66
Pinput	14443	37.93316	209.8388	0	15023

Tlabor	10640	265.9244	572.6855	1	13167
ALTWASORS	13480	.1378338	.3447383	0	1
Swcons	13480	.0416172	.1997202	0	1
soil_depth	15606	3.360502	1.720819	1	6

Variable Obs	Mean	Std. Dev.	Min	Max	
Inv	13480	.1887982	.3913628	0	1
Invexp	13480	36.78631	980.2843	0	76200