The Effect of Tenure Security and Land Fragmentation on Productivity and Investment in Smallholder Agriculture: Evidence from Tiyo Woreda, Arsi, Ethiopia

By

Amare Teklu

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By
Amare Teklu Yirbecho
Faculty of Business and Economics

Approval by Board of Examiners:

Dr. Assefa Admassie
Advisor

Signature

Dr. Andre Croppenstedt
Examiner

Signature

Dr. Mulat Demeke
Examiner

Signature

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ABSTRACT

Heavy state intervention over rural lands, lack of established legal and institutional framework to access, use and transfer land has caused land tenure insecurity in Ethiopia. At the same time, population pressure, periodic land redistribution and inheritance practices led to subdivision of holdings as the number of young landless farmers grew up with no alternative off-farm employment opportunity. Despite the prevalence of the problem, there have not been rigorous empirical investigations that explicitly address the issue of tenure insecurity and land fragmentation in relation to agricultural productivity in Ethiopia.

This study is undertaken to investigate whether the existing land tenure system in Ethiopia affects farm productivity and resource management practices. Specifically, it tests the general hypothesis that tenure insecurity and fragmentation of holdings undermine productivity and discourage land improvements. Based on a household survey data from Arsi, the study has supported the proposition that land tenure insecurity and fragmentation have significant effect on productivity and land improving investments.

Though the study does not provide evidence to support the direct impact of tenure insecurity on input application, the results implied that the disincentive effects of tenure insecurity on land improvements could contribute to lower productivity of land in the long-term. Fragmentation of holdings, on the other hand, is found to undermine productivity directly by affecting the management of farming operations as well as through its negative effect on input use. The study also found that land fragmentation discourages farmers' incentive to manure their fields.

CHAPTER - I INTRODUCTION

The predominantly customary land tenure systems that prevailed in sub-Saharan Africa have become major research and policy concern, as the ability of these indigenous systems to accommodate the demands of the growing population, agricultural commercialization and market integration comes into question. Unlike the western style privatized and exclusive land ownership system, these systems allow community or state controlled land access with specified (restricted) use and transfer rights based on membership to a specific social group or residence to a specific locality. As population increases and land becomes scarce, the land tenure system provides land access to the growing land claimants through non-market mechanisms such as customary inheritance, informal land contracts, or state sponsored land redistribution. The persistence of such land access mechanisms and absence of established legal framework underlying the process has resulted in increasing land tenure insecurity and continued land fragmentation that have become a growing concern for policy makers and researchers.

1.1 The problem and objectives of the study

Lack of legal mechanism to ascertain ownership, the power of the state or local community to decide over individual holdings and absence of reciprocal compensatory provisions have resulted in a growing feeling of uncertainty over individual holdings. Such a feeling of insecurity over landholding is believed to have serious consequences on farmer decision making. It shortens farmer's time horizon discouraging him from taking long-term actions and hence undermines the demand for investment on land. Insecurity of tenure, on the other hand, curtails investment supply by reducing the credit worthiness of land. Insecure tenure also undermines the tradability of land and causes inefficiency by hampering the gains from trade. The overall impact, thus, being very low investment on land and inefficient cultivation.

When farms become smaller and fragmented, farm operation becomes costly as transportation and management cost of labour and other inputs increases. It becomes uneconomical to undertake land-improving investments that require larger scales of operation, thus reducing the incentive for long-term land improving investments. Consequently, fragmentation of holdings is believed to contribute to unwise use of resources and environmental degradation.

In Ethiopia, the strong hold of the state over rural lands since 1974 and its subsequent actions of land allocation through redistribution, collectivization, villagization and resettlement programmes, which were taken without the consent of the holders and with no compensation for lost property, have sown the seeds of tenure insecurity. No farmer feels immune from further land redistribution that may affect his holding, and there is no legal document or established mechanism through which to ascertain the existing holding. The new constitution of 1994 which reaffirmed the state ownership of rural lands and the subsequent land redistribution measures carried out by some regional states have all but confirmed once again that rural land holding is not farmers' choice variable. Thus, there is a general feeling of insecurity over individual land holdings in rural Ethiopia. With repeated redistribution and physical relocation of land based on family size and equal opportunity to accommodate the growing population individual land holding has been reduced and farms have become more fragmented.

What are the consequences of tenure insecurity and continued fragmentation of holdings on the way farmers allocate their resources? Did tenure insecurity and land fragmentation contribute to the lower level of agricultural productivity and farm investment, and to the continued resource degradation, which characterizes the smallholder agriculture in Ethiopia? If so, can increased tenure security and/or less fragmented holdings enhance efficiency of resource use and investment? If the land tenure situation is indeed a constraint to increased productivity and

investment, then policies that emphasize the role of improved technology, agricultural extension, credit provision and price incentives will not bring the desired outcomes. The answers to the above questions have strong implications on development policies that are aimed at raising productivity, enhance investment and facilitate the path for sustainable development in the agricultural sector, in particular, the smallholder agriculture.

However, the diversity and complexity of customary land tenure systems have made it difficult to have a clear understanding and consensus on their impact on agricultural productivity and investment. Several empirical investigations have come up with mixed results. The fact that the system for the most part is ruled by customary values has made it difficult to have a clear understanding of the workings of the system in the context of economic theory. Thus, an empirical investigation based on the specific circumstances of a country is highly required.

The objective of this study, in general, is to investigate the effect of the prevailing land tenure system on agricultural productivity and resource management practices, in the context of the smallholder agriculture in the Ethiopian highlands. Under this general objective, the study specifically attempts to accomplish the following purposes:

- Determine whether and to what extent the existing land tenure system caused tenure insecurity and land fragmentation;
- Explore the links between tenure insecurity, productivity, and investment;
- Explore the links between degree of land fragmentation, productivity and investment in the context of the smallholder agriculture in Ethiopia, and

1.2 Scope and significance of the study

This study, based on primary data collected in one of the most productive regions of the country, attempts to show how land tenure insecurity and fragmentation affects farmers' decision in allocating their resources. However, Ethiopia is a country of differences, with different agroecological environments and farming systems, diverse cultural settings as well as varying man-land ratio across regions. Because of these, the degree of the problems of tenure insecurity and land fragmentation as well as their effect on farmers' actions may vary from region to region. Particularly, the issue of tenure in regions producing annual crops is different from those producing perennial crops. For this reason the scope of this study is limited to the mixed farming systems of Ethiopian highlands that are based on rain-fed agriculture and producing annual crops. Thus, the outcomes of the study cannot be taken as a general evaluation of the overall land tenure system in the country. But, it can be extrapolated to regions of similar agroecological and socioeconomic settings.

The outcome of this study, in general, shades light on the ongoing debate on the effect of land tenure system on agricultural productivity and resource management by providing empirical evidence. Particularly, in this important moment in Ethiopia, where no sustainable land access mechanism has been put into place yet, the results of the study can be important empirical evidence on the possible gains or losses of policy interventions in land matters. The study can induce a policy awakening effect by presenting evidences on the consequences of the land tenure system on agricultural productivity and resource management.

As there is a lack of well-tested empirical study in Ethiopia with regard to the effect of property right institutions on agricultural productivity, the results of the study can provoke similar studies of wider coverage. It adds to the existing stock of knowledge regarding the relationship between

land tenure system and agricultural productivity. It also helps to narrow the research gap in understanding the link between the dynamics of land tenure system and farmer resource use decisions and practices.

2.1 Land tenure in the Pre –1975 period

Like in most agrarian societies, land was the major source of livelihood for the ruled and the key instrument of power and influence for the rulers and the issue of land tenure was the issue of power and governance in feudal Ethiopia. Owing to the diverse agroecological and cultural settings and shaped by the different historical and socio-political events that occurred in different parts of the country, the land tenure system varied from region to region. According to the specific tradition and agroecological setting, different types of land tenure arrangements existed in different parts of the country, which provided different levels of use and transfer rights for holders. For analytical purpose, the different land tenure arrangements, in general, can be categorized into two: usufructuary tenures and private tenures (Dessalegne, 1984).

The 'rist' system was one of the oldest and most common forms of usufructuary tenures that characterized the land tenure system of northern Ethiopia. Under this system, land holding was primarily based on hereditary rights subject to the payment of taxes and other services to the local administration or 'gult' (Hoben, 1973). Holders of 'rist' right can inherit their holdings, but cannot sell, mortgage or exchange it in any form. Those who hold 'gult' rights over these 'rist' lands had the right to collect taxes and provide judiciary services. This land tenure system featured communal characteristics and provided somewhat an assured access to land to all members of the community and protected the security of individual holdings by honoring hereditary rights and denying access to outsiders. However, the tradition of 'fair' subdivision of holdings to heirs had led to a continuing fragmentation of holdings in the densely populated northern highlands where this form of tenure dominated.

Though the 'rist' system was the major form of land tenure system in the northern part of the country, it was later introduced to some parts of the south and central regions after the latter came under the control of the Emperial regime at the beginning of the century.

The 'semon' and 'maderia' or 'yemengist' were another forms of usufructuary tenures whose primary reversionary rights were held by the church and the state, respectively. Holders of 'semon' land had the right to lease out or inherit it, subject to tribute and services provided to the church. But they cannot sell, mortgage or exchange it in any form. 'maderia' or 'yemengist' lands were originally unoccupied lands that were declared state property. These state lands were granted to individuals in lieu of their loyal or patriotic service to the crown. These lands can be leased out temporarily, but cannot be inherited or sold out. Most of such lands were found in the conquered areas of the south.

All the 'rist', 'semon' and 'maderia' or 'yemengist' tenures were similar in the sense that all provided use rights to the holder while institutions held the ultimate reversionary rights over individual holdings. These institutions are the community for 'rist', the church for 'semon' and the state for 'maderia' and 'yemengist' lands. Thus, the security of tenure on individual holdings was highly dependent on the holder's relationship to the institution governing his access to land.

After the south, west and eastern parts of the country came under the control of the Emperial government, all occupied (settled) land was expropriated from peasants and chieftains and was given to officials and loyalists of the crown (Dessalegne, 1984). All unoccupied land became the property of the state, which in turn granted it out to men of influence and power, as an instrument to buy loyalty or discourage opposition. This constituted what was called the 'gebbar' system, which is a sort of freehold tenure. Holders of such rights have the right to transfer the land through sale, mortgage or exchange subject to the land tax to be paid to the government treasury. As most of the

occupied land was granted to the powerful and the well connected, the mass of the peasantry in these areas was subjected to coercive tenancy and a very high degree of tenure insecurity. This system somewhat resembled the western style 'private' tenure, but still the state held the ultimate reversionary rights overall such 'private' lands. This tenure system resulted in a high degree of tenure insecurity, inequality of holdings and landlessness, but not land fragmentation, as was the case under the 'rist' system.

The land tenure system in the peripheral areas of the eastern, western and south west lowlands was largely governed by indigenous communal land tenure systems but remained relatively untouched by the social, economic and political developments that plagued the country since the beginning of this century (Hoben, 1996).

The primary beneficiary of the land tenure system in the pre-1975 period was the state itself, as land and the system of access to it provided the major power and wealth base to the ruling aristocracy. Consequently, no significant policy measures were introduced as expected. However, some other factors like the process of modernization and expansion of the state apparatus, industrialization and market expansion as well as population pressure dictated some minor policy reforms. The major one was the abolition of the 'gult' rights and the introduction of administrative and tax reform in 1966 (MLRA, 1967). This measure strengthened 'rist' rights in the north, weakening the power of 'gult' holders and making landholders in direct contact with the state. However, in the south, the policy reform transformed land grants of the state into freeholds, weakening peasants' access to land which led to increased tenure insecurity and massive evictions as commercialization and mechanization came into being (Hoben, 1996).

Overall, the policy attitudes with regard to land tenure were gradually moving towards private or freehold tenure as indicated in the regime's Second Five-Year Plan that put a strong emphasis on

modernization. However, the policy actions were so late to redress the severe consequences of the land tenure system on the peasantry and the overall social, economic and political aspects of the country that led to a sweeping political movement.

2.2 *Land tenure in the Post-1975 period*

The most radical move in the land tenure history of Ethiopia has been made when the military government issued its land reform policy in 1975 that nationalized all rural lands. Among everything else, the 1975 land reform put a uniform land tenure system across the country and abolished all forms of hereditary and traditional rights over land. By doing so, it provided access to land to the deprived peasantry and eliminated tenancy, landlessness, landlordism and exploitation in the south while reducing land-holding inequalities in the north. Usufruct right became all one can get by holding land as all forms of land transactions were prohibited. The power and responsibility to allocate and administer land was given to the local Peasant Associations (PAs), which also serve as the lower administrative unit of the regime.

Since this major agrarian reform, rural farmlands in Ethiopia have belonged to the "people" but controlled by the government. The only formal way of obtaining access to land was through membership in the PAs. In order for newly formed households to obtain crop or pasture lands, the PAs periodically redistributed existing lands between households based on family size and land quality to balance inequality and accommodate landlessness.

Before the applaud for the 'great' land reform even subsided, peasants came under the direct control of the state than ever before and access to land became politicized. Subsequent measures of land redistribution, collectivization, villagization and resettlement programmes have shown peasants who

really decides on their holdings and feelings of tenure insecurity increased.

The practice of land redistribution based on family size and equal opportunity have contributed to land fragmentation (Fasil, 1980). As rapid population growth, degradation and declining productivity of land and static land tenure system constrained land access for small farmers, land fragmentation became one of the coping strategies to tackle the growing problem of landlessness (Aklilu and Tadesse, 1994). Continued land redistribution has also contributed to an increased feeling of insecurity of tenure as average holding declines and physical relocation of land continues which further led to a disinvestment in land (Bruce, Hoben, Rahmato, 1993). Lack of legal provisions to protect holdings and to resolve the conflict between individuals' and state right over land, as have been observed in the coffee growing areas of Keffa, Illubabour and Wolega, has resulted in increased feelings of insecurity over holdings by local farmers as the number of new land claimants increased (Tessema, 1994).

The economic reform of the Derg regime in 1990 that liberalized agricultural marketing also allowed farmer-to-farmer contracts in land, which the 1975 proclamation had outlawed, but with no legal and institutional provisions to support the reform.

In 1991, the new government suspended the system of land distributions but left most other elements of the former land tenure system in place. Redistribution failed as a sustainable mechanism for adjusting to rural demographic dynamics, which is manifested by the growing population of landless farmers. When the new constitution of Ethiopia was drawn in November 1994 it reaffirmed state ownership of rural lands and prohibited land sales and the issue of land redistribution has yet to be clarified.

The land tenure situation has been an issue of high priority in the framework of the recent

economic reform as the current land policy has a dampening effect on the long-term investment gains and hence may hold back increased incomes for the poor which adjustment policies would aim to achieve. In this connection, improved tradability of land with specific instruments for land transfer has been suggested as an important step towards improved long-term productivity in the agricultural sector (World Bank, 1992).

Different arguments have been forwarded with regard to the response of customary land tenure systems to the changing economic and ecological environment. Some of the basic issues are whether the existing land tenure systems provide sufficient tenure security that enable efficient land transfers, wider scope for land improving investments and raising productivity. There are continued arguments regarding the extent and cause of land fragmentation and its effect on productivity and investment. Most of the arguments regarding these issues are based on different theoretical premises, use different methodologies and have come up with different results.

3.1 Land tenure security, Productivity and Investment

Land rights are associated with the right to use and transfer land by the holder as determined by law, custom or specific agreements, depending on the circumstances. Tenure security, in general terms, can be defined as the holder's perception of the likelihood of loosing these rights over land. Clearly defined rights are those that are exclusive to a specific holder, identifiable and legally verifiable (Barrows and Roth, 1990). The existence of such rights and the legal provisions to protect and enforce them constitutes a complete security over the holding of land.

It is widely claimed that increased tenure security enhances better use of land resources. The theoretical framework laid out by neo-classical economists explains the benefits of increased tenure security in terms of increased incentives for investment and reduced uncertainties in land transfers as leading to increased investment demand and efficient use of land (Barrows and Roth, 1990). A secured holding raises the likelihood of realizing the rewards of long-term investments, which motivates holders to demand more investments. A secured holding, on the other hand, lowers the cost of lending because of the higher credit worthiness of the holding and this

reduces the supply price of credit. The combination of higher incentives for investment and cheap credit supply increase investment on land. More capital and land improvements on land increase the productivity of variable inputs used and, consequently, output per unit of land is expected to be higher (Feder, 1986). Feder and Nornoha (1987) used a model of an optimizing farmer to explain and test the effect of tenure security on long-term actions of the farmer. The effect of tenure security on productivity and investment is mainly channelled through the credit market. However, Feder and Nornoha (1987) hold that even if credit is not a binding constraint, tenure security still affects input use and productivity because farmers have less incentive to invest.

The greater security over a holding reduces uncertainties associated in land transfers which reduces transaction costs and leads to efficient allocation of land resources by equalizing factor proportions across farmers through trade. Thus, the presence of secured holdings allocates land resources to those who can put it into its best use, thus raising the level of efficiency of resource use and resulting in an output gain to the society.

Feder and Onchan (1987) in their study in Thailand have found that tenure security, in the form of land title, enhances capital formation by providing better incentives and improved access to credit. The study by Gavian and Fafchamps (1996) in Niger has also supported this positive relationship between tenure security and farm investment when they found out that farmers tend to divert land-improving investments to the more secured holdings. More recently, Hayes and others (1997), studying the customary land tenure in the peri-urban areas of Gambia, have found that tenure security positively affects yields through its effect on long-term investments.

Other studies, on the other hand, have challenged this view with their finding that tenure security has little or no effect on productivity and investment. The studies argue that the extent to which

tenure security can lead to increased investment and efficient land transfers is highly dependent on the ability of the existing rural factor markets to mediate factor exchanges which is so weak in the African context (Barrows and Roth, 1990; Place and Hazell, 1993; Migot-Adholla and et al., 1991). There are empirical evidences on the failure of rural markets in Africa to equalize factor proportions across farmers (Collier, 1987) which put additional element in the understanding of the relationship between tenure security, productivity and investment (Place and Hazell, 1993). Many ambitious measures taken by African policy makers to increase tenure security and thereby bring more efficient use of land resources, like land registration, titling and consolidation, have failed. The basic reason is attributed largely to the fact that the measures have overestimated the efficiency of rural factor markets in mediating the anticipated effects, and overlooked the role played by the indigenous land tenure systems in land transfers and provisions of security through non-market and non-legal mechanisms (Atwood, 1990; Blarel and et al, 1992).

Sjaastad and Bromley (1997) also questioned the validity of the positive relationship between tenure security and investment motives. They argue that under conditions where investments can be recovered even if land is lost and where certain types of investments in land are a legitimate way of claiming more secure rights to land, then the argument that tenure insecurity leads to underinvestment is less convincing. In fact, they have suggested a possibility of reversing the causality in the relationship between tenure security and investment as more investments can lead to more secured rights over land.

In general, despite the theoretically well justified and sound proposition that tenure insecurity inhibits investment and undermines productivity of land, there does not seem to be well-grounded empirical evidence to support it, at least as sound as the theoretical justification is. The results obtained by the various empirical investigations are mixed predicting different relationships and channels of interactions between tenure security, productivity and investment.

These are indications of the limitations of using the neo-classical framework to explain the various forms of customary land tenure systems and the need to have a much wider framework that incorporates institutional aspects and market imperfections in dealing with land tenure issues in sub-Saharan Africa (Barrows and Roth, 1990). Moreover, the complex nature of the relationship between tenure security, productivity and investment has posed methodological difficulties in identifying and handling the various two-way causality and simultaneous relationships in the models used to analyse the interactions, leading to various results for the same issues observed.

3.2 *Land fragmentation, Productivity and Investment*

Land fragmentation is a land holding pattern where a single farm consists of several physically scattered parcels over a wide range of area. As there is no standard and objective measure of land fragmentation, in absolute terms, it is difficult to determine when farms are "too" fragmented. But, in general, one can have a measure of the relative degree of land fragmentation by looking into such parameters as farm size, the number of parcels in a farm, size of parcels relative to the total farm size, spatial distribution of parcels, average and total distance to parcels and even shape of parcels. Accordingly, several indices were used by different researchers to measure fragmentation levels using only some of the parameters (Bentley, 1987).

Land fragmentation is a very common phenomenon in most developing countries, and particularly in Africa. Several factors can lead to fragmentation depending on the particular instance and these can be broadly grouped into supply factors and demand factors (Bentley, 1987). In the former case, fragmentation is an outcome of population growth, customary partible inheritance practices, land redistribution, and inefficiencies in rural factor markets (Blarel and et al., 1992; Bentley, 1987). These factors lead to involuntary fragmentation of holdings, which is

usually associated with adverse consequences on agricultural production. This view has been the main justification for land consolidation programmes that had been carried out in many developing countries to get away with the problem of land fragmentation and the associated effects on productivity and investment.

In the case of demand factors, land fragmentation is considered farmers' choice variable. Here, fragmentation is an outcome of a deliberate check by farmers to spread risk, benefit from ecological diversity or schedule crops (Bentley, 1987). It is argued that such demand driven (voluntary) land fragmentation usually provides better production possibilities and leads to higher productivity and efficient farming. Those who held such view argue that ambitious consolidation programmes may disrupt farmers' risk diversification mechanism and result in inefficient farming, particularly where land quality and the ecological environment are diverse (Blarel and et al, 1992).

The most widely believed effect of land fragmentation is related to farm efficiency. When farmers operate on scattered fields, the travel time between fields increases labour cost and reduces effective time spent on farming, decreasing labour productivity. Similarly, machinery hours, transportation costs and water use will rise and the scope for effective management of farming operation will be severely limited and the overall efficiency of production will be hampered. Land fragmentation also limits the scope for effective water use strategies, like irrigation, and soil conserving investments and also results in the loss of land for boundaries and access routes (Bentley, 1987). When a farm consists of several scattered parcels, land-improving measures would be difficult and costly, and consequently, farmers become reluctant to undertake long-term conservation investments.

Jabarin and Epplin (1994), in their study in Jordan, have shown that land fragmentation increases

input costs and lead to decreasing efficiency. Similarly, Parik and Shah's study in Pakistan (1994) on the measurement of technical efficiency of farming operation have found land fragmentation as one of the factors contributing to farming inefficiency. Bakhshoodeh and Najafi (1991) and Oktay and Yildirim (1980) also confirmed the negative effect of land fragmentation on the efficiency of farming in Iran and Turkey, respectively, and suggested government sponsored land consolidation programmes.

Berry and Cline (1979) argue that farming operation on smaller fields is more efficient than on larger fields and that fragmentation of holdings in this sense could be an advantage to the farmers. However, their study has less relevance to African context as it is based on the comparison of the larger capitalist commercial type farms operated by hired labour with those smaller subsistence farms farmed by family labour and under the assumption of perfect labour, capital and credit markets. In his study in Arsi, Ethiopia, Mulat (1995) has found no relationship between level of fragmentation and technical efficiency of farms, but found that farm size and technical efficiency are positively related. The study by Blarel and others (1992) in Ghana and Rwanda have found no significant relationship between land fragmentation and productivity and investment. They noted that the emphasis should be placed on removing the inefficiencies in rural factor markets that are the root causes of land fragmentation. They maintain that land fragmentation rather benefits farmers in risk management, overcoming seasonal labour shortages and diversifying crops in accordance with soil variation and rule out the need for costly consolidation programmes to raise productivity and facilitate investment.

Empirical investigations regarding the effect of land fragmentation on input use, productivity and investment have come up with mixed results and suggest different policy options to get away with the problem. However, all argue that the continuation of the process of subdivision of individual holdings is undesirable, particularly, when the process is triggered by factors external

to farmers' decision. Land consolidation programmes have not been successful and neither are they favoured by the research results on their desirability. The consensus seems to be centered on the need to further investigate the mechanism through which level of fragmentation affects the level and cost of input use, the resulting outputs as well as long-term investment actions. Such an investigation should clearly take into consideration the performance of rural factor markets in facilitating factor transaction which are crucial for efficient farming.

CHAPTER - IV METHODOLOGY AND DATA

4.1 Conceptual framework and hypotheses

In the brief review of the Ethiopian land tenure system in Chapter II, it is apparent that the problems of continuous subdivision of holdings and increasing tenure insecurity have persisted as a result of rigid land tenure policies in the face of mounting population. Since land tenure insecurity and land fragmentation are critical problems facing the smallholder farmer, the interest here is to investigate whether and how these problems affect farmer's action.

Land tenure insecurity discourages expenditures that increase the productivity of inputs used in the production process. At some point in time, therefore, there will be less stock of land improvement on insecure holdings and, consequently, input use is expected to be less optimal. Less optimal input use leads to lower output per unit of land put under cultivation. Tenure insecurity, thus, undermines yield through its effect on input use. Similarly, it discourages medium and long-term land improving investments. In view of the present situation in the country investments on land are less likely to enhance security of tenure, as is the case in some traditional land tenure systems. Farmers were not compensated for lost property during the past land redistribution, collectivization or villagization schemes and presence of fixed investments have not influenced the way land was allocated. For this reason, we have assumed that tenure insecurity is exogenously determined.

Previous studies (Feder, 1987; Hayes and others, 1997) have not properly accounted for the time lag between perceived tenure insecurity and the observed investment actions. Hayes and others used current perceptions of land rights as a measure of tenure security, which they included in their model to relate it to the stock of investments presently existing on land. However, decision

to undertake these land improvement investments had been influenced by farmer's perception in the past, not by the current perception. Because of the dynamic nature of the socio-economic environment, perceptions with regard to rights over land may change overtime. In Africa, where most of the policies are characterized by inconsistency, ambiguity and arbitrariness, the rapidly changing political environment can easily influence farmers' perception of their rights over land. Thus, the effect of tenure insecurity on investment actions should be analyzed in a dynamic framework that relates perception of 'insecurity' at one time with observed investment actions in the next time. Accordingly, in this study the dynamic nature of investment decision and action is considered by distinguishing between existing stock of investments that were undertaken based on past perception of land rights and flows of investments on land that have been made after the observed perception of land rights.

Land fragmentation is a consequence of population pressure, egalitarian land redistribution and inheritance practices that are external to farmers' decision. The restrictions on land transfers and heavy transaction cost of informal land markets would make it costly for farmers to fragment their holdings deliberately, as the private benefit of doing so would be less than its private cost. Accordingly, it is plausible to assume that the level of fragmentation is exogenously determined.

Land fragmentation primarily affects input application. Cultivation on multiple, far away or even irregularly shaped fields makes it difficult for the farmer to apply inputs effectively. Moving inputs, human and animal labour, farm implements and harvest between fields and homestead is both inconvenient and costly. Thus, higher input cost per unit of land undermines the profitability of working on the land and discourages optimum input use leading to lower productivity of land.

Even if input use remains the same, working on more fragmented holdings affects yield as a

result of the difficulty to manage multiple or far away fields. Thus, degree of fragmentation affects productivity of land indirectly through its effect on input use and directly by hampering effective management strategies of farmers.

Similarly, investment expenditures will not enjoy economies of scale when spend on fragmented holdings. It is economical for a farmer to fence one field than two separate fields with same total area. The same is true for far away fields as cost of investment will be higher and the ability to protect them will be less making them risky. As a result, fragmentation of holdings may discourage long-term investment expenditures on land, which in the long-term leads to lower productivity.

The following flow chart summarizes the channels through which tenure insecurity and land fragmentation affect productivity and investment and describes the basic hypotheses, which this study aims to test.

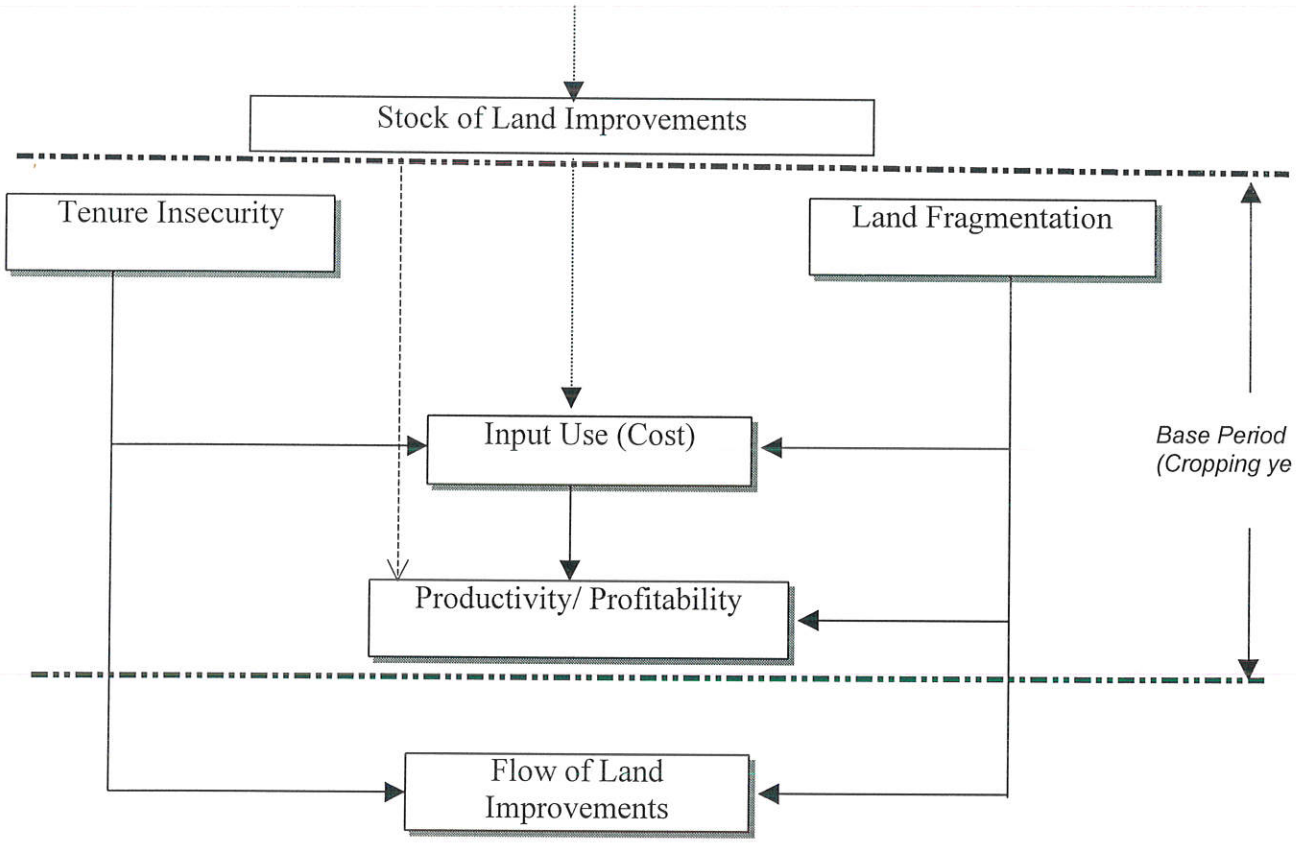

Fig. 1: The relationship between insecurity, fragmentation, productivity and investment

The above conceptual framework implies that there are three testable hypotheses. First, there is a need to test whether tenure insecurity felt by a farmer and the degree of fragmentation of his holdings negatively affect the level of input use. Secondly, it is necessary to test whether the implied negative effect of tenure insecurity and land fragmentation on input use and the direct effect of fragmentation on farm management translate into lower output per unit of land. And thirdly, one has to test whether tenure insecurity and land fragmentation discourage the flow of medium and long-term land improvements.

4.2 The Theoretical Model

To test a hypothesis in a world of economic reality, it is necessary to develop a theoretical model. Based on the conceptual framework discussed above, the hypothesized relationship between tenure insecurity and land fragmentation, and input use, productivity and investment can be modelled in a manner that represents actual economic behaviour and suitable for analytical purposes.

Input Use

It is hypothesized that tenure insecurity and land fragmentation affect input use. To test this hypothesis, it is necessary to model the relationship between input use and its determinants in addition to tenure security and fragmentation variables.

Existing stock of land improvements determine input levels to the extent that they substitute or complement some input types. For example, a farmer may not find it necessary to apply fertilizers if the field is already well manured, fallowed or croprotated. In this particular instance, input use will be lower as less (or no) fertilizer is applied and the labour that would have been required to apply fertlizers is saved.

Depending on the efficiency of factor markets, households' factor endowments influence input levels. If labour and oxen markets do not function well, input use can be different across households with differing labour, oxen and land ratios. Traditional labour and oxen exchange arrangements are common in most parts of rural Ethiopia. But since land markets act as mediums through which farmers equalize their different factor proportions, a constraint in this market can lead to inefficient input applications based on factor endowments instead of marginal productivity.

Access to input is an important determinant of input application. It is primarily determined by farmers' ability to pay for inputs, availability of inputs as well as information. In this connection household wealth, access to credit, education, farming experience and exposure to extension services as well as access to basic infrastructures and proximity to urban centers are important determinants of access to input. Moreover, specific characteristics of the land on which the input is applied determine the type, method and quantity of input to be applied. Such characteristics include field size, topography, fertility of the soil, intensity of cultivation on the land, etc.

The above discussion regarding the determinants of input use on a particular field can be summarized and best described in the following equation:

$$N = N(S, F, L^{\circ}, Fe, Hw, Cr, In, Av, Fc) \quad (1)$$

Equation (1) above states that input levels on a particular field is determined by: the level of tenure insecurity over the field (S), degree of fragmentation of holdings (F), stock of land improvements on the field (L°), household factor endowments (Fe), household wealth (Hw), access to credit (Cr), information (In), availability of inputs (Av) and field characteristics (Fc).

Yield (productivity)

The level of inputs used in the production process primarily affects productivity levels. It is also hypothesized that degree of fragmentation of holdings not only affects input application, but also undermines productivity by disrupting the effective management of farming operation. The following yield equation incorporates this hypothesis and demonstrates the actual phenomenon in farming operation.

$$Y = Y (N, F, L^{o}, Lq, Cp, Fs, Ec) \quad (2)$$

According to the above model, yield levels are determined by the level of inputs used (N), degree of fragmentation of holdings (F), stock of land improvements (L^{o}), type of technology used (Tk), land quality (Lq), cropping pattern (Cp), field size (Fs) and ecological conditions (Ec).

Land Improvements

Land improvements are medium or long-term actions to enhance the productive capacity of land or conserve its capacity from degradation. As any other investment action, they involve a commitment of resources at one time with the expectation that the realization of their fruits will enhance future productivity. Consequently, decision on such actions is highly dependent on farmers' current expectation of their future benefits. Therefore, tenure insecurity felt by a farmer at present determines his incentive for investment on land in the future.

$$L^{1} = L (S, F, L^{o}, Hw, Cr, Fp, In, Fc) \quad (3)$$

In the above land improvements equation (3), it is hypothesized that current degree of tenure insecurity (S) and land fragmentation (F) affect future flow of investments a farmer undertakes to improve the productivity of his field (L^{1}). Base period stock of land improvements (L^{o}) is the starting points for a decision to invest on land improvement. Household wealth (Hw), access to credit (Cr) and information (In) are expected to enhance farmers' ability to invest on their land. Field problems (Fp) and other field specific characteristics (Fc) are also included in this equation as they are expected to have a direct effect on investment motive.

4.3 The Empirical Model and Estimation Procedure

The estimation of the above theoretical model can be made on the linear forms of the following empirical equations:

$$N_{ih} = a_0 + a_1 S_{ih} + a_2 F_h + a_3 L^o_{ih} + a_4 Hw_h + a_5 Cr_h + a_6 In_h + a_7 Av + a_8 Fc_{ih} \quad (1')$$

$$Y_{ih} = b_0 + b_1 N_{ih} + b_2 F_h + b_3 L^o_{ih} + b_4 Tk_{ih} + b_5 Lq_{ih} + b_5 Fs_{ih} + b_6 Cp_{ih} + b_5 Ec_j \quad (2')$$

$$L^1_{ih} = c_0 + c_1 S^o_{ih} + c_2 F_h + c_3 L^o_{ih} + c_4 Hw_h + c_5 Cr_h + c_6 Fp_{ih} + c_7 In_h + c_8 Fc_{ih} \quad (3')$$

Where:

N_{ih} = Base period cost of total inputs per hectare on the i^{th} field of the h^{th} HH.

Y_{ih} = Base period value of net output per hectare on the i^{th} field of the h^{th} HH.

L^1_{ih} = Flow of land improvements after the base period on the i^{th} field of the h^{th} HH.

S_{ih} = Possession of short-term use rights (tenure insecurity) on the i^{th} field of the h^{th} HH at the base period.

F_h = Level of fragmentation of land operated by h^{th} HH – weighted average distance to field

L^o_{ih} = Stock of medium-term soil investments at the base period on the i^{th} field of the h^{th} HH.

Tk_{ih} = Technology used in the production process - eg. share of modern inputs in the total input

Fc_{ih} = Characteristics of the i^{th} field of the h^{th} household – (Size, Soil, topography, years of cultivation)

Hw_h = Household wealth – (value of livestock, owned land, etc)

Cr_h = credit use by the hth household

In_h = Access to information by the hth household – (farming experience, education)

Av = Availability of inputs – (access to market and other infrastructures- village characteristics)

Lq_{ih}= Land quality – (fertility, intensity of cultivation before)

Ec_j= Ecological condition – (climate, altitude...)

a_0, b_0, c_0 = constants

The yield equation contains endogenous explanatory variable (N), which is determined in the first equation. In such instances, OLS estimation on the yield equation does not result in consistent and efficient estimates because of the endogeniety of the input variable. Therefore, it is necessary to use a Generalized Least Squares estimation technique for this particular equation. A 2-Stage Least Squares (2SLS) estimation has been employed to account for the endogeniety of input use in the yield equation, by using relevant instruments for input in the yield equation. The input and land improvement equations can be estimated by applying OLS to each, as all the right hand side variables are exogenous.

4.3 The data

The above model is estimated using a household survey data collected by the International Livestock Research Institute (ILRI) in 1994 and by the author in 1998, in Tiyo Woreda of Arsi Zone, Oromia Region. Data was collected in four Peasant Associations (PAs) - Abichu, Bilalo, Ketar Genet and Mekro Chebote, all of which are close to Assela, the capital of Arsi zone, with 7 to 15 kms distance. The study sites were selected for their varying altitudes and thus mix of crop and livestock activities. Table 4.1 below depicts some of the characteristics of the study sites.

Table 4.1 - Characteristics of the study sites

	Abichu	Bilalo	Ketar	Mekro
Population	1431	1357	2237	1927
Distance from the main road (km.)	8	0	23	0
Distance from Asella	15	7	30	5
Cropping pattern - Wheat	52%	29%	73%	55%
Balrley	37%	33%	14%	24%
H. Bean/F. Peas	7%	16%	12%	12%
Land Use - Cropped area	69%	60%	93%	84%
Total yield per ha. (Birr)	1431	1357	2237	1927

Source: ILRI Land Tenure Survey in Arsi, 1994.

Ketar and Mekro, found at lower altitudes than Abichu and Bilalo, are relatively more populated and highly productive regions, producing largely the most profitable wheat crop. Both sites are highly cropped as households allot 84-93% of their holding for crop than to pasture. Abichu and Bilalo, on the other hand, are relatively less populated and less cropped where households cropped about two third of their land holding leaving one-third of their holding for pasture which is consistent with the very high livestock holding in these sites. As these sites are at higher altitudes, barley takes the larger share of the area than wheat and they are generally less productive than Ketar and Mekro

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Farm households were grouped according to their membership in the PA, which corresponds to their official access to agricultural land. Accordingly, there were "landless" households who have not acquired either crop or pasture land from the PA but have access to land through various contracts, and "landed" households who have received at least one crop or pasture field through PA distributions. A total of 161 farmers were selected for the study representing both groups of farmers using stratified sampling technique. However, landless farmers were slightly over-represented in the sample to maintain an adequate picture of their responses as they are expected to experience relatively higher degree of tenure insecurity. Below, shown in Table 4.1, is the distribution of sampled farmers across study site by their respective tenure category.

Table 4.1 - Distribution of sample farmers by study site and tenure category

	Abichu		Bilalo		Ketar		Mekro		Total	
Landless	12	31%	5	13%	14	30%	15	42%	46	29%
Landed	27	69%	35	87%	32	70%	21	58%	115	71%
Total	39		40		46		36		161	

Source: ILRI Land Tenure Survey, 1994.

The data were collected at three levels: household, field and plot levels. Data collected on each of sample households covered all areas of households' demographic characteristics, livestock and field inventories and credit use.

Some selected characteristics of sampled households are summeraized in Table 4.2 below. Average age in the study area is 35 with no significant difference across PAs. On average, farmers' experience in farming activity is 19 years, which means that an average farmer starts farming activity at the age of 16, usually along with parents. More than two-thirds of the farmers are literate, who at least can read and write.

Table 4.2 - Selected household characteristics of sampled farmers by study site

	Abichu	Bilalo	Ketar	Mekro	Total
Average age of farmer	36	32	38	35	35
% of literate farmers	74	72	62	70	69
Family size in labour units (*)	2.02	1.96	1.77	1.92	1.91
Farming experience in years	19	17	21	20	19
Livestock holding in TLU (**)	5.1	3.6	2.6	2.9	3.5
No. of oxen owned	2.2	1.8	1.3	1.2	1.6
Land holding per household, ha.	2.5	1.5	0.9	1.4	1.6
Average area per field, ha.	0.70	0.57	0.51	0.54	0.58
No. of fields per holding	3.8	2.9	2.9	3.0	3.2

Source - ILRI Land Tenure Survey 1994.
(*) - Family labour units. Source: Bekele(1991), see Appendix A.1 for conversion method
(**) - Tropical Livestock Unit. Source: Gryseels(1989), see Appendix A.2 for conversion method

An average farm household cultivates 1.6 hectares of cropland, owns 1.6 oxen and has 1.9 family labour units. In other words an average factor proportion in the study area is about 1 family labour : 1 oxen : 1 hectare of crop land. This implies the existence of a room for factor transaction to fill the demands of the highly labour and oxen intensive crop production practised in the area. Abichu and Bilalo tend to have relatively more land, labour and oxen per household than Ketar and Mekro, but the difference is statistically insignificant. However, as these sites are at higher altitudes and have vast pastures suitable for livestock production, they have significantly higher livestock holdings than Ketar and Mekro.

Field level data included various forms of land contracts, farming problems, cropping strategies, and management approaches. Out of all sampled fields about three-fourth are PA allocated fields used by PA farmers while the other one-fourth constitute fields acquired through farmer-to-farmer informal contracts and used either by PA or non-PA farmers. The most common form of

informal land contract is borrowing or gift, usually from parents or relatives to young landless farmers. This mode of access to land accounted for 50% of all informally contracted PA lands. Renting and sharecropping account for 33 and 17 percent, respectively (Gavian and Amare, 1996).

Plot level data was collected on detailed input use and crop production. Data on investments made by farmers since 1994, opinions on tenure insecurity and land fragmentation issues, as well as patterns of land access and inheritance practices overtime has been collected during March 1998 in the same study sites.

Measuring tenure insecurity

It is very difficult to find a standard and objective measure of tenure insecurity. Studies on this subject used various measures. However, tenure insecurity is a subjective variable reflecting perceptions of individual farmers with regard to the certainty of their holding which depends on the specific socio-economic environment in which the farmer operates. Moreover, it is difficult to objectively measure 'feelings' of insecurity. Thus getting an appropriate proxy that can at least explain farmers' perception of their rights over land is one of the challenges of such studies.

In Ethiopia, tenure insecurity in the holding of rural lands emanates primarily from government's absolute control over all rural lands besides the lack of clear land policy and established legal and institutional framework to access, use and transfer land. Except for some social ties and political commitments that might help enhance the security of holdings, farmers can do nothing to improve the level of certainty they feel over their individual holdings. As far as farmers' economic decision is concerned, therefore, tenure insecurity is exogenously determined.

However, farmers may experience different levels of tenure insecurity, even if each hold land under the same tenurial arrangement. This is so mainly because of informality of farmer-to-farmer land contracts and ambiguity of the government's land policy that does not put clear provisions on how to enforce land rights over existing holdings. There is also a severe lack of information by farmers, which gives rise to different perceptions about the certainty of tenure depending on farmers' past experience and their access as well as ability to process information. To see how tenure insecurity affects farmers' action, therefore, their perception of security is very important.

The extent and nature of use and transfer rights associated with each type of land tenure and how these rights should be enforced have not been clearly defined or stated. As a result, each farmer has his own perception of the extent of rights he has (or lack) out of a range of available use and transfer arrangements on a particular land. This bundle of use and transfer rights can be used as a basis to compute a reliable measure of the level of tenure security felt by the farmer over that particular holding. For example, one farmer operating a rented field may have the right to plant any crop of his choice while another renter may feel that the landlord will not let him plant a crop of his choice. In this particular case, we can see that the former is enjoying relatively more use rights over the land than the latter even if both farm rented fields.

A list of short-term and long-term land use, management and transfer options were enumerated to farmers to identify the bundle of land use or transfer rights they have on each field. Making free crop choice, fallow for one year, building soil bunds and dirt canals are considered short-term use rights while planting trees, fallow for more than a year, constructing irrigation and drainage canals, stone bunds and terraces, fences and other permanent structures are treated as long-term use rights. Short-term transfer rights include the right to share out or rent out fields on a short-term contract while lending and bequeathing a field are considered relatively long-term

transfer rights. Selling, as it is outlawed by constitution, is out of the list. Accordingly, for analytical purpose, fields for which farmers have only short-term use rights are labelled 'less secure' fields while fields for which farmers have both short-term and long-term use rights are labelled 'more secure' fields. A dummy variable indicating whether a particular field is in the less secure category is computed and used as a proxy for tenure insecurity in the model. Using the same analogy, 'less secure' and 'more secure' fields in terms of having short and long-term transfer rights were distinguished.

Table 4.3 - Distribution of fields by level of tenure insecurity across study site

	Abichu	Bilalo	Ketar	Mekro	Total
% of less secure (use right) fields	3	24	27	9	16
% of less secure (transfer right) fields	25	27	33	46	32

Source: ILRI Land Tenure Survey 1994.

The above table shows that level of tenure insecurity varies across PAs and that farmers enjoy relatively more use rights than transfer rights. On average about 16% of the fields were categorized as insecure fields using use rights as criterion. But, about one-third of the fields are insecure when transfer rights, excluding selling, are used as a measure of tenure security. This might seem a bit exaggerated figure given the ban on permanent land transfers through selling or mortgage. The figure, however, is reasonably higher because selling is not included in the transfer options enumerated to the farmers and PA farmers do have long-term transfer rights such as lending out and bequeathing. Thus, it is not surprising to find farmers having long-term transfer rights, in the form of lending or bequeathing, in 64% of the fields.

Measuring land fragmentation

From a household point of view dividing one holding equally between three heirs may not be taken as fragmentation as each receive one whole field. But this is indeed fragmentation if one looks at the community level because a single holding has now become three. Community level analysis of land fragmentation, however, requires advanced techniques like the GIS and it is beyond the scope, and indeed an important limitation, of this study. This study is restricted to land fragmentation at a household level.

Various indices have been developed by researchers to measure how far land is fragmented. Generally, these measures focus on the relative number, size, distance and shape of fields used by farmers. But, there is no single measure that incorporates all aspects of fragmentation.

The interest here is in the type of fragmentation process induced by policy, demographic factors and long-lived tradition. Fragmentation of holdings in this sense, thus, refers to subdivision and relocation of holdings. When it is said that farmer's holdings are more fragmented, it is meant that he is operating on relatively smaller, far away or multiple fields of same total area than he used to.

In view of their effect on farming operation, relative distance and size of holdings operated by a farmer are important indicators of land fragmentation. To this end, fragmentation measures should take into account such factors. But, there is no reliable index that shows the combined effect of the two.

Simpson Index has been the favoured measure of degree of fragmentation of holdings in recent literatures (Blarel and others, 1992; Hayes and others, 1997). It is a measure of the relative size of

fields in a holding and is calculated as one minus the sum of the squares of the areas of each field divided by the square of the total area of the holding.

$$SI = 1 - (\sum A_i^2 / A^2)$$

Where Ai is the area of a particular field (parcel) i, and
A is the total size of a holding ($\sum Ai$)

This index will be in the range of 0 and 1. A value of 0 indicates one consolidated field while a value of 1 means an infinite number of fields of equal size. An index close to 1 indicates higher degree of fragmentation of holdings. However, a simpson index of 0 gives the same weight both for a holding close to home and one that is very far from farmer's home, considering each as one consolidated holding. This conceals one of the important aspects of fragmentation: distance.

Distance to fields can be a good indicator of fragmentation of holdings if it incorporates some information about the relative size of fields. Total distance to fields is simply the sum of round trip distance to each of the fields in a holding. However, this is not the right approximation of the actual distance as the number of trips a farmer makes to each field may not be the same. Number of trips farmers make to each field can be approximated by the relative size of the field, though it is dependent on the intensity of farming as well as other factors such as fertility, access roads, etc. When a farmer operates on multiple fields of different sizes, then it is plausible to assume that he will make more trips to the larger fields relative to the smaller ones. Thus, the ratio of the size of each field relative to the smallest field size, calculated as follow, can approximate the number of trips to a field:

$$TR_i = A_i / A^s$$

Where: TR_i = Trips (approximately) made to field i
A_i = Size of field i
A^s = Size of the smallest field

Thus, using the above information on number of trips, distance to each field is adjusted for relative size of the field. Multiplying the estimated number of trips by the round trip distance to each field, area-weighted distance of fields is calculated as follows:

$$AWD_i = D_i \cdot TR_i$$

Where: AWD_i = Area-weighted distance of field i
D_i = Round trip distance to field i
TR_i = Estimated number of trips made to field I

Once the distance of each field is adjusted by estimated number of trips, it can be aggregated to household level, by summing up across fields, to get the total area-weighted distance of fields at a household level (TAWDHH), calculated as follow, which can be use as an indicator of degree of fragmentation.

$$TAWDHH = \sum AWD_i$$

The above measure of fragmentation incorporates both relative size and distance information to arrive at a plausible measure of degree of fragmentation at the household level.

Table 4.4 shows the distribution of the above measure of degree of fragmentation across study sites. According to the table 38% of the households belong to the highest distance category, with an area-weighted total distance of more than 1.5 hrs. A comparison across the PAs shows that Abichu and Ketar have relatively the highest distance indicators, with 40-50% of the households belonging to the highest distance category.

Table 4.4 - Distribution of households by area - weighted distance of fields

TWADHH (in hours)	Abichu (%)	Bilalo (%)	Ketar (%)	Mekro (%)	Total (%)
0 - 0.50	21	36	16	32	26
0.5 - 1.5	29	39	44	32	36
1.5 - 3.0	21	19	30	9	21
3.0 and above	29	6	10	27	17

Source: ILRI Land Tenure Survey, 1994

Input Use

It is difficult to have an aggregate measure of input use. This is because crop production involves various types of inputs measured in different units. In this study, four major input types were identified for analytical purpose: Human labour, power, chemicals and seed.

Human Labour: This involves application of human labour power in various stages of the production cycle, starting from the first ploughing up to the final stage of harvest and storage. Each stage of activity involves different intensities of work and requires different skills, all of which is best reflected in the wage rates applied to each type of work. Thus, using local wage rates for each type of work, the total labour hours can be converted into an aggregate measure of labour input. However, labourers themselves are different in their skill and capacity to undertake each activity, and this poses another aggregation problem. To overcome this, the human labour involved in the production process should be classified according to skill and capacity. The labour of children, women and men has been separated and each group is given a weight that reflects their respective physiological characteristics. Similarly, distinction has been made between family and hired labour to account for skill differences and the former is given a relatively lower weight relative to the market wage rate of the latter. In this manner, an aggregate

value of labour input is calculated for each field taking into account the multiple tasks and labour types involved in crop production.

Power: This involves the use of oxen power and machinery, i.e. tractor, combine harvester and thresher. The oxen labour hours were recorded for each type of work and were converted into Birr using the local oxen hire rates, which take into account quality of oxen used like age and breed. Machinery hours were easily converted into costs using the actual payment farmers made for the services, as no farmer owned such machinery. The total cost of oxen and machinery is summed up to arrive at the total value of power input applied on a particular field.

Chemicals: Under this category, inputs like fertilizer, pesticides, herbicides and insecticides are grouped. As all of these inputs were purchased with uniform prices, their total cost is taken as a measure of total value of chemical input used in the production process.

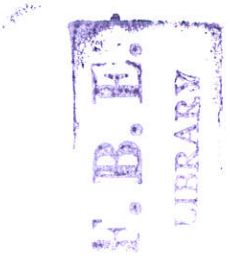
Seed: Quantities of seed applied for each crop planted on the field were converted into value using market prices existed during that particular cropping season to come up with total value of seed used on a particular field.

Human labour, power, chemicals and seed were the principal inputs used in the production process, and the total value of all these inputs applied on each field constitutes total input use for each of the fields under study. To account for field size differences, input use per hectare has been used as a measure of input levels in the empirical model.

Yield / Productivity

Yield, or quantity of output per unit of land, is a very common measure of productivity of land. But when different crops are grown on a piece of land, it is not proper to aggregate the quantity of different outputs to arrive at an aggregate measure of yield. This is because different crops have different importance attached to them, which is reflected in their prices, and the resulting aggregate measure will have no meaning. To overcome this problem, average market price of each crop can be used to convert quantities into value and calculate total value of outputs per unit of land as an aggregate measure of productivity.

To avoid the input effect in the estimation of yield, where input use is also an explanatory variable, it is necessary to separate the input components from the gross value of outputs. This helps to analyze the effects of land tenure insecurity and fragmentation on net value of output, or value added, per unit of land put under cultivation. This measure shows the performance of farming operation and gives a good picture of its implication on farmers' income and food security. Accordingly, in this study, net value of outputs per hectare, i.e., gross value of outputs less value of total input used, has been used as a measure of productivity.



Land Improvements

The most common land improvement practices in the area are crop rotation, fallow and manure application. These are medium-term investment actions that improve the fertility of the soil. Farmers also dig drainage canals to avoid the most frequent waterlogging problems, but these actions were done in almost every cropping season and their effect is limited to one cropping season. Long-term investment actions like planting trees, building stone bunds and canals, are very few to include them in the analysis. Given the very high problem of waterlogging in the

study area (Gavian and Amare, 1996), this may indicate that tenure insecurity problem on the part of the farmers makes them reluctant to commit their resources for a long lasting solutions to their field problems.

Therefore, medium term soil improving measures like manure application, crop rotation and fallow are considered in these analysis as measures of land-improving investments farmers undertake on their land, as they are common in the area and likely to be influenced by tenure insecurity and land fragmentation.

However, it is very difficult to measure the value of such land improvements. In fact, it is almost impossible to quantify the exact value of planting leguminous crops on a particular field in enhancing the fertility of the soil. With regard to the objective of this study, however, information on the exact amount of investment will not be of much relevance once it is known whether a particular field has been improved or not.

A binary variable that indicates whether a particular field has been manured, fallowed or crop rotated in any one year during the period 1990-1994 can be used as a measure of stock of medium-term land improvements that are assumed to have existed on the field in the 1994 base period. Similarly, information on manuring, crop rotation and fallow during the period 1994-1998 is used as a measure of flow of land improvements after the 1994 base period. Farmers easily remember whether they have undertaken any of these land improvement actions in a period of 5 years and, consequently, the measures are found to be reliable.

The data shows that (Table 4.5) about 77% of the fields in 1994 were already improved by medium-term soil improvements undertaken during a period of five years before 1994. Long-term improvements during the same period were very small, observed in only 8% of the fields.

After 1994 and until 1998, half of the sample fields were improved in some way, a relatively lower figure compared to the situation in the pre-1994 period.

Other relevant variables were measured in a straightforward way. The area share of wheat crop on a particular field is used as a measure of cropping pattern. This is taken as a plausible measure of cropping pattern because wheat on average covers 52% of the total crop area, and major differences in farming operations occur based on the relative importance of wheat in the area.

Land quality is proxied by the dominant soil type on the field. This is based on the assumption that soil types can indicate the fertility of the soil. Black soil, which is dominant in Arsi, is considered most fertile. However, the colour of soil is a crude measure of soil fertility as the latter depends on many other factors like rainfall intensity of cultivation, temperature, etc. Field characteristics such as soil type, presence of field problems, such as erosion, and topography of the field, i.e., whether the field is flat or sloppy, are jointly used both to proxy land quality and account for differences in field characteristics.

Household wealth is a subjective measure based on the local meaning of wealth. In Arsi, like in most rural areas in Ethiopia, livestock holding is the best measure of wealth. Farmers hold livestock as productive assets and for social status. They use livestock holdings like banks where they can store their savings in a way that bears them an interest and can meet recurring cash needs by easily disposing them. Accordingly, the Birr value of total livestock holding per TLU (Tropical Livestock Unit) is used as indicator of household wealth in this study.

Though formal credit is rare, farmers use informal credit for various purposes. Many farmers used credit for household consumption purposes. Farmers' use of informal credit for agricultural activities, which is taken by 9% of them, is used as a measure of access to credit. Though no

information is collected on farmers' interaction with extension and development agents, the literacy level and farming experience of farmers is used as an indicator of access to information. Access to infrastructure, availability of inputs and ecological conditions are best represented by using dummies for study sites that differ in their proximity and agroecological environment.

Table 4.5 below summarizes the description of all variables discussed above and used in the estimation of the empirical model. The first group shows the description of variables measured at the field level while the second category is a set of household level variables that are used in the model.

Table 4.5 – Descriptive statistics for model variables

Variable	Variable Description	Measurement	Obs	Mean	Std. Dev.	Min.	Max.
	Field Level Variables						
nvpha	Net output per hectare	In Birr	275	1068.14	1061.40	-753.57	5933.39
inpha	Input per hectare	In Birr	275	944.58	263.12	124.27	1692.46
techn	Share of power and chemicals in the total input	In Birr	275	.39	.08	.08	.66
medt_li	Land improvement: fallow/manure/rotation 1990-94	Dummy	275	.77	.42	-	-
longt_li	Land improvement: presence of permanent structures	Dummy	275	.08	.27	-	-
invest86	Land improvement: fallow/manure/rotation 1994-1998	Dummy	275	.48	.50	-	-
manure	Land improvement: manure 1994-1998	Dummy	275	.08	.15	-	-
fallow	Land improvement: fallow 1994-1998	Dummy	275	.09	.16	-	-
rotation	Land improvement: crop rotation 1994-1998	Dummy	275	.35	.48	-	-
less_ur	Less secure fields: Possession of short-term use rights	Dummy	275	.13	.34	-	-
less_tr	Less secure fields: Possession of short-term transfer rights	Dummy	275	.27	.45	-	-
pafield	Mode of access to land: Whether the field is PA or contract	Dummy	275	.59	.49	-	-
erosion	Field Problems: Presence of erosion on field	Dummy	275	.25	.44	-	-
flat	Topography of field: Fields on flat topography	Dummy	275	.72	.45	-	-
black	Soil type: Fields with dominant black soil	Dummy	275	.56	.50	-	-
farea	Field size	Hectare	275	.57	.43	.10	2.52
fyears	Cultivation intensity: years of cultivation on field	Years	275	5.83	7.00	1	41
whhash	Cropping pattern: Area share of wheat planted on the field	Percent	275	.52	.46	0	100.00
	Household Level Variables						
twadhh	Fragmentation: Total area-weighted distance of fields	Minutes	153	128.89	282.65	1	3187.86
tlu	Livestock holding per household : Tropical livestock Units	TLU	153	3.54	3.49	0	18.39
creduse	Informal credit use for agricultural activity	Dummy	153	.09	.29	-	-
othincom	Non-farm income sources: trade, crafts, transfers,	Dummy	153	.44	.50	-	-
nfield	Number of fields	Number	153	3.18	1.78	1	10
hharea	Size of land operated by HH	Hectare	153	1.55	1.22	.25	7
paland	Size of PA-land held and operated by HH	Hectare	153	1.08	1.10	0	4.5
agehead	Age of the household head	Years	153	35.34	16.33	17	87
eduhead	Literacy of farmer; whether he reads/writes	Dummy	153	.69	.47	-	-
flabour	Household labour endowment	Labour units	153	1.92	1.11	.18	5.86
labpha	Labour-land ratio	Labour per ha.	153	1.74	1.17	.15	8.16
wealth	Livestock wealth of the HH: Total livestock value per TLU	Birr per TLU	153	681.20	226.55	185.71	1540.00
oxen	Oxen ownership by the HH	Number	153	1.65	1.63	0	10
oxpha	Oxen-land ratio	Oxen per ha.	153	1.05	1.11	0	8
farmexpr	Farming experience: no. of years in farming	Years	153	20.66	16.53	1	74

CHAPTER - V RESULTS AND DISCUSSION

Because of the short-term nature of informal land contracts and the traditional practice of inheritance, some of the fields in the 1994 sample were no more under sampled farmers' control and some fields are newly acquired since then. Therefore, fields acquired after 1994, for which there is no production data, and fields whose contract ended since 1994, for which no investment data is available, are dropped from the analysis. Accordingly, the analysis covered 275 fields that are still under cultivation by 153 farmers since 1994, representing 86.7% of the 1994 sample.

The input equation is estimated by OLS as all of the right hand side variables are exogenous. But for the yield equation, a commonly used Generalized Least Squares method, 2SLS, has been employed to estimate the parameters of the structural model. A logit model is used to estimate land improvements as they involve dummy dependent variable. A fixed-effects model is estimated for all equations using clustered analysis to allow the estimation of household level variables in a field level data. All the regressions were run using Intercooled STATA 5.0 for Windows 95, a powerful statistical software which provides heteroskedastic consistent (White's-corrected) standard errors (or, robust standard errors). To see the separate effects of use and transfer rights as a measure of tenure insecurity and to allow easy comparison of the two proxies, both are included in the regressions as they have low correlation to cause multicollinearity problem. The detail result of all regressions is presented in Appendix B.

5.1 Input Use

The OLS estimation of the input equation, summarized in Table 5.1 below, resulted in a fairly lower fit with 20% of the variation of the dependent variable explained by the model. The

coefficients of the tenure insecurity and fragmentation variables showed negative signs as hypothesized. A joint test for the tenure insecurity and fragmentation variables (see Appendix B.1), however, shows that both variables are jointly relevant to explain input use.

The coefficient of the distance variable (TWADHH), which is a proxy for fragmentation, is highly significant to explain input use, supporting the hypotheses that fragmentation of holdings results in lower level of input use. But, having short-term land use rights (LESS_UR) or short-term transfer rights (LESS_TR), which are used as a proxy for tenure insecurity, is not found to be significant to affect input use. This might explain the insignificant effect of tenure insecurity on decisions that have short-term effects, such as input use. Having shorter time horizon, farmers have every reason to apply as much inputs on insecure fields as on secure fields.

Table 5.1 - Result of the OLS estimation on the Input equation: Dependent variable - Total Input

Explanatory Variable	Coefficients		t-statistics
LESS_UR	-41.75		-0.73
LESS_TR	6.62		-0.13
TWADHH	-0.41	***	-3.92
OTHINCOM	95.24	***	2.78
BLACK	54.51	*	1.70
FAREA	-89.99	**	-2.48
WHHASH	134.36	***	3.86
N = 262	R^2 = 0.2023		F(17, 141) = 8.16
			Prob > F = 0.00

*** = p < 0.01, ** = 0.01 < p < 0.05, * = 0.05 < p < 0.10

Among the household level variables, the dummy for non-farm income (OTHINCOM) has significant and positive coefficient. As expected, non-farm income from trade, crafts and rents as well as remittance and other transfers significantly enhance inputs use of farmers. Wheat cropping (WHHASH) and black soil (BLACK) are significant in affecting input use. Wheat is the most profitable crop in the area because of its higher price and yield, which motivates farmers to

divert more resources to wheat production. Thus the positive and significant coefficient of WHHASH implies that wheat cultivators apply more inputs relative to barley cultivators as the former has got more yield and fetches higher price than the latter. Black soil, which is a proxy for fertile land, also enhances input use as it is expected to have higher returns per unit of input applied.

Oxen and labour endowments (see Appendix B.1 for OXPHA and LABPHA, respectively) did not show significant effect on input use. This is an indication of the existence of well functioning oxen and labour market in the form of various labour and oxen sharing and exchange arrangements so that farmers can equalize factor proportions through trade. At the same time the model states that medium-term land improvements (MEDT_LI) do not have significant effect in substituting inputs, as shown by the negative but insignificant coefficient. Since a dummy variable is used for stock of investments and most fields, about 77%, were improved, the result might have been influenced by the low variation across farmers.

Farm size (FAREA) has shown negative and significant coefficient. If input per hectare declines as farm size increases, this might be an indication of constraints in the input markets to allow proportional increase of inputs with area. But, the coefficients of labour, oxen and even credit use are not significant enough to justify the failure of these factor markets. The possible explanation for this will be that farmers enjoy economies of scale because they apply less input per unit of land as farm size increases, and yet get same outputs. The result supports the argument regarding the effects of fragmentation in that it shows the advantages of operating on larger or consolidated holdings.

5.2 Productivity

The 2SLS estimation on the yield equation, which is summerized in Table 5.2 below, resulted in fair fit of 39% in both cases, relatively better than the input equation. Input use per hectare is included as an explanatory variable in the yield equation using relevant instrumental variables to account for the endogeniety problem. However, it is not significantly related to productivity of land. This result is influenced, in part, by the aggregation of all inputs used in the production process.

On the other hand, the result shows that household level fragmentation of holdings significantly undermines productivity, as the negative and significant coefficient of TWADHH indicates. This supports the underlying hypothesis about the direct effect of degree of fragmentation on productivity.

Medium-term soil improvement does not significantly enhance productivity, as its positive but insignificant coefficient indicates (not shown in the Table). The measure of medium term land improvements was aggregated for a period of 5 years (1990-94) while the effect of these soil improvement measures last for 2 or 3 years. Consequently, the weak effect of earlier improved fields might undermine the stronger effect of lately improved fields, resulting in a weak relationship of stock of improvements to current yield. Farmers apply more input on Wheat fields and get more outputs as the positive and significant coefficient of WHHASH shows. Similarly wheat producing Mekro and Ketar PAs are more productive than the Barley producing PAs as shown by the positive and significant coefficient of PA34, the variable that represents these PAs. To allow for differences in technology, a variable (TECHN) that indicates the share of modern inputs (machinery and chemicals) in the total input used is included in this model, but it is not significant to explain yield differences across fields.

TABLE 5.2 – RESULTS OF THE 2SLS ESTIMATION: - DEPENDENT VARIABLE - NET VALUE OF OUTPUT PER HECTARE

Explanatory Variable	Coefficients		t-statistics
INPHA	-0.11		0.89
TWADHH	-0.09	*	-1.87
PAFIELD	446.76	***	3.08
OXPHA	119.57	**	2.39
FLABOUR	112.53	*	1.87
EROSION	-248.85	*	-1.95
WHHASH	689.68	***	4.48
PA34	809.35	***	6.50
N = 262	R^2 = 0.3731		F(15, 141) = 21.75
			Prob > F = 0.00

*** = $p < 0.01$, ** = $0.01 < p < 0.05$, * = $0.05 < p < 0.10$

The coefficient of FAREA is not significant despite the fact that field size is negatively associated with input use. It is an interesting result in that working on larger fields is less costly as one gets same outputs with lower input application. The corollary of this is one explanation of the consequences of land fragmentation on production costs when it results in smaller and smaller holdings. Productivity on fields with erosion problems, as expected, is lower as the negative and significant coefficient of EROSION shows.

Oxen and labour endowments, on the other hand, enhance productivity. This implies that farmers make use of their labour and oxen very efficiently on their own fields. Despite the their insignificant effect on total input use, oxen and labour holdings result in productivity differences across farmers, which they were not able to equalize through exchange. This in part explains that there is certain degree of constraint in labour and oxen markets. A dummy variable for mode of field access (PAFIELD), indicating whether the particular field is PA allocated or informally contracted, is entered in this estimation and is found to be highly significant and positive. This shows that PA fields are not only more secure, but that they are also well managed under the same farmer for longer years than short-term contracted fields that change hands frequently.

5.3 Land Improvements

A binary variable indicating whether a farmer has undertaken any one of the most common land-improving measures, i.e. manure, fallow or crop rotation, on a particular field since the 1994 cropping year is a dependent variable in the investment equation. A clustered logit analysis is used to estimate the model. Table 5.3 summarizes the results of the logit analysis.

The estimation correctly predicted 65% of the outcomes, and the results show that short-term use rights significantly discourage land improvements while short-term transfer rights do not affect at all the probability to improve the land. This indicates the insufficiency of transfer rights relative to use rights to explain farmers' motivation to invest.

Table 5.3 - Logit analysis on the investment equation: - Dependent variable - Medium-term soil improvement

Explanatory Variable	Odds Ratio		z
LESS_UR	0.19	***	-2.96
LESS_TR	1.14		0.34
TWADHH	1.00		-0.67
CREDUSE	5.61	***	2.64
EROSION	1.99	**	2.18
HHAREA	1.00		0.01
N = 262	Correctly predicted = 65%		Chi(18) = 31.46
			Prob > Chi = 0.0175

*** = p < 0.01, ** = 0.01 < p < 0.05, * = 0.05 < p < 0.10

As expected presence of field problems such as erosion, other things remaining constant, increases the probability of land improvement. Similarly, access to credit enhances the incentives to invest on land. Farm size (HHAREA) is not significant to influence incentives for land improvement.

But fragmentation of holdings is not found to be significant to affect land improvements even though its coefficient is negative as expected. This is because of the aggregate measure of land

improvement used in the model. Since there are some land improvement practices, like crop rotation, which are not directly affected by degree of fragmentation, the aggregate measure conceals the effect of fragmentation on some land improvement practices like manure application. To disaggregate these effects, separate regressions were run using the dummies for manure application and crop rotation as dependent variable.

Table 5.4 below shows the results of the estimation when manure application enters as a dependent variable. The model correctly predicted 97% of the outcome and the fragmentation variable has become highly significant and negative. Manure application involves moving the manure between fields and demands higher labour input. In the face of fragmentation this entails higher labour cost and the practice will not be economical. Thus, farmers will be less motivated to apply manure when fields are too fragmented.

Table 5.4 - Logit analysis on manuring: - Dependent variable - Dummy for manure application

Explanatory Variable	Odds Ratio		z
LESS_TR	2.61		-1.05
TWADHH	0.99	***	-2.63
TLU	1.17		1.49
FARMEXPR	0.89	**	-2.31
EXPSQ	1.00	*	1.93
EROSION	0.39		-1.64
BLACK	5.83	***	2.73
FAREA	3.30	*	1.66
WHHASH	0.20	**	-1.96
N = 228	Correctly predicted = 97%		Chi(17) = 58.15
			Prob > Chi = 0.000

*** = $p < 0.01$, ** = $0.01 < p < 0.05$, * = $0.05 < p < 0.10$

All fields with only short-term use rights (LESS_UR=1) were not manured at all during the 1994-98 period, and consequently the variable could not be estimated and automatically dropped from the analysis (see Appendix B.4). It is apparent that having only short-term use rights highly discourages manure application because only fields with long-term use rights were manured.

However, having short-term transfer rights does not significantly affect manure application, as shown by the higher but insignificant odds ratio of LESS_TR. Fields with erosion problems (EROSION) are less likely to be manured. These fields are usually found in sloppy land and are liable for erosion, and consequently, farmers will be less likely to apply manure in such fields as it will be easily washed away. But, the fertile black soil fields (BLACK) have higher probabilities of manure application as they have higher returns relative to other land types. Larger fields (FAREA) are suitable for economical use of labour in manure application and hence have higher probabilities of improvement. Farming experience is negatively related to manure application at early stages. But, as the positive sign of its square (EXPSQ) shows, the relationship reverses in the later stages, implying that farmers tend to apply manure as they get well experienced in farming operations.

Livestock holding (TLU), which is the source of manure, is not as strongly significant to affect manure application as expected. According to the model, the ratio of the odds of manure application on insecure fields as a result of one more TLU is 1.17, which is higher, but this is true at a low probability of 86%. Since, most of the farmers own livestock in the study area, livestock holding may not affect the probability to manure fields but rather it may affect the quantity of manure applied on each farm.

In the study area, farmers use highly improved wheat seed varieties than anywhere else. These varieties demand higher fertilizer application and most wheat cultivators rely on fertilizers for better wheat yields than applying manure. As this model predicts, wheat cultivators are less likely to apply manure, which is consistent with the actual practice in the area as they are likely to divert the manure to fields with other crops.

Table 5.5 - Logit analysis on crop rotation: - Dependent variable - Dummy for undertaking crop rotation

Explanatory Variable	Odds Ratio		z
LESS_UR	0.22	**	-2.31
LESS_TR	0.89		-0.31
TWADHH	1.00		0.13
HHAREA	1.04		0.22
WEALTH	1.00	*	1.94
N = 262	Correctly predicted = 68%		Chi(17) = 22.05
			Prob > Chi = 0.2298

*** = $p < 0.01$, ** = $0.01 < p < 0.05$, * = $0.05 < p < 0.10$

The estimation on crop rotation resulted in a fair fit, correctly predicting 68% of the outcomes. As shown on Table 5.5 above, crop rotation is significantly affected by tenure insecurity, but not by land fragmentation. The other interesting result is the positive and significant coefficient of the household wealth variable. Other things remaining constant, farmers are more likely to use crop rotation when they can afford the possible short-term income loss as a result of the changing cropping pattern. Thus wealth is more likely to enhance incentives for crop rotation as the model correctly predicts. Farm size (HHAREA) is positively related but not significant to influence decision on crop rotation.

CHAPTER - VI SUMMARY AND CONCLUSION

6.1 Summary

Based largely on the neoclassical economic theory of transaction costs, the vast literature on land tenure issues in the past have stressed the importance of security of tenure in enhancing efficient farming and promoting investments. In this respect, the dominantly traditional and communal system of land tenure in Sub-Saharan Africa has been considered an obstacle to raise agricultural productivity. Recent findings, however, have challenged this view and are now redirecting the blame towards inefficient rural credit, labour and other factor markets existing in these countries.

Similarly, fragmentation of holdings has been an important center of research and debate with regard to its effect on farm operations. Empirical investigations on the effect of fragmentation revealed contrasting views ranging from the ones that emphasize its undesirable consequence on effective farm management and investment actions to those that appreciate its advantage as a risk diversification mechanism. However, each outcome is dependent on the methodology followed and the specific institutional and agroecological setting through which the study is carried out.

As a result of excessive state power over rural lands, lack of established legal and institutional framework to access, use and transfer land the problem of land tenure insecurity has persisted in Ethiopia. At the same time, population pressure, periodic land redistribution and inheritance practices led to subdivision of holdings as the number of young landless farmers grew up with no alternative off-farm employment opportunity. Despite this, Ethiopia has not yet benefited from rigorous empirical investigations that explicitly address the issue of tenure insecurity and land fragmentation in relation to agricultural productivity.

This research is undertaken to investigate whether the existing land tenure system in Ethiopia affects farm productivity and resource management practices. Specifically, it tests the general hypothesis that tenure insecurity and land fragmentation undermine productivity and discourage land improvements.

Based on a household survey data from Arsi, this study has supported the proposition that land tenure insecurity and fragmentation have significant effect on productivity and land improving investments. Though the study does not provide evidence to support the direct impact of tenure insecurity on input application, the results implied that the disincentive effects of tenure insecurity on land improvements could contribute to lower productivity of land in the long-term. This is reinforced further by the finding that PA fields are more productive than the less secure contract fields.

Fragmentation of holdings, on the other hand, undermines productivity directly by affecting the management of farming operations as well as through its negative effect on input use. The study also found that land fragmentation discourages farmers' incentive to manure their fields.

The outcomes of this study largely depend on the proxies used to measure tenure insecurity and land fragmentation as much as on the specific socio-economic and agroecological settings under which the study is carried out. To this extent, the findings of the study have important implications to the existing knowledge regarding the relationship between property rights institutions and agricultural productivity.

First, the study has found that perceived use rights rather than transfer rights are much more significant to affect farmers' decision in investment actions. Given the generally imposed state ownership of land, farmers are highly concerned about how far they can use the land than how

far they can transfer their right over the land. In fact, according to the data on farmers' opinions the majority of sampled farmers do not want to sell their land. But, they have expressed their concern about their right to decide on crop choice, undertake medium term and long-term improvements, plant trees or build permanent structures, etc. In other words, secure and long-term use right over their holdings is what farmers need most to operate efficiently and confidently, even if they can not sell the land.

Secondly, the empirical evidence from this study supports the supply side explanation for the fragmentation of holdings. The findings illuminate the fact that fragmentation of holdings in the face of imperfect land markets has adverse consequences on farming operation. The study has shown that farmers are constrained to use land markets to overcome the problems of distance and scatter of fields, and consequently apply sub-optimal level of inputs, produce lower outputs per unit of land and lack sufficient incentives for land improvement. The study suggests that mere consolidation of holdings may not reverse the undesirable effects brought about by fragmentation of holdings unless the constraints in land transfer as well as imperfections in other rural factor markets are removed.

Third, previous studies ignored the distance factor in the measurement of land fragmentation and consequently overlooked this important aspect of fragmentation, which resulted in an understatement of its effect on farming operation. The commonly used Simpson Index shows the spatial dispersion of fields based on relative sizes with no reference made to distance of fields. Studies based on such measurement are less likely to detect the strong effects of fragmentation as result of the distance effect in limiting input use and lowering yields. This study used a proxy for fragmentation that incorporates both the distance and relative size aspects of land fragmentation and found that fragmentation of holdings indeed affects input use, productivity and land improvement.

6.2 Conclusion

Addressing the deeply rooted problems of Ethiopian agriculture has been the critical challenge for policy makers and researchers alike. Lower productivity and investment are age-old features smallholder agriculture, and consequently farmer income has been kept low and the threat of food insecurity persisted. Continuous cultivation of crop lands without a meaningful effort to preserve, if not to increase, its productive capacity led to the degradation of the fertility of the soil.

Despite the strong measures taken to revitalize the backward agriculture through price liberalization and provisions of package programmes, the institutional aspects of the reform measures has been overlooked. Property right institutions are the mediums through which different markets interact and operate efficiently. In particular, land tenure system is the central property right institution in agrarian economies. A land tenure system that is not properly instituted to allow legal and secure access to land puts a constraint on other rural markets and leads to inefficiency and undesirable use of resources. To this extent, addressing the land tenure issue in the Ethiopian agriculture would be a primary concern if the expected fruits of liberalization and package programmes were to materialize.

Assurance of secure, legal and long-term use rights over land to holders is the necessary step to reverse the effects of tenure insecurity. Given farmers' past experiences, this requires more than a decree to change their expectation of the likelihood of state interventions in land matters. Continuous and unpredictable land redistribution did much to aggravate the insecurity of rural land holdings and increased the fragmentation of holdings. Access to land based on political stance and through institutions that are politically affiliated to the government should be replaced by an enforceable legal and institutional framework and transparent land administration.

This would minimize the uncertainties in the holding of rural lands and boost farmers' incentives for effective management of their land. Provision of input credit and extension services would complement such a liberal and legal atmosphere in land markets and would lead to higher efficiency of resource use. Land saving technologies and intensive farming will relieve the pressure on land resources and can fight back the increasing fragmentation of holdings. Facilitating the conditions for off-farm employment opportunities to absorb the growing labour force in agriculture will be a long lasting solution to the increasing pressure on land resources.

Establishment of complex institutional framework and structures to administer land is not an easy task as it appears. Providing off-farm employment opportunities or adopting land saving technologies is not simple either. In fact, it is not the intent of this paper to specify a policy prescription to this complex issue based on a very limited research undertaking. However, the findings suggest that the first step towards a solution is a clear understanding of the problem and honest appreciation of its consequences. The policy machinery should encourage dialogues and country wide investigation into the complex issues of land tenure institutions to come up with alternative options and to decide on the least-cost way of dealing with the problem.

BIBLIOGRAPHY

Aklilu, K. and Tadesse Alemu, (1994) 'Rapid Population Growth and Access to Farm Land: Coping Strategies in Two Peasant Associations in North Showa', in Dessalegne Rahmato (ed.) *Land Tenure and Land Policy After Derg*, Proceedings of the Second Land Tenure Workshop, May, 1994, Addis Ababa.

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

Barrows, R. and Michael Roth, (1990) 'Land Tenure and Investment in African Agriculture: Theory and Practice', *Journal of Modern African Studies*, Vol. 28, No. 2, pp 265-297.

Bekele Shiferaw, (1991) 'Crop-livestock Interaction in the Ethiopian Highlands and Effects on Sustainability of Mixed farming: A Case Study From Ada District', M. Sc. Thesis, Agricultural University of Norway, June 1991.

Bentley, J. (1987) 'Economic and Ecological approaches to Land Fragmentation: In defence of Much-Maligned Phenomenon', *Annual Review of Anthropology*, Vol. 16.

Berry, R. Albert and William R. Cline, (1979) 'Agrarian Structure and Productivity in Developing Countries', The Johns Hopkins University Press, Baltimore and London.

Blarel, B., Peter H., Frank. P, and John Q., (1992) 'The Economics of Farm Fragmentation: Evidence from Ghana and Rwanda'. *The World Bank Economic Review*, Vol. 6, No. 2, pp. 233-254.

Bruce, John, Allan Hoben and Dessalegne Rahmato, (1993) After the Derg: An Assessment of Rural Land Tenure Issues in Ethiopia, Draft paper submitted to the workshop on Rural Land Tenure Issues in Ethiopia, 27-29 August 1993, Addis Ababa.

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

Dessalegne Rahmato, (1984) Agrarian Reform in Ethiopia, Scandinivian Institute of African Studies, Uppsala, 1984.

Feder, Gershon (1986) Land Ownership Security and Farm Productivity in Rural Thailand, *Agricultural and Rural Development Department, Research Unit Discussion Paper, ARU 51, World Bank, April, 1986.*

Feder, G. and Noronha (1987) 'Land Rights Systems and Agricultural development in sub-Saharan Africa' *World Bank Research Observer*, Vol. 2, No. 2.

Feder, G. and Onchan T. (1987) 'Land Ownership Security and Farm Investment in Thailand' *American Journal of Agricultural Economics*, Vol. 69 No. 2.

Gavian, S. and Amare Teklu, (1996) 'Land Tenure and Farming Practices: The case of Tiyo Woreda, Arsi, Ethiopia', in Mulat D., Wolday A., Tesfaye, Z., Solomon B. and Simeon E. (eds.) *Sustainable Intensification of Agriculture in Ethiopia,* Proceedings of the Second Conference of the Agricultural Economics Society of Ethiopia, 3-4 October 1996, Addis Ababa, pp 74-97.

Gavian, S. and Marcel Fafchamps,(1996) 'Land Tenure and Allocative Efficiency in Niger', *American Journal of Agricultural Economics*, Vol. 78 No. 2, pp 460-471.

Gavian, S. and Simeon Ehui, (1996) 'The Relative Efficiency of Alternative Land Tenure Contracts in Arsi Zone, Ethiopia', in Mulat D., Wolday A., Tesfaye, Z., Solomon B. and Simeon E. (eds.) *Sustainable Intensification of Agriculture in Ethiopia,* Proceedings of the Second Conference of the Agricultural Economics Society of Ethiopia, 3-4 October 1996, Addis Ababa, pp 98-125.

Guido Gryseels, (1988) Role of Livestock on Mixed Smallholder Farms in the Ethiopian Highlands, PhD Dissertation, Agricultural University of Wageniungen, The Netherlands.

Hayes, J., M. Roth and L. Zepeda, (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.

Hazell, P. and Frank Place, (1993) 'Productivity Effects of Indigenous Land Tenure Systems in Sub-Saharan Africa', *American Journal of Agricultural Economics*, Vol. 75, No. 1, pp 10-19.

Hoben, Allan, (1973) Land Tenure Among he Amhara of Ethiopia: The Dynamics of Cognatic Decent, The University of Chicago Press, Chicago and London.

Hoben, Allan, (1996) Land Tenure Policy in Ethiopia: Issues for Smallholder Sustainable Agricultural Growth, Report prepared for the World Bank, November, 1996.

Imperial Ethiopian Government Ministry of Land Reform and Administration, (1967) Report on the Land tenure Survey of Arussi Province, Prepared by the Department of Land Tenure, August 1967, Addis Ababa.

Jabbarin, A. S., and Epplin F.M., (1994) 'Impacts of and Land Fragmentation on the Cost of producing Wheat in the Rain-fed Region of Northern Jordan', *Agricultural Economics*, Vol. 11, No. 2-3, pp 265-297.

Michael Roth, (1993) 'Somalia Land Policies and Tenure Impacts: The Case of Lower Shebelle', in "Land in African Agrarian systems" Thomas J. Basset and Donald E. Crummey (eds.), The University of Wisconsin, Madison.

Migot-Adholla,S, Peter H., Benoit B., and Frank. P, (1991) 'Indigenous Land Rights Systems in Sub-Saharan Africa: A Constraint on Productivity?', *The World Bank Economic Review*, Vol. 5, No. 1, pp 155-175.

Mulat Demeke, (1989) The Production Efficiency of Food Production in Ethiopia: The Case of Some Farms in Arsi Province, PhD. Dissertation, University of Strathclyde, Germany

Oktay, E. and Yildirim A.G.I. (1992) 'The Importance of Land Consolidation in Rural Development of Turkey' *Yuzuncu-Yil-Universitesi-Ziraat-Facultesi-Dergisi*, Vol. 2, No. 1.

Tessema Chekun, (1994) 'Land Tenure Issues in High Potential Coffee Growing Areas: Overview of South Western Ethiopia, Keffa, Illubabour and Wolega', in Dessalegne Rahmato (ed.) *Land Tenure and Land Policy After Derg*, Proceedings of the Second Land Tenure Workshop, May, 1994, Addis Ababa.

World Bank, (1992) Towards Poverty Alleviation and Social Action Programme

Yibeltal, Gebeyehu, (1995) 'Population Pressure, Agricultural Land Fragmentation and Land Use: A Case Study of Dale and Shashemene Woredas, Southern Ethiopia', in "Ethiopian Agriculture: Problems of Transformation" Proceedings of the Fourth Annual Conference on the Ethiopian Economy, Mulat Demeke and Dejene Aredo (eds.), Addis Ababa.

APPENDIX - A: CONVERSION TABLES

APPENDIX - A.1: Conversion of Family Size into Standard Labour Units

Sex/age category	Condition	Labour unit
< 8 or > 75	All	0
Children (8-14)	1	0.5
Children (8-14)	2	0.25
Adult male (15-65)	1	1.0
Adult male (15-65)	2	0.5
Old men (66-75)	1	0.5
Old men (66-75)	2	0.25
House wives (15-65)	2	0.5
House wives (66-75)	2	0.25
Adult females (15-65)	1	0.7
Adult females (15-65)	2	0.35
Old women (66-75)	1	0.35
Old women (66-75)	2	0.18

Source : Bekele (1991)

Condition
1. Full time worker
2. Part-time worker

APPENDIX - A.2: Conversion of livestock herd into Tropical Livestock Units

Species	TLU
Calf	0.2
Bull	1.0
Heifer	0.5
Cow	0.8
Ox	1.1
Sheep	0.09
Horse	0.8
Mule	0.8
Donkey	0.36
Poultry	0.01

Source: Gryseels (1989)

APPENDIX - B: REGRESSION RESULTS

APPENDIX - B.1: OLS Estimation of the Input Equation

```
Regression with robust standard errors                Number of obs =     262
                                                      F( 17,   141) =    8.16
                                                      Prob > F      =  0.0000
                                                      R-squared     =  0.2023
Number of clusters (hhid) = 142                       Root MSE      =  244.27

------------------------------------------------------------------------------
             |               Robust
       inpha |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     less_ur |  -41.74974   57.15968    -0.730   0.466    -154.7505    71.25103
     less_tr |   6.621007   52.56245     0.126   0.900    -97.29136    110.5334
      twadhh |   -.040555   .0103443    -3.921   0.000    -.0610049   -.0201051
     medt_li |  -63.99303   44.33327    -1.443   0.151    -151.6369    23.65081
         tlu |  -1.359696     6.0305    -0.225   0.822    -13.28158    10.56219
      wealth |  -.0023324   .0691302    -0.034   0.973    -.1389982    .1343333
       oxpha |  -8.208501   14.65911    -0.560   0.576    -37.18855    20.77155
      labpha |   22.12267   16.31569     1.356   0.177    -10.13233    54.37768
    othincom |   95.23618   34.25452     2.780   0.006     27.51734     162.955
     creduse |  -87.00274   74.34366    -1.170   0.244    -233.9751    59.96959
      paland |   24.33009   17.41722     1.397   0.165    -10.10256    58.76275
     erosion |   -53.8032   37.01678    -1.453   0.148    -126.9828    19.37645
       black |   54.50685   32.10029     1.698   0.092    -8.953227    117.9669
       farea |  -89.98955   36.26854    -2.481   0.014      -161.69   -18.28913
      fyears |   .0697562   1.496752     0.047   0.963    -2.889219    3.028732
      whhash |   134.3551   34.82942     3.858   0.000     65.49974    203.2105
        pa34 |   9.268347   32.07719     0.289   0.773    -54.14606    72.68275
       _cons |   884.8182   83.67632    10.574   0.000     719.3959    1050.241
------------------------------------------------------------------------------

. test less_ur twadhh

 ( 1)  less_ur = 0.0
 ( 2)  twadhh = 0.0

       F(  2,   141) =    7.80
       Prob > F      =  0.0006
```

APPENDIX - B.2: 2SLS Estimation of the Yield Equation

```
2SLS regression with robust standard errors                   Number of obs =     262
                                                              F( 15,   141) =   21.75
                                                              Prob > F      =  0.0000
                                                              R-squared     =  0.3731
Number of clusters (hhid) = 142                               Root MSE      =  859.25

------------------------------------------------------------------------------
             |               Robust
       nvpha |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       inpha |  -.1135349   .7849321    -0.145   0.885    -1.665292    1.438222
       techn |  -991.0195   777.7342    -1.274   0.205    -2528.547    546.5076
      twadhh |  -.0860417    .046134    -1.865   0.064    -.1772456    .0051621
     medt_li |   170.7465   157.1297     1.087   0.279     -139.888    481.3811
     pafield |   446.7605   145.2681     3.075   0.003     159.5753    733.9456
    farmexpr |  -17.60367    16.3558    -1.076   0.284    -49.93797    14.73063
       expsq |    .205057   .2229306     0.920   0.359    -.2356615    .6457756
       oxpha |   119.5694   50.01408     2.391   0.018     20.69496    218.4438
       farea |  -74.92825   114.8542    -0.652   0.515    -301.9871    152.1306
     flabour |   112.5272   60.16926     1.870   0.064    -6.423349    231.4777
      labpha |  -35.34228    54.9595    -0.643   0.521    -143.9934    73.30887
     erosion |  -248.8513   127.9638    -1.945   0.054    -501.8269    4.124316
       black |  -170.8864   129.2383    -1.322   0.188    -426.3817    84.60889
      whhash |   689.6817   153.9482     4.480   0.000     385.3367    994.0267
        pa34 |   809.3469   124.4392     6.504   0.000     563.3391    1055.355
       _cons |   584.5056   940.8035     0.621   0.535    -1275.398     2444.41
------------------------------------------------------------------------------

. test inpha twadhh medt_li

 ( 1)  inpha = 0.0
 ( 2)  twadhh = 0.0
 ( 3)  medt_li = 0.0

       F(  3,   141) =    2.10
            Prob > F =    0.1023
```

APPENDIX - B.3: Logit Analysis of Land Improvement Equation

Logit Estimates — Number of obs = 262
chi2(17) = 31.46
Prob > chi2 = 0.0175
Log Likelihood = -162.79274 — Pseudo R2 = 0.1022

(standard errors adjusted for clustering on hhid)

invest86	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
less_ur	.185042	.1056639	-2.955	0.003	.0604243	.5666682
less_tr	1.137893	.4313619	0.341	0.733	.5412784	2.392114
twadhh	.9998729	.0001909	-0.666	0.505	.9994989	1.000247
medt_li	1.679414	.6577564	1.324	0.186	.7794312	3.618578
tlu	.9790567	.0656714	-0.316	0.752	.858445	1.116614
wealth	1.000946	.0008274	1.144	0.253	.9993259	1.002569
oxpha	1.016318	.178122	0.092	0.926	.7208521	1.43289
labpha	1.342386	.2960687	1.335	0.182	.8712477	2.0683
farmexpr	.9846744	.0376324	-0.404	0.686	.913611	1.061265
expsq	1.000125	.0005488	0.228	0.819	.9990502	1.001202
othincom	.6848758	.2283184	-1.135	0.256	.356324	1.316372
creduse	5.604594	3.654328	2.643	0.008	1.561495	20.11628
erosion	1.985934	.6237285	2.184	0.029	1.073063	3.675398
black	.9084976	.2693038	-0.324	0.746	.5081643	1.624215
hharea	1.001096	.1797266	0.006	0.995	.7041411	1.423285
whhash	1.110217	.3462416	0.335	0.737	.6024837	2.045836
pa34	.6723213	.2534766	-1.053	0.292	.3211141	1.407649

Classified	True D	True ~D	Total
+	69	36	105
-	56	101	157
Total	125	137	262

Correctly classified 64.89%

APPENDIX - B.4: Logit Analysis of Manure Application

Logit Estimates — Number of obs = 228
chi2(16) = 58.15
Prob > chi2 = 0.0000
Log Likelihood = -20.182001 — Pseudo R2 = 0.2726

(standard errors adjusted for clustering on hhid)

Note: less_ur~=0 predicts failure perfectly
less_ur dropped and 34 obs not used

manure	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
less_tr	2.612312	2.381391	1.053	0.292	.43759	15.59491
twadhh	.9887236	.0042717	-2.625	0.009	.9803865	.9971316
medt_li	1.7846	1.163617	0.888	0.374	.4971985	6.405483
tlu	1.170993	.124123	1.489	0.136	.9513245	1.441385
wealth	.9999783	.0017785	-0.012	0.990	.9964986	1.00347
oxpha	1.278802	.3658938	0.860	0.390	.7298868	2.240532
labpha	1.463542	.3681771	1.514	0.130	.8938656	2.396285
farmexpr	.8911284	.0444967	-2.308	0.021	.8080482	.9827505
expsq	1.001472	.0007648	1.926	0.054	.9999742	1.002972
othincom	.80192	.6492968	-0.273	0.785	.1640334	3.920396
creduse	1.827623	2.133341	0.517	0.605	.1854812	18.00834
erosion	.3896105	.2245261	-1.636	0.102	.1259208	1.205491
black	5.826342	3.764016	2.728	0.006	1.642445	20.66813
farea	3.30139	2.380231	1.657	0.098	.8035239	13.56422
whhash	.1967673	.1633561	-1.958	0.050	.0386621	1.001429
pa34	1.342471	1.236663	0.320	0.749	.2206942	8.166175

Correctly classified 97.37%

APPENDIX - B.5: Logit Analysis of Crop Rotation

Logit Estimates — Number of obs = 262
chi2(18) = 22.05
Prob > chi2 = 0.2298
Log Likelihood = -156.38396 — Pseudo R2 = 0.0791

(standard errors adjusted for clustering on hhid)

rotation	Odds Ratio	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
less_ur	.2170783	.1438438	-2.305	0.021	.0592352	.7955233
less_tr	.8896862	.3355362	-0.310	0.757	.4248296	1.863198
twadhh	1.000019	.0001499	0.126	0.899	.9997253	1.000313
medt_li	1.850084	.7382063	1.542	0.123	.8463533	4.044188
tlu	.9822208	.059984	-0.294	0.769	.8714177	1.107113
wealth	1.001535	.0007934	1.937	0.053	.9999815	1.003092
oxpha	1.276015	.2494482	1.247	0.212	.8698704	1.871791
labpha	1.170938	.2416332	0.765	0.444	.7814142	1.754635
farmexpr	.9723804	.0337335	-0.807	0.419	.9084617	1.040796
expsq	1.000426	.0004829	0.883	0.377	.9994804	1.001373
othincom	.8532328	.2649977	-0.511	0.609	.4641952	1.568319
creduse	1.206737	.6910412	0.328	0.743	.3927986	3.707281
erosion	1.39069	.4464675	1.027	0.304	.7412422	2.609157
black	.7650369	.2245933	-0.912	0.362	.430322	1.360101
hharea	1.036613	.1663882	0.224	0.823	.7568137	1.419856
farea	1.236302	.3949341	0.664	0.507	.6610133	2.312274
whhash	.635576	.1980354	-1.455	0.146	.3451013	1.170546
pa34	.9412992	.3400986	-0.167	0.867	.4636412	1.911056

Classified	True D	True ~D	Total
+	24	14	38
-	68	156	224
Total	92	170	262

Correctly classified 67.56%

DECLARATION

I, the undersigned, declare that this thesis is my own original work and has not been presented in any University. All sources of materials for this thesis have been fully acknowledged.

Name: Amare Teklu

Signature: 

Date: May, 1998

Place: Addis Ababa