LAND TENURE AND LAND MANAGEMENT IN THE HIGHLANDS OF NORTHERN ETHIOPIA*

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Abstract

Land tenure security is important to encourage investment in land improvements as well as the development of efficient land markets. In Ethiopia, empirical analysis is required to find out the effect of the current land tenure system on farmers' propensity to invest in land improvements, and the development and functioning of land markets. Data collected from 50 communities in the highlands of Tigray in 1998 was used to investigate the functioning of land markets, and determine the relationship between perceived land tenure security and land investments in the region. We found out that informal land markets (sharecropping and fixed rental) are emerging in the region, and while quality of land is an important determinant of rental price in fixed lease, quality appears to play limited role in determining the land holder's share in sharecropping. Landlessness is increasing in the region. Perceived tenure security is important for making land investments and use of improved farming practice. However, investments in land do not appear to have significant effect on perceived tenure security of farmers. Our results imply that there is a need to improve tenure security of farmers in order to encourage land investment. The role of public policy in facilitating the development of the fledgling land markets needs to be explored. The wishes and preferences of farmers regarding land tenure arrangements and land administration should be considered as crucial inputs to future land tenure arrangements. Moreover, an open, concerted and inclusive debate on the relevance and feasibility of alternative land tenure arrangements for the country or for different parts of the country needs to be encouraged. Alternative tenure arrangements need to be evaluated based on the level of security they provide to farmers, since tenure security is more important than the mode of ownership.

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1. INTRODUCTION

Significant improvements in agricultural productivity are crucial to address the worsening conditions of poverty and food security in sub-Saharan Africa (Omiti et al., 2000). In Ethiopia, improvement in land productivity is vital to enhance and sustain the welfare of the largely agrarian population (World Bank, 1989). The traditional land use and land management practices that used to sustain the welfare of human population under low population pressure with little or no technical inputs can no longer able to support the growing population. Per capita food production declines due to increasing population density and degradation of the natural resource base which results in deteriorating human welfare conditions.

In Ethiopia improvements in agricultural productivity require a more efficient use of rural resources, especially land, labor and traction power, since these resources are the major inputs of agricultural production. Better performance of agriculture will, therefore, depend considerably on how well the constraints hindering the proper functioning of markets for these key factors of production are addressed (Omiti et. al., 2000).

Increasing population results in land scarcity and, when alternative employment opportunities outside agriculture are limited, it may eventually lead to landlessness. Under this situation, well functioning land markets may result in welfare gains by allocating the land resource to more efficient users and by permitting land consolidation to achieve economies of size. For example, Holden et al. (2001) concluded that improvement in the labor and land rental markets in the Ethiopian highlands might reduce inefficiency in the agricultural sector. Similarly, in Coastal China, improvements in land markets and associated institutions were found to be a major contributor to higher allocative efficiency (Yao, 1996).

However, for land markets to function efficiently, low transaction costs and tenure security are essential. Land tenure security is important not only for the development of efficient land markets, but also for investment in land improvement. For example, Gebremedhin and Swinton (2003) found that farmers' perceived land tenure security in Tigray, northern Ethiopia, was significantly and positively associated with long-term soil conservation investments such as stone terraces. Similarly, Feder and Onchan (1987) found in Thailand that ownership security was significant in explaining the incidence of land improvements. The findings of Pender and Kerr (1998) in India also suggest that improvements in land markets increase conservation investments on farm land.

Efficient use of the land resource also requires access to agricultural inputs such as farm labor, traction power and farm implements. At peak periods of agricultural activities, traction constraint (eg. for land preparation) or labour constraint (eg. for weeding, harvesting) may result in low land productivity. Efficient labour and traction

markets may, therefore, contribute to welfare gains by allocating these resources to their best use. However, in the absence of institutional support, markets for agricultural land, farm labor and traction are unlikely to develop and operate efficiently. The development of agricultural factor markets need broad and committed public intervention. For example, Bruce and Migot-Adholla (1994) posit that even in free market systems, other incentives in addition to security are required to encourage land sales and rental markets.

In Ethiopia, after almost two decades of socialist oriented economic policy under the military regime, the existing Ethiopian Government has been taking measures to liberalize the economy since 1991. In the agricultural sector, measures to liberalize the input and output markets and increase institutional support, such as agricultural research and extension services, have been taken. In Tigray and Amhara regions, land titling aimed at improving farmers' land tenure security has also been implemented. The titling process provides certificates of holding but does not bestow ownership since, constitutionally, land belongs to the state.

The long-term impact of the measures taken by the government to improve agricultural production will depend on their effect on the structure and stability of economic incentives available to farmers. Whether or not government policies are conducive to investment in agriculture and whether the incentive structure translates into a more sustainable use of the natural resource base are empirical questions.

This paper is intended to assess the land use and land tenure situation in the Tigray since 1991 and investigate the effect of land tenure security on land management. Descriptive and econometric analyses of data collected in 1998 from 50 *tabias*[1] (communities) and 100 villages are used. We found out that an informal land market (fixed rental and sharecropping) is emerging in Tigray, and while the quality of land is an important determinant of rental price in fixed lease, quality appears to play a limited role in determining land holder's share in share cropping. Landlessness is increasing in the region. Perceived tenure security is important for making investments in land improvements, and use of improved farming practices. However, investments in land do not appear to have a significant effect on perceived tenure security of farmers.

The paper is organized as follows. Section two presents the data and results of analysis of descriptive information. Section three deals with the empirical approach, while section four presents results of the econometric analysis. The last section presents conclusions and implications of results.

[1] *Tabia* is the lowest administrative unit in Tigray usually comprising of four to five villages.

2. DATA

The analysis in this paper is based on community level data collected from 50 *tabias* and 100 villages in the highlands of the Tigray region during 1998/99. Sample *tabias* were selected following random sampling stratified by distance to the nearest town and presence of irrigation projects. Two villages were randomly chosen from the selected *tabias*. A semi-structured questionnaire was administered to a group of representative individuals both at the *tabia* and village levels. Each group comprised of ten respondents chosen to represent different age cohorts, primary occupations, gender and villages. Information was collected on changes in agricultural and resource conditions between 1991 and 1998, and their causes and impacts.

Land use and land tenure

In Tigray, the dominant land tenure systems for rainfed cultivated and irrigated land are owner used and sharecropped, with limited use of fixed lease and borrowing. Homesteads are mostly owner used with limited use of fixed lease. However, homesteads are not sharecropped. Few *tabias* reported the existence of private pasture. Irrigated land appears to be more prevalent in more densely[2] populated areas. In 1998, 35% of *tabias* with low population density and 86% of *tabias* with high population density reported owner used irrigated lands. The results for 1991 are also similar, with 35% of *tabias* of low population density and 79% of *tabias* with high population density reporting owner used irrigated lands.

The number of landless households in Tigray is increasing. According to respondents, the average number of landless households per *Tabia* was 104 in 1991. This figure grew to 264 in 1998, an increase of 140% (Table 1). The pattern of landlessness appears to show a marked difference with population density and market access[3]. Landlessness is higher in low population density and low market access areas.

Table 1: Number of Land Less Households in *Tabia* by Population Density and Market Access

Year	Average	Population Density		Market Access	
		Low	High	Low	High
1991	104	196	64	115	63
1998	267	318	251	277	232

[2] *Tabias* were classified as high population density if they had more than 100 people per km^2.
[3] *Tabias* were classified as high market access if they are within 1 change to zero km distance from the nearest town.

Land is acquired in Tigray in several ways. These include distribution, sharecropping, fixed lease, borrowing, inheritance and "accommodation"[4]. However, there have been changes in the importance of these means of land acquisition in the region between 1991 and 1998 (Table 2). While the use of fixed lease appears to be increasing, the use of distribution, "accommodation", and inheritance are decreasing. Sharecropping arrangements also appear to be shifting towards equal share between the owner and the leaseholder. However, the use of borrowing showed no change. A household level analysis in south central Tigray showed that land transfer through leasing or sharecropping was higher in high altitude areas and with female headed households (Gebremedhin, 1998).

Table 2: Change in Methods of Land Acquisition (1991 – 1998) by Population Density and Market Access*

Means of acquisition	Average	Population Density		Market Access	
		Low	High	Low	High
Inheritance	2	1.59	2.32	2	2
Distribution	2.12	1.86	2.28	2.01	2.55
"Accommodation"	1.61	1.61	1.61	1.66	1.39
Fixed Lease	3.86	3.88	3.84	3.94	3.63
Sharecropping(1/2)	3.3	3.58	3.25	3.34	3.17
Sharecropping(1/3)	3.2	3.67	2.76	3.16	3.54
Sharecropping(1/4)	2.58	2.64	1.75	2.62	2
Borrowing	3	3	3	3	No obs

* 1 = major decrease, 2 = minor decrease, 3 = no change, 4 = minor increase, 5 = major increase

The quality of land appears to determine its rental price. In 1998, the average rental price per ha for land with fixed lease was Birr[5] 450, 550, and 845 for poor, medium and good quality land, respectively (Table 3). The rental price also appears to show marked difference with population density and market access. Rental prices tend to be higher in high population density areas. However, rental prices surprisingly seem to be higher in low market access areas.

[4] "Accommodation", locally called "Mishigishag" is an institution where a landless household is allotted land from communal land or from households who are believed to have larger land, without making a major land distribution in the community.

[5] In 1998, 7.02 Birr= 1 US $.

Table3: Average Rental Price in 1998 for Fixed Rental by Soil Quality, Population Density and Market Access (Birr/ha)

Soil Type	Average	Population Density		Market Access	
		Low	High	Low	High
Poor Soil	450	---	450	577	320
Medium Soil	550	315	709	604	452
Good Soil	845	400	972	906	746

Under share tenancy, the land holder received on average about half of the grain, and about 15% of the straw or crop residue in 1998 (Table 4). Land holders' share of grain and straw does not appear to be influenced by differences in land quality, nor by population density or market access, consistent with the standard theory about sharecropping being a balance between incentive problems in wage contracts and risk pooling advantage of sharecropping. Under share cropping arrangements, land holders contribute to labor, seed and fertilizer costs, although traction and equipment costs are entirely covered by the leaseholder. On average, land owners contributed about 10% of labor, 16% of seed and 5% of fertilizer cost in 1998 (Table 5). The proportion of labor cost covered by the land owner seems to be higher in low market access areas than in high market access areas.

Table 4: Land Holders Share under Share Tenancy by Population Density and Market Access (1998)

Out put	Soil Type	Average	Population Density		Market Access	
			Low	High	Low	High
Grain	Poor Soil	0.43	0.33	0.47	0.42	0.45
	Medium Soil	0.44	0.32	0.50	0.43	0.48
	Good Soil	0.45	0.35	0.50	0.44	0.49
Straw/Crop Residue	Poor Soil	0.14	0.09	0.13	0.12	0.18
	Medium Soil	0.13	0.11	0.14	0.11	0.19
	Good Soil	0.14	0.14	0.14	0.12	0.18

Table 5: Land Holder's Share of Cost Under Share Tenancy by Population Density and Market Access (1998)

Cost	Average	Population Density		Market Access	
		Low	High	Low	High
Labor	0.1	0.11	0.1	0.11	0.04
Seed	0.16	0.06	0.22	0.08	0.11
Fertilizer	0.05	0.09	0.03	0.06	0.03
Oxen	0	0	0	0	0
Equipment	0	0	0	0	0

The average duration of contract for both sharecropping and fixed lease arrangements appears to be two years, and seems to be independent of the type of crop planted by the leaseholder; population density and market access (Table 6). Moreover, the likelihood of renewal of lease or sharecropping contracts is not affected by the type of crop planted, or investment in soil and water conservation and tree planting (Table 7). This suggests that lease and sharecropping contracts in the region do not provide incentive to leaseholders to invest in land improvement practices.

Table 6: Average Duration (years) of Contract by Population Density and Market Access (1998)

Land Tenure	Crop Type	Average	Population Density		Market Access	
			Low	High	Low	High
Fixed Rental	Teff	1.73	1.69	1.77	1.68	1.81
	Legumes	1.69	1.62	1.77	1.68	1.70
	Other Crops	1.61	1.60	1.63	1.59	1.66
Share Tenancy	Teff	1.98	2.10	1.93	2	1.92
	Legumes	1.90	1.95	1.87	1.90	1.89
	Other Crops	1.94	2.06	1.88	1.94	1.91

Table 7: Factors Affecting Likelihood of Renewal or Extension of Land Lease or Share Cropping Arrangement by Population Density and Market Access*

	Factors	Average	Population Density		Market Access	
			Low	High	Low	High
Tenant	Plant Teff	3.06	3	3.09	3.08	3
	Plant Legumes	3.12	3	3.19	3.16	3
	Use Manure	3.14	3.1	3.16	3.16	3.05
	Invest in SWC	3.15	3.1	3.19	3.20	3
	Plant Trees	3	3	3	3	3
Owner	Invest in SWC	3	3	3	3	3
	Plant Trees	3	3	3	3	3

* 1=reduces significantly, 2= reduces slightly, 3=no effect, 4= increases slightly, 5= increases significantly

Farmers in Tigray do not perceive that their land tenure security can be enhanced by investing in the land, such as soil and water conservation practices, planting trees, clearing the land or building fences (Table 8). This perception appears to be unaffected by differences in population density or market access. However, land tenure security has a significant perceived impact on the incentive of farmers to invest in land improvements (Table 9). Land tenure security significantly affects farmers' incentives to invest in constructing soil and water conservation practices, building fences, and planting trees. Tenure security also appears to affect the likelihood of fallowing land for more than a year. The effect of tenure security on farmer incentives to invest in land improvements appears to be consistent regardless of population density or market access conditions.

Table 8: Factors Affecting Land Tenure Security by Population Density and Market Access*

Factors	Year	Average	Population Density		Market Access	
			Low	High	Low	High
Building Fences	1991	3.06	3.04	3.08	3.06	3.06
	1998	3.36	3.54	3.29	3.41	3.17
Planting Trees	1991	3.07	3.05	3.09	3.08	3.05
	1998	3.35	3.61	3.24	3.38	3.23
Cutting Trees	1991	3.10	3.25	3.04	3.11	3.06
	1998	2.95	2.73	3.05	2.93	3.06
Clearing Land	1991	3.06	3.09	3.05	3.07	3.05
	1998	3.08	3.08	3.09	3.04	3.23
Constructing or Maintaining SWC	1991	3.14	3.24	3.11	3.14	3.16
	1998	3.16	3.12	3.18	3.12	3.27
Leaving Land Fallow	1991	2.94	3	2.90	2.92	3
	1998	3.12	3	3.18	3.11	3.16
Constructing a House	1991	3.15	3.24	3.12	3.14	3.21
	1998	3.08	3.31	2.97	3.10	3

*1 = decrease substantially, 2 = decrease slightly, 3 = no effect, 4 = increase slightly, 5 increase substantially

Table9: Factors Affected by Tenure Security by Population Density and Market Access* (1998)

Factors	Average	Population Density		Market Access	
		Low	High	Low	High
Building Fence	4.96	4.9	4.98	4.96	4.94
Planting Trees	4.83	4.9	4.79	4.80	4.94
Cutting Trees	3.13	2.46	3.40	3.16	2.98
Clearing Land	4.49	4.62	4.46	4.45	4.69
Constructing or Maintaining SWC	4.70	4.70	4.7	4.64	4.94
Leaving Land Fallow	4.46	4.46	4.42	4.5	4.30
Constructing a House	3.73	3.66	3.75	3.72	3.76
Reside outside of Tabia	3.77	3.90	3.71	3.88	3.34

*1 = decrease substantially, 2 = decrease slightly, 3 = no effect, 4 = increase slightly 5 = increase substantially

3. EMPIRICAL APPROACH

Our primary focus in this paper is to determine if farmers' perceived land tenure security affects investments in land improvement and use of improved farming practices that maintain soil fertility, after controlling for other factors that could affect investment in land and improved land use. The analysis aims to test the general hypothesis that perceived tenure security will enhance investments in land and use of improved farming practices.

We used the proportion of households in *Tabia who* made private investments in stone terraces, tree planting and soil bunds between 1991 and 1998 as indicators of investment in land. We used changes in the proportion of households who used fallowing for more than a year and composting between 1991 and 1998 as indicators of improved farming practices that maintain or enhance soil fertility. Stone terraces and tree planting are long-term investments, the returns of which may take several years in the future. Hence, farmers' incentive to invest in these practices is expected to be dependent on perceived land tenure security. Soil bunds are low cost medium-term investments, but tenure security is still important for investment decisions since returns accrue in the future. Fallowing and composting are expected to improve soil fertility. However, farmers with low tenure security may not opt to fallow their land or use compost as they may not be certain of cultivating the same land during the next cropping seasons.

We used seven indicators of tenure security. These included number of land distributions in *tabia* since 1974; number of years since last land distribution in *tabia;* number of landless households in *tabia* in 1991 and change in number of landless households between 1991 and 1998; land tenure security feeling of community members in 1991, whether it was high or moderate (as opposed to highly or moderately insecure); tenure security perception of community members, whether it improved moderately between 1991 and 1998 (as opposed to no change); and tenure security perception of community members whether it improved significantly between 1991 and 1998 (as opposed to no change).

We expected that the frequency of land distributions in the community would be associated with less tenure security, and thus less investment on the land or use of improved land management practices. Number of years since last land distribution was expected to enhance tenure security and thus investment, since it is an indicator of stability of tenure in the region, after controlling for other indicators of tenure security. The number of landless households in 1991 and the change in the number of landless households were expected to be associated with less tenure security, since the higher the number of landless households, the higher would be community expectations for land redistribution to take place. The survey also solicited directly community perceptions of tenure security in 1991 and 1998. Community perceptions of tenure security in 1991 were solicited in ordinal terms (highly insecure, moderately

insecure, moderately secure, and highly secure). A dummy variable was constructed from the ordinal responses (1=highly or moderately secure, 0=highly or moderately insecure). Community perceptions of change in their tenure security in 1998 (cf. 1991) were solicited in ordinal terms (deteriorated significantly, deteriorated moderately, no change, improved moderately, and improved significantly). Since perceived tenure security either remained the same or improved in the sample communities, two dummy variables were constructed from the ordinal responses (1= improved moderately, 0=no change; and 1=improved significantly, 0=no change).

In order to isolate the effect of these tenure security variables on land investment and improved farming practices, we controlled for indicators of agricultural potential (annual precipitation and average elevation), and market access. We also controlled for changes in literacy in villages between 1991 and 1998. We included zonal dummies to control for zone specific factors that may have a bearing on land tenure, such as differences in land administration and community involvement in land related issues.

The econometric model is given by:

$$Y_{v2} - y_{v1} = a_2 - a_1 + b(x_{v2} - x_{v1}) + (c_2 - c_1)z_v + e_{v2} - e_{v1}$$

Where y_{vt} is the proportion of households in village v who invested in land or used improved farming practices in year t, x_{vt} is a vector of time varying factors affecting land investment or use of improved practices, z_v is a vector of observed fixed factors affecting land investment or use of farm practices, and e_{vt} are unobserved time varying factors. This first difference model eliminates unobservable fixed factors as a source of omitted variable bias. The observable fixed factors (z_v) will have effect only if their marginal impact has changed over time.

Perceived tenure security variables may also be endogenous to land investment, since farmers may feel that their tenure security can be influenced by their land management decisions, especially long-term investments. Analysis of descriptive information showed that farmers in the study area do not believe that their land investment decisions influence their tenure security. This result was also confirmed by an exogeneity test using Hausman's test (Hausman, 1978).

We used maximum likelihood two-limit Tobit procedure to estimate the equations for the changes in the proportion of households who invested in stone terraces, tree planting, and soil bunds, since these variables are censored from both sides. We used ordinary least squares (OLS) to estimate the equations for the changes in proportion of households using fallowing and composting since theses variables were continuous.

5. RESULTS

Results of the determinants of land investments are given in Table 10. Three of the seven tenure security variables in the case of investment in stone terraces, and two of them in the case of tree planting are significant with the expected signs, supporting the general hypotheses that tenure security is important for investment in land. In the case of investment in soil bunds, two of the tenure security variables are significant with one having the expected sign.

Table 10: Determinants of land investments in the highlands of Tigray[1]

Variable	Stone Terrace (Tobit[2])	Tree Planting (Tobit[2])	Soil Bund (Tobit[2])
Number of land distribution since 1974	0.01540	0.04374	-0.03698
Number of years since last land distribution in *Tabia*	0.02663**	0.01294	-0.02486
Number of landless households in *Tabia* in 1991	-0.00053**	0.00048	0.00211***
Change in number of landless households (1991 – 1998)	-0.00073***	0.00004	-0.00081
If community felt very or moderately secure in 1991	0.15732	0.68895**	0.14717
If land tenure security improved significantly (1998 – 1991)	-0.06490	0.74333***	0.081103
If land tenure security improved moderately (1998 – 1991)	-0.06330	-0.24963	0.35504**
Average elevation (meters)	0.00042*	-0.00169	0.00003
Average annual precipitation (mm)	0.00062	0.00169	-0.00275**
Change in proportion of households who are literate (1998 – 1991)	0.47635**	-0.76777	0.27268
Distance to market (walking minutes)	0.00018	0.00047	-0.00057
Central Zone *(cf. South Zone)*	0.18188	0.31770	0.19013
East Zone *(cf. South Zone)*	0.05512	0.41756	0.05169
West Zone *(cf. South Zone)*	0.21141	0.32152	0.27355
Area of *Tabia*	0.00164	0.00197	-0.00454**
Constant	-1.3333	-2.5143	1.79430
Number of observations	91	88	91
F	3.55	2.25	3.38
Prob > F	0.0001	0.0008	0.0002

*** Significant at 1%, ** significant at 5%, * significant at 10%.

[1] All regression results are corrected for sampling stratification and weights, and standard errors are robust to hetroskedasticity and non-independence within the primary sampling units.
[2] Survey Interval Regression was used to estimate the two-limit maximum likelihood Tobit models.

The duration since last land distribution in *tabia* is associated with higher investments in stone terraces, as expected, but failed to influence investments in tree planting or soil bunds. Number of landless households in 1991 and change (increase) in number of landless households between 1998 and 1991 are associated with less investment in stone terraces. When the number of landless households increases, the expectation of communities for a redistribution of land to occur increases thus reducing the tenure security perception of land owning households. However, the number of landless households in 1991 is associated with investment in soil bunds. It could be that farmers with less tenure security resort more to investing in soil bunds, practices that are low cost and medium-term soil and water conservation investments. Gebremedhin and Swinton (2003) found that tenure security is more important for investment in durable long-term investments such as stone terraces, than for short-term low cost investments such as soil bunds.

Communities which felt secure about their land tenure in 1991 and communities whose tenure security perception improved significantly between 1991 and 1998 invested more in tree planting than those who felt insecure in 1991 and those whose tenure security perception remained the same between 1991 and 1998. Moreover, moderate improvement in tenure security is also associated with increased investment in soil bunds.

We also found out that investment in stone terraces is higher in higher altitude areas, and in areas where literacy is higher. Literacy, as a means of access to written information, may raise the awareness of households regarding the availability and importance of land investments, and improved efficiency of farm operations. Investment in soil bunds is less in areas of higher rainfall, perhaps because of water logging problems, but higher in higher elevation. Area of *tabia* decreased investment in soil bunds.

The results of the regression estimates for fallowing and composting also support the general hypotheses that tenure security is important for improved farming practices that would have a carry-over effect in soil fertility (Table 11). Secure land tenure perception of communities in 1991 is associated with higher fallowing, as expected. Increases in number of landless households in *tabia* is also associated with reduced fallowing. Moderate or significant improvements in perceived tenure security is associated with higher use of composting. However, contrary to expectations, we found out that moderate improvement in land tenure security is associated with reduced fallowing. Fallowing is higher in higher altitude areas, and in areas closer to market places. There is more use of fallowing in the eastern zone compared to the southern zone, and more use of composting in the central zone compared to the southern zone.

Table 11: Determinants of use of improved farming practices in the highlands of Tigray[1]

Variable	Fallowing (OLS)	Composting (OLS)
Number of land distribution since 1974	-0.00201	0.03516
Number of years since last land distribution in Tabia	0.00766	0.00315
Number of landless households in Tabia in 1991	0.00001	0.00012
Change in number of landless households 1991 - 1998	-0.00025**	-0.00002
If community felt very or moderately secure in 1991	0.11073*	0.08529
If land tenure security improved significantly (1998 – 1991)	0.00382	0.21856*
If land tenure security improved moderately (1998 – 1991)	-0.09674**	0.20113***
Average elevation	0.00017***	0.00008
Average annual precipitation	0.00022	-0.00004
Change in proportion of households literate (1998 – 1991)	0.00023	0.05844
Distance to market	-0.00023**	-0.00016
Central Zone *(cf. South Zone)*	0.01583	0.13834**
East Zone *(cf. South Zone)*	0.08742*	0.08030
West Zone *(cf. South Zone)*	0.00189	0.07078
Tabia area *(cf. South Zone)*	.00199***	-0.00145
Constant	-0.74437	-0.19051
Number of observations	91	91
R-squared	0.28	0.32

*** Significant at 1%, ** significant at 5%, * significant at 10%.

[1] All regression results are corrected for sampling stratification and weights, and standard errors are robust to hetroskedasticity and non-independence within the primary sampling units.

One of the reasons that the explanatory variables may be insignificant is if there is a high colinearity among the variables. We tested for multicollinearity and found that it is not a problem in the data set. The maximum variance inflation factor we found is 8, and most variables have variance inflation factors of less than 5.

6. CONCLUSIONS AND IMPLICATIONS

According to survey respondents, landlessness is increasing in the Tigray region. Between 1991 and 1998, the number of landless households per *tabia* grew by more than 140%. Informal land transactions are practised in the region, including sharecropping, fixed lease paid in cash or in kind, and borrowing. The use of fixed lease as a means of land acquisition, although very low, appears to be increasing, and sharecropping arrangements seem to be shifting towards equal share between the landholder and the leaseholder. While the rental price of land seems to depend on the quality of land, sharecropping ratios appear to be independent of the quality of land.

While land owners cover part of labour, seed and fertilizer costs in sharecropping arrangements, traction and equipment costs are entirely covered by the shareholders. The average term for sharecropping and fixed lease is about two years, and is not influenced by the type of crop planted. Likelihood of renewal of sharecropping or lease contracts is not affected by the type of crop planted or land investment by the tenant. Farmers reported that while tenure security is highly likely to affect farmer incentives to invest in land, farmers' investment in own land is unlikely to affect tenure security. Irrigated land appears to be concentrated in high population density areas.

Econometric analysis of the effect of tenure security in land investments and use of improved farming practices show that tenure security is an important determinant of farmers' incentives to invest in land and use improved farming practices. Stability of tenure encourages investment in stone terraces, while tenure insecurity due to a higher number of landless households has the opposite effect. Moderate improvements in perceived tenure security results in higher investment in soil bunds. Significant improvements in tenure security is important for investment in tree planting.

Our results imply that improving tenure security is important for improved land management in the region. The land titling that took place in Tigray, coupled with the regional legislation that prohibits further land redistribution, is an important step in this direction. However, legal guarantee for farmers' use rights in perpetuity, their right for compensation for investments made in land in case of special-circumstances of land redistributions, and the right to bequeath land to children could strengthen tenure security.

The results also imply the need to explore the potential role that public policy plays to facilitate the development of the fledgling land market. Moreover, restrictions on land exchange, such as those which limit land transactions to two years, may need to be revisited. The wishes and preferences of farmers regarding land tenure arrangements and land administration should be considered as crucial inputs to future tenure arrangements in the region.

An open, concerted and inclusive debate on the relevance and feasibility of alternative land tenure systems for the country or different parts of the country needs to be encouraged. The debate on land tenure should broader than being fixated on the state/public versus private ownership dichotomy, since these are only two polar end points of a continuum of several possible tenure arrangements. Each potential land tenure system needs to be evaluated in terms of its effect on the tenure security it provides to farmers, since security is more important than the mode of ownership.

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Annex: Summary statistics of variables used in regression

Variable	No of observations	Mean	Std. Dev.	Min	Max
Proportion of households who invested in soil bunds (1991-1998)	100	0.23	0.30	0	1
Proportion of households who privately invested in SWC (1991-1998)	100	0.52	0.30	0	1
Proportion of households investing in tree plantation (1991-1998)	100	0.58	0.36	0	1
Change in proportion of households using compost between 1998 and 1991	100	0.17	0.25	-0.80	0.90
Change in proportion of households fallowing between 1991 and 1998	100	-0.07	0.13	-0.50	0.10
Number of land distribution in *Tabia* since 1974	100	3.58	1.12	1	6
No of years since last land distribution in *Tabia*	100	8.84	2.53	1	19
Number of landless households in *Tabia* in 1991	100	89.26	157.65	0	750
Change in number of landless households (1991-1998)	100	160.60	168.65	-210	800
If community felt very or moderately secure in 1991	100	0.80	0.40	0	1
If land tenure security improved significantly (1998-1991)	100	0.16	0.37	0	1
If land tenure security improved moderately (1998-1991)	100	0.66	0.48	0	1
Average elevation (meters)	92	2003.04	297.21	1278.73	2725.14
Average annual precipitation (mm)	92	641.10	85.57	501.37	870.5
Change in proportion in households who are literate (1988-1991)	88	0.34	0.12	-0.19	0.62
Distance in market (walking minutes)	100	167.20	124.76	10	720
Central Zone	100	0.34	0.47	0	1
East Zone	100	0.24	0.43	0	1
West Zone	100	0.14	0.35	0	1
Area of *Tabia*	98	57.24	35.24	12.30	179