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# LAND REDISTRIBUTION, TENURE INSECURITY, AND INTENSITY OF PRODUCTION: A STUDY OF FARM HOUSEHOLDS IN SOUTHERN ETHIOPIA

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**ABSTRACT**

This study analyzes the determinants of land tenure insecurity and its impact on intensity of use of purchased farm inputs among households in Southern Ethiopia. Seventeen percent of the households stated that they were tenure insecure. The feeling of tenure insecurity could be caused by the land redistribution policy in Ethiopia where household size has been the main criterion used for land allocation after the land reform in 1975. This would imply that land rich households should be more tenure insecure. Alternatively, the local power structure may be strong enough to counter this and cause the land rich, who are also likely to be influential, to be able to protect their land rights. The analysis revealed that, in the overall sample, relative farm size was not significantly correlated with tenure insecurity. When testing for each site, however, we found that in four of the sites per capita farm size was positively associated with tenure insecurity, while in five other sites it had a significant negative association. This may be due to local historical, cultural, and demographic differences giving way to differences in the effects of the redistribution policy and the local power structure on tenure insecurity.

We assessed the impact of tenure insecurity on the intensity of use of purchased farm inputs. The tenure insecurity variable was insignificant. Farmers in areas with a positive correlation between farm size and tenure insecurity were more likely to purchase farm inputs. Larger farms were more likely to use purchased inputs, but this effect was lower in areas with a positive correlation between farm size and tenure insecurity. Poverty and subsistence constraints may explain this absence of higher intensity of use of purchased inputs on small farms. By contrast, the land redistribution policy may have improved small farms' access to purchased farm inputs.

Key words: land redistribution, tenure insecurity, farm input intensity, resource poverty, Southern Ethiopia.

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# LAND REDISTRIBUTION, TENURE INSECURITY, AND INTENSITY OF PRODUCTION: A STUDY OF FARM HOUSEHOLDS IN SOUTHERN ETHIOPIA

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## 1. INTRODUCTION

The distribution of land resources is a central political economy question in many developing countries. Disputes over land have been the root cause of civil wars and revolutions, much so because land has been the primary means of generating livelihood for the overwhelming majority of the rural population in these countries (Deininger and Binswanger 1999; Deininger and Feder 1998). Furthermore, the way land tenure is instituted and the consequent perceptions and expectations of the land holders may directly affect the way farms are managed (Firmin-Sellers and Sellers 1999; Maxwell and Wiebe 1999; Sjaastad and Bromley 1997; Gavian and Ehui 1999; Place and Migot-Adholla 1998; Li et al. 1998; Besley 1995; Platteau 1996; Alemu 1999) and this may have efficiency as well as sustainability consequences.

In the land reform in Ethiopia in 1975 all land was appropriated by the state after the new military regime took over. Landlords lost their land rights and land was distributed to individual households with household size being the main criterion for land allocation (Rahmato 1994b; Ege 1990, 1994; Abegaz 1994; Pausewang 1988; Teferi 1994; Alemu 1999; Yohannes 1994; Admassie 1995; Joireman 1994). As household sizes

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change over time and new households appear, there was also a need to redistribute land at later stages to improve or maintain the egalitarian distribution and to provide land to new landless households. But how did this policy affect tenure insecurity? And has the land reform in Ethiopia eliminated the influence and power of the local elites? Or do the relatively land rich have the power to retain their land and therefore do not feel more tenure insecure? Given that the land policy has affected the level of tenure insecurity in Ethiopia, how does this affect the intensity of production of farm households? Alemu (1999) found that small farms invested more in land conservation than large farms in a sample of households from central and northern Ethiopia. He claimed that this lower investment on large farms was due to their higher level of tenure insecurity as they were more likely to lose land in future redistributions. An alternative hypothesis could be that small farms invest more on the land because land is scarcer and therefore more valuable (Boserup's (1965) hypothesis). We address these issues by analyzing data from 500 households in 15 different sites in southern Ethiopia. We find that the relationship between farm size and tenure insecurity is site-specific, and that the land redistribution policy, through its effect on tenure insecurity, has little impact on the intensity of use of purchased farm inputs, even in areas with a positive correlation between farm size and tenure insecurity. Larger farms were more likely to purchase farm inputs and to plant perennials, indicating that poverty and subsistence constraints may limit the ability of small farmers to intensify production by purchase of inputs or to invest in perennials. Tenure insecurity also appeared not to affect whether farmers planted perennial crops.

The rest of the paper is arranged such that we present the theoretical approach in part 2, followed by a description of the study area and data in part 3. In part 4 we present a description of the methodological approach. We then present the results and discussions in part 5 followed by the conclusion.

## 2. CONCEPTUAL FRAMEWORK AND HYPOTHESES

Tenure insecurity is defined here as the perceived probability or likelihood of losing ownership of a part or the whole of one's land without his/her consent (Sjaastad and Bromley 1997, Alemu 1999). The strength of this perception may have a bearing on how farmers manage their land and this in turn has an effect on agricultural production and sustenance of the people who directly depend on it. Many authors (Maxwell and Wiebe 1999; Alemu 1999; Deininger and Feder 1998; Li et al. 1998; Lawry 1994; Kidanu and Alemu 1994) have argued that tenure insecurity discourages investment on land by removing the incentives for it, as one may not be able to collect the expected flow of benefits of one's efforts if there looms a threat of losing the land in the future. It is also possible that land tenure arrangements that assign land rights to the community or to landlords, rather than to the actual land users, may discourage long-term investment in land improvement (Hayami and Otsuka 1993).

Through investment, farm households improve their productivity, leading to increased agricultural output and increased income and wealth level. By providing incentives for exerting non-observable extra efforts (Deininger and Feder 1998) and for use of purchased inputs, tenure security may also have an impact on productivity and farm output, even in the short-run.

Knox McCulloch, Meinzen-Dick and Hazell (1998) emphasize how spatial and temporal characteristics of technologies have implications for the relevance of tenure insecurity and the need for collective action. Tenure insecurity is likely to be of less importance if costs and benefits accrue in the short run than if the benefits accrue over a longer time period. We may therefore expect tenure insecurity to have more impact on decisions like tree planting, building of conservation structures or irrigation, than purchase of fertilizer, seeds and other inputs providing short-term returns. Our basic hypothesis is therefore that tenure insecurity has no impact on intensity of use of purchased farm inputs but that it has an impact on growing of perennials. The fact that planting of perennials and other long-term production decisions play a role only in some farming systems, while annual crops and short-term production decisions totally dominate other farming systems, therefore may imply that tenure insecurity may only matter in farming systems where long-term production decisions are important.

Gavian and Fafchamps (1996, p.461) found that "existing empirical studies have failed to establish strong links between land rights, investment, and agricultural productivity on African croplands." They refer to only one unpublished study (Kille and Lyne 1993) that has succeeded in empirically linking tenure security to input use. Place and Hazell (1993) found that land rights (use rights or transfer rights) were not significantly related to yields in Ghana, Kenya and Rwanda. They also found no relationship between total costs of non-labor inputs and land rights in Ghana while there was a positive correlation between the incidence of some types of land improvement and land rights in Rwanda. Use of credit was also not significantly related to land rights. They concluded that lack of access to credit, insufficient human capital, and labor shortages adversely affected investment decisions more than insecurity of tenure. Barrow and Roth (1990) found no link between land title or land rights and land improvements in Kenya. Gavian and Fafchamps (1996) found that tenure insecurity might incite farmers to divert scarce manure resources to more secure fields whenever they can, as they preferred to use manure on own rather than on borrowed fields. Fortmann et al. (1997), in a study of tenure security and gender differences in tree planting in Zimbabwe found that women were less likely to plant trees where they have less security of duration of tenure.

Gavian and Ehui (1999) found in a study in Arsi in Ethiopia that informally contracted lands appeared to be farmed 10-16% less efficiently but that such lands actually received more, rather than less, inputs. They attributed the gap in factor productivity to differences in input quality or lack of skills in applying inputs. Another study of the same data (Pender and Fafchamps 2001), found no significant difference in input intensity or output value on own vs. sharecropped fields after having controlled for differences in village, household and plot characteristics.

## THE ETHIOPIAN LAND REFORM AND TENURE INSECURITY

Proclamation 31, 1975, "Public Ownership of Rural Lands," prohibited private ownership of land; transfers of land by sale, lease and mortgage; as well as hiring of labor. It acknowledged only use rights to land and set a maximum farm size of 10 hectares. In this way absentee landlordism was eliminated and only owner cultivation became legal. The previous landlords could retain some land if they were willing to cultivate it themselves. They received no compensation for their losses and tenants were freed from all their obligations to their previous landlords.

Land was distributed to households and family size was the main criterion for land allocation. Consideration of land quality, operational capacity, and previous land possession depend on local circumstances as the process of land redistribution was decentralized to the Peasant Association level, the smallest administrative unit, which comprised an area of approximately 800 ha of land (Rahmato 1984). Subsequent land redistributions served to improve upon the initial distribution and to allocate land to new persons who were eligible to receive land. The timing and frequency of such redistributions varied from locality to locality. This policy created a fear among those who had larger land areas, however, as there was a need to take land from them in order to have something to give to those with no or very little land (Ege 1997).

As a consequence of this land policy, Alemu (1999) claims that the farm households' tenure security in Ethiopia is inversely related to the farm size they hold (adjusted for household size) (Hypothesis 1).

*Determinants of Tenure Insecurity*

In this paper we provide a test of Alemu's hypothesis that farm households with larger relative farm size feel more tenure insecure than those with relatively less land. This may also indicate the effect of Ethiopia's land policy on farm household perceptions of tenure security.

The perception of tenure insecurity as discussed above can be illustrated in a simple model as:

$$N = N(R) \tag{1}$$

where $N$=1 when the household fears losing land, $N$=0 otherwise. If this fear is influenced by the relative farm size due to the land redistribution policy and $R$ is relative farm size[3], Hypothesis 1 implies that;

$$\frac{\partial N}{\partial R} > 0 \tag{2}$$

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[3] R is the farm size per capita of the household divided by the average farm size per capita in the community.

An opposing scenario may also be envisaged. The local power structure may subvert the official policy[4], and the more powerful households may have succeeded in retaining more land. They may also feel confident that they can use their influence to keep their larger holdings even if new land redistributions were to take place, thus they feel more tenure secure (Hypothesis 2). The model therefore becomes:

$$N = f(R, P(R)) \qquad (3)$$

where $P$ is the power of the household. In this case the relationship between farm size and tenure insecurity becomes ambiguous:

$$\partial N/\partial R = \partial f/\partial R + (\partial f/\partial P)(\partial P/\partial R) <> 0 \qquad (4)$$

If the second term dominates over the first term, the effect of the local power structure dominates the effect of the redistribution policy and we expect a negative sign, implying that larger farms feel more tenure secure. The net effect of the two may differ from locality to locality depending on the local historical, cultural, and demographic differences. Hence, in some localities the power structure may dominate and per capita land holding may be negatively associated with tenure insecurity, while in other locations local power structure may matter less and per capita land holding may be positively correlated with tenure insecurity.

Another hypothesis on the interaction of land allocation policy and tenure insecurity arises from a stipulation that rural households must demonstrate farming capacity in order to retain their land. Households that fail to farm all their land

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[4] It appears that this hypothesis was behind the recent land redistribution exercise in the Amhara region of North-central Ethiopia. Rahmato (1984) also reported considerable cross-community variation in terms of how the initial land distribution and later redistributions were actually practiced.

themselves and instead rent out[5] part of or all their land may therefore feel less tenure secure (Hypothesis 3), even though short-term renting of land has become legal under the new constitution.

Farm households with perennials are expected to feel less tenure insecure (Hypothesis 4), as perennial crops are often seen to strengthen claims to land and demonstrate continuous use (Sjaastad and Bromley 1997, Besley 1995).[6]

Household wealth variables and cash crop orientation may be signs of power and these may reduce tenure insecurity (Hypothesis 5). We have therefore included livestock holding and area share of cash crops in the model. Since there is overlap between cash crops and perennials, the perennial subsistence crop *enset* was kept as a separate variable and other perennials were included in the cash crop area.

We summarize the model for determinants of tenure security as follows[7];

$$N = f\{R, D_{RO}, A_{prn}, Ox, TLU, D_S , Z^h\} \qquad (3)$$

where,

- $N$ = Perception of tenure insecurity of a household (dependent variable). If a household feels tenure insecurity, the variable takes the value of 1, and 0 otherwise.
- $R$ = Relative farm size. A positive sign is expected for the variable if the land redistribution policy causes tenure insecurity.

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[5] We define "renting" of land in a wide sense, including renting by fixed-rent as well as sharecropping arrangements.
[6] We have information from Tigray that planting of trees has been used to gain more secure rights to land (Hagos, pers. com.).
[7] For testing on site by site basis, we use the same model except for replacing R with $D_{FS}$*R. It allows us to test how relative farm size is related to tenure insecurity in each site.

- $D_{RO}$ = Dummy variable, =1 for households renting out land through fixed rent or sharecropping arrangements. Positive sign expected.
- $A_{prn}$ = Area share of perennials. Expected sign of the variable is negative.
- $Ox$ = Oxen holding. Indicator of land operating capacity and wealth (power). A negative sign may be expected for the variable.
- $TLU$ = Livestock holding, excluding oxen (in tropical livestock units). Livestock here is taken as a proxy for wealth, because it is considered to be a standing capital. It is to capture the effect of wealth and may be an indicator of social status and influence (power) of the household in the community. Expected sign is negative.
- $D_S$ = location dummy. Differing signs may be expected depending on local historical differences.
- $D_S*R$ = location specific relative per capita farm size. This variable tests whether tenure insecurity increases with farm size in each location. Different signs may be expected depending on local historical, cultural, and demographic differences.

- $Z^h$ = Household characteristics. In this category we have[8]:
    - Age of head of household (*HHage*), the sign of the variable may be positive if the old are losing their influence in the community and may feel more tenure insecure, or negative if they hold an influential position.
    - Sex of the household head (*HHsex*). Female-headed households may have less influence in the community than their male counterparts and may feel more insecure about their tenure.
    - Education level (*Educ16th* = number of household members with education up to grade 6, *Educ6th* = number of household members with education above grade 6). The higher the level of education, the more informed the household is likely to be about the recent land redistribution exercise in the Amhara region[9], which may have created fears that land would be redistributed elsewhere as well. We expect the variables to be positively correlated with tenure insecurity.

*Tenure Insecurity and Land Use Intensity*

In this section we look at the relationship between tenure insecurity and intensity of farm input use among the farm households in Southern Ethiopia. We explore if tenure insecurity negatively affects intensity of farm input use. We also look at the effect of land

[8] We have left out household size (HHS) because we have already used the variable in converting household land holdings to per capita holdings and its effect is, therefore, already included in the model.
[9] This redistribution was quite extensive in the Amhara region and served to punish those who had been local leaders under the Derg regime as these were perceived to have obtained too much land.

scarcity (population pressure) on farm input use, and see if per capita farm size and farm input use are inversely related.

In a neo-classical economy with perfect markets input intensity would be independent of farm size and household characteristics, and so only land characteristics would matter. An inverse relationship between input intensity and farm size occurs due to imperfections in more than one market, of which markets for labor, credit, and security may be important (Heltberg 1998). And there are serious imperfections in rural factor markets in Southern Ethiopia. Holden and Yohannes (2000) found that the majority of households did not participate in markets for land and oxen, and a considerable proportion of households did not participate in labor and credit markets.

Some households use no purchased farm inputs, making this variable censored at zero. This may be due to access problems, limited ability to buy, risk, and/or low profitability. It may also be most appropriate to look at this as two decisions. Households first decide whether to use or not to use purchased farm inputs and then, if they want or are able to use, they decide how much they are to use/purchase.

We take the intensity of use of purchased farm inputs (such as seeds, fertilizer, pesticides and herbicides) per unit operated area as an indicator of land use intensity. We test whether farm input intensity is affected by tenure insecurity, either through the decision whether to use purchased input or not, and the decision on how much to use. We test this versus alternative hypotheses regarding determinants of intensity of production. For example, is it rather the land scarcity that is the real force behind the level of intensity of use of purchased farm inputs? We can also envisage that both factors may be at work. Hence, we present farm input use intensity as,

$$I = I\{N(R), R\} \tag{4}$$

where I stands for input use intensity, and the rest are as defined in (1) above.

We hypothesize that

$$\frac{\P\ \mathrm{I}}{\P \mathrm{N}} < 0 \tag{5}$$

That is, intensity of input use is reduced by tenure insecurity. Assuming that equation (2) above holds, farm households with larger per capita land holdings feel more tenure insecure and so use less purchased farm inputs per farm size. This implies that

$$\overset{(-)}{\frac{\P\ \mathrm{I}}{\P \mathrm{N}}}\ \overset{(+)}{\frac{\P N}{\P \mathrm{R}}} < 0 \tag{6}$$

Based on the Boserup (1965) hypothesis, we also have that

$$\frac{\partial I}{\partial R} < 0 \tag{7}$$

That is, intensity of farm input use is inversely related to per capita farm size. This effect may appear in cross section data when factor markets are imperfect and is in line with the finding of an inverse relationship between farm size and land productivity that derives from more intensive use of labor on small farms. If equations (2) and (7) above hold, then the inverse relationship may be caused by a combination of tenure insecurity and land scarcity factors. If (2) does not hold but (7) does, then the inverse relationship is caused purely by the land scarcity/population pressure effect.

Specifically, we assert that:

- Land scarcity (population pressure on land) is the main determinant of intensity of farm input use. Hence, households with smaller relative farm size are expected to have larger farm input intensity than households with a larger relative farm size. This may lead to the frequently found inverse relationship between yields and farm size (Heltberg 1998). The question is whether this relationship holds within smallholder agriculture in Ethiopia.

- Poverty and subsistence constraints may undermine the ability of households to purchase farm inputs. These constraints are likely to be more binding on relatively small farms than on relatively large farms. This may imply that the probability and level of use of purchased farm inputs will increase with farm size.
- If tenure insecurity affects farm input intensity negatively, we expect the level of farm input intensity to be lower in communities where equation (2) holds (have a positive correlation between farm size and tenure insecurity). A dummy variable (*DI*) is included for communities with a positive correlation between relative farm size and tenure insecurity. A negative sign may indicate that the redistribution policy has resulted in lower intensity of use of purchased farm inputs in areas where it has been most efficient. A positive sign may indicate that the redistribution policy has had a positive effect on intensity of use of purchased farm inputs. The latter may arise because of more equal access to inputs.
- In communities where equation (2) holds we expect a more negative relationship between relative farm size and farm input intensity. Including the interaction variable DI*R tests this.
- We expect that households with larger own land/operated land ratio ($A_{ratio}$) have higher farm input intensity for two reasons: a. For those renting in land, the Marshallian inefficiency ascribed to sharecropping practices suggests that farmers

will use less inputs on sharecropped land than on own land[10]. b. For those renting out land, this practice may allow intensification on own operated land and give a similar result when factor markets are imperfect. The option of renting out land may allow them to concentrate purchased inputs on a smaller area of land[11]. Households renting out part of their land ($A_{ratio}$>1) may feel less tenure secure overall (Hypothesis 3), although they may also feel more tenure secure for the land they are operating and for which input intensity is measured.

- Other inputs in farming (labor and oxen for plowing) may be complements or substitutes to purchased farm inputs. Imperfections in the markets for these inputs make the household endowments of these to be a good indicator of access.
- Market access may also affect use of purchased farm inputs. Distance to market and transportation technologies are used as indicators of market access. Education could also influence access to off-farm employment[12]. Off-farm income was left out as it was considered endogenous and dependent on other RHS variables and no good additional instruments were available for its prediction.

Finally, a number of household characteristics may influence production decisions as these are non-separable from consumption decisions when markets are imperfect. Empirically, we model farm input intensity among farm households in Southern Ethiopia as:

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[10] A large proportion of land renting in the area is in the form of sharecropping. The Marshallian effect is only relevant when the own to operated land ratio is less than one.

[11] Lack of oxen and inability to rent in oxen is an important reason why land is rented out.

[12] Off-farm income could serve to relax the cash constraint and therefore contribute to more purchase of farm inputs but it could also have the opposite effect because access to off-farm income reduces interest in and capacity to farm intensively. Off-farm income was negatively associated with farm size, livestock wealth and age of household head, and positively associated with education of household members.

$$I = I\{R, A_{ratio}, Ml, Fl, TLU, Ox, Mrktd, t_I, N, DI, DI{*}R, D_S, Z^h\} \quad (8)$$

where the amount of purchased farm inputs ($I$) is a function of relative farm size ($R$), ratio of own land to total operated land ($A_{ratio}$), male labor force ($Ml$), female labor force ($Fl$), livestock holding ($TLU$), oxen ($Ox$)[13], market distance ($Mrktd$), transportation technology dummies ($t_i$), perception of tenure insecurity ($N$)[14], dummy ($DI$) for communities where larger relative farm size is related to more tenure insecurity, interaction term ($DI{*}R$) giving the relative farm size in $DI$ communities, site or farming systems dummies ($D_S$), and household characteristics ($Z^h$). The expected signs of the variables are; $R$ (-), $A_{ratio}$ (+), $Ml$(+/-), $Fl$(+/-), $TLU$ (+), $Ox$ (+), $Mrktd$ (-), $t_i$ (+), $N$ (-), $DI$(-), $DI{*}R$(-), $D_S$ (+/-), $Z^h$ (+/-). The input and stock variables are per unit of operated land.

We would expect a similar effect on investment in perennials as on input intensity. The direction of causality is more uncertain when it comes to planting of perennials, however. Perennials were also planted in only six of the 15 sites. We analyzed what factors were correlated with the decision to have perennials or not. The same factors as above were included as RHS variables.

## 3. STUDY AREA AND DATA

The study was carried out in 1997-98 in 15 different sites in Southern Ethiopia. The sites (clusters) were selected such that the major agro-ecological, cropping practices,

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[13] Livestock holding and oxen holding were not so closely correlated that it created a multicollinearity problem.

[14] Both predicted $N$ and actual $N$ were tested.

market access and demographic variations in the region were included. The survey included a sample of 505 farm households (30 to 35 households randomly selected from each site) that were interviewed using a formal questionnaire. The major variables used in the analysis are presented in Table 1. We see that 17% of the households stated that they were tenure insecure. The shares of households in each site that were feeling tenure insecure are presented behind each site dummy in Table 1. There was considerable variation in this percentage across sites (from zero to 66%). More detailed information on each site is provided in Appendix 1. The sites were also divided in six farming systems, D1 to D6, and this grouping was used in some models. A brief description of the farming systems is provided in Appendix 2.

**Table 1--Overview and Definition of Variables**

| Variable | Description | Mean | Std. Dev. |
|---|---|---|---|
| Tenurepr (*N*) | 1=tenure insecure, 0= tenure secure | 0.17 | - |
| Hhsize | Number of persons in the household | 7.67 | 3.253 |
| Hhage | Age of the head of the household | 44.73 | 0.620 |
| Hhhsex | Sex of household head; male=1, female=0 | 0.95 | - |
| Educ16th | Household members with education up to grade 6 | 2.20 | 0.087 |
| Educ6th | Household members with education above grade 6 | 0.57 | 0.046 |
| Totland | Total owned farm land holding (in Timad) | 6.35 | 5.21 |
| Relar (*R*) | Relative farm size in community | 0.95 | 0.89 |
| Rentoutd ($D_{RO}$) | Dummy for renting out land | 0.08 | |
| Ownoprat ($A_{ratio}$) | Ratio of own land to operational land holding | 0.93 | 0.40 |
| Perenla ($A_{ens}$) | Share of land covered with perennials | 0.31 | 0.68 |
| TLUop | Livestock (in tropical livestock units) per operational holding (op) size | 0.95 | 0.877 |
| Oxenop (*Ox*) | Oxen holding per op size | 0.21 | 0.242 |
| Equinop | Total Equine holding (head count) per op size | 0.09 | 0.160 |
| Mlabop (*Ml*) | Male labor units of the household per op size | 0.57 | 0.633 |
| Flabop (*Fl*) | Female labor units of the household per op size | 0.53 | 0.585 |
| D*varname* | Dummy variable: 1=do not own variable, 0= otherwise | | |
| ln*varname* | Logarithmic transformed variable, ln*varname*=0 if d*varname*=1 | | |
| Mrktdist (*Mrktd*) | Distance of market (in minutes required to reach it) | 80.22 | 72.076 |
| Pinpop | Value of purchased inputs per op size (in birr) | 50.03 | 67.41 |
| Site1 | dummy = 1 if Damot Waja-kero (Sodo area, Wollaita) | 0.06 | |
| Site2 | dummy var. = 1 if Elka (Abosa area, Zway) | 0.06 | |
| Site3 | dummy var. = 1if Kersa Ilala (Kuyera area, Arsi Neghele) | 0.18 | |
| Site4 | dummy var. = 1 if Woyo Medhane-Alem (Arsi Neghele) | 0.13 | |
| Site5 | dummy var. = 1 if Chefasine (Tula area, Sidamo) | 0.00 | |
| Site6 | dummy var. = 1 if Chuko (Wondo Genet area, Sidamo) | 0.03 | |
| Site7 | dummy var. = 1 if Beche (Mareko area, Guraghe Zone) | 0.03 | |
| Site8 | dummy var. = 1 if Koka Neghewo (Koka area, Modjo) | 0.09 | |
| Site9 | dummy var. = 1 if Dekabora (Edjersa area, Modjo) | 0.37 | |
| Site10 | dummy var. = 1 if Woyo-Gabriel (Meki) | 0.00 | |
| Site11 | dummy var. = 1 if Dobi Gogot (Butajira area, Guraghe) | 0.66 | |
| Site12 | dummy var. = 1 if Amburse (Shone area, Hadiya Zone) | 0.47 | |
| Site13 | dummy var. = 1 if Abota Olto (Boditi area, Wollaita) | 0.11 | |

| | | |
|---|---|---|
| Site14 | dummy var. = 1 if Ghedeba (Alaba) | 0.29 |
| Site15 | dummy var. = 1 if Hidi (Debre Zeit) - Reference site | 0.14 |
| s*i*Rela | Site-specific relative farm size, *i* =1-15 | |
| D1-D6 | Farming System Groups, see Appendix 2 | |
| Trans1 | Dummy var.=1 if walking - Reference transport | |
| Trans2 | Dummy var.=1 if using public transport | |
| Trans3 | Dummy var.=1 if using horse cart | |
| Trans4 | Dummy var.=1 if partly public transport & partly walking | |
| Dinsec (*DI*) | Dinsec=1 in communities with positive N*R, Dinsec= 0 otherwise | |
| Relinsec (*DI*R*) | Relative farm size in communities with positive N*R | |

Site1 – site 15 mean values in the table are % feeling tenure insecure in the sample.

To control for the differences in agro-ecological conditions, cropping practices, population pressure, market access, and prices of purchased inputs between the sites, we have included dummy variables for the 15 sites with one site (Site 15) serving as a reference site. The reference site is Hidi (Debre-Zeit area), a high potential cereal (small grains) - livestock zone with relatively good market access. Likewise, for the transportation technology we have 4 dummies, namely walking (Trans1), using public transport (Trans2), using horse/donkey cart (Trans3), and partly walking partly public transport (Trans4), and the reference is Trans1. We have also included a variable, equines (donkeys, horses and mules), that represents the major transportation animals in Ethiopia.

## 4. ECONOMETRIC ESTIMATION

*Estimation of Tenure Insecurity Model*

The perception of tenure insecurity and the factors affecting it can be modeled as,

$$N = \beta' x + \varepsilon \qquad (9)$$

where $N$=1 if the household feels tenure insecure, and $N$=0 otherwise, $x$ is an array of factors that may cause or are associated with tenure insecurity, $\beta$ is a vector of parameters, and ε a vector of error terms. Assuming that the disturbances are normally distributed, the probability of N = 1 (which expresses tenure insecurity here) can then be specified as a Probit model,

$$Prob(N = 1) = F(\beta' x) \tag{10}$$

We estimated a maximum likelihood Probit model with robust (White/sandwich) estimation, correcting for cluster sampling and heteroskedasticity.

*Estimation of the farm input intensity model*

The intensity of production may be specified as a selection model as a sizeable number of households (57 households) used no purchased farm inputs and because other factors may affect use/no use (self-selection or rationing) and cause selection bias (Heckman 1990);

$$I_{0i} = x'_i\beta + u_{0i} \tag{11}$$

with the "switching" equation

$$d_i = 1(z_i'\gamma + u_{1i} > 0) \tag{12}$$

which is equal to one when its statement is true and zero otherwise. The conditional estimation for those using purchased farm inputs then becomes;

$$E(I|x_{I,}, z_I, I_I > 0) = x'_i\beta + \lambda(z_i'\gamma) \tag{13}$$

where

$$\lambda(z_i'\gamma) = E(u_{0i} | u_{1i} \geq -z_i'\gamma) \tag{14}$$

We used both a Heckman model, which depends on the assumption that the error terms are normally distributed and is sensitive to heteroskedasticity, and an approach suggested by Deaton (1997). A Probit model was first run to predict the probability of a household using purchased farm inputs such as fertilizer, seeds, pesticides, and herbicides. Following Deaton's approach, the predicted probabilities of using purchased inputs were incorporated in polynomial form (of third degree) in the censored regression estimation. The polynomials play a role similar to that of the inverse Mills' ratio, but the normality assumption for the distribution of the error terms is relaxed (Deaton 1997).

We tested the linear model for heteroskedasticity, using Cook and Weisberg (1983) tests, and found it to be significant[15]. By transforming to log-log form the problem was reduced but not eliminated. These two approaches revealed no significant selection bias. We therefore present only the results of the least squares (efficient but inconsistent) model. standard errors in the model were corrected for heteroskedasticity by using the conservative heteroskedasticity-consistent covariance matrix ($\Omega$) (HCCME), called HC3 (Davidson and MacKinnon 1993). This method has performed very well in Monte Carlo experiments and is considered better than the White/sandwich method (Davidson and MacKinnon 1993).

As a third robust estimation approach, we used Powell's censored least absolute deviations (CLAD) estimator (Powell 1984). It provides consistent parameter estimates and is considered a desirable alternative due to its robustness to conditional heteroskedasticity and distributional misspecification of the error term (Chen and Khan 2000). The model may be specified as follows;

$$I_{0i} = 1(x'_i\beta + u_{0i}) = \max(0,\ x'_i\beta + u_{0i}) \qquad (15)$$

We take the median conditional on x to get;

$$q_{50}(I_{0i} \mid x_i) = \max(0, x_i'\beta) \qquad (16)$$

---

[15] A Cook-Weisberg test for heteroskedasticity gave a Chi-sq.(1)=49.56 (P=0.0000), rejecting homoskedasticity

where $q_{50}(I_{0i} | x_i)$ denotes the median of the distribution conditional on $x_i$ and the median of $u_{0i}$ is assumed to be 0. $\beta$ can be consistently estimated by the parameter vector that minimizes;

$$\sum |I_{0i} - \max(0, x_i'\beta)| \qquad (17)$$

Knowledge of the distribution is not required for consistency, and homoskedasticity is not assumed. Median regressions are used repeatedly, first on the total sample and later on a truncated sample. Each time observations with negative predicted values are eliminated, till convergence. Standard errors are finally estimated through bootstrapping. This approach tends to create larger variances (less efficient) than least squares methods and a fairly large sample size may be required. We present the results of the efficient least squares model and the consistent but less efficient CLAD model.

Maximum likelihood probit models were used to assess the factors correlated with planting of perennial crops, correcting standard errors for cluster design and heteroskedasticity.

## 5. RESULTS AND DISCUSSION

*Tenure Insecurity Model*

The results of maximum likelihood Probit estimation of the tenure insecurity model are presented in Table 2. We first discuss the results of the general model (without site-specific effects) and afterwards the results of the model with site-specific effects.

For the general model we see that relative farm size was not significant but the sign was positive as suggested by Hypothesis 1. The rent out dummy variable was significant at 10% level, indicating that households renting out land feel less tenure secure as we hypothesized. Enset area share (a perennial crop) was significant and had the expected negative sign pointing in the direction of our initial hypothesis that perennials may reduce tenure insecurity. None of the household characteristics variables were significant.

**Table 2--Probit Estimates of Tenure Insecurity with Site-Specific Tests**

| | General Model | | Model with Site-Specific Effects | |
|---|---|---|---|---|
| **Variables**[2] | **Coef.** | **P>\|z\|**[1] | **Coef.** | **P>\|z\|**[1] |
| hhhage | 0.000965 | 0.881 | 0.0027236 | 0.689 |
| hhhsex | 0.199077 | 0.466 | 0.2079233 | 0.445 |
| educ16th | -0.0109675 | 0.730 | -0.0183129 | 0.587 |
| educ6th | 0.1322191 | 0.131 | 0.1443961 | 0.191 |
| nettlu | 0.0337248 | 0.177 | 0.0406668 | 0.113 |
| noofoxen | -0.0048299 | 0.961 | -0.0366238 | 0.723 |
| relar | 0.2426061 | 0.118 | | |
| rentoutd | 0.5656099 | 0.084 | 0.601858 | 0.087 |
| ensetare | -0.3195928 | 0.094 | -0.4474695 | 0.045 |
| site1 | -0.5107306 | 0.069 | -0.9180668 | 0.001 |
| site2 | -0.6957648 | 0.001 | -1.063443 | 0.002 |
| site3 | -0.0340123 | 0.894 | -1.24525 | 0.000 |
| site4 | -0.1059916 | 0.638 | 0.0697507 | 0.861 |
| site6 | -1.095049 | 0.003 | -44.93096 | 0.000 |
| site7 | -0.8095587 | 0.002 | -29.71774 | |
| site8 | -0.587644 | 0.027 | -1.746506 | 0.000 |
| site9 | 0.8238848 | 0.000 | 0.5615941 | 0.001 |
| site11 | 1.474776 | 0.000 | 0.850053 | 0.020 |
| site12 | 1.060046 | 0.000 | 0.43746 | 0.180 |
| site13 | -0.161268 | 0.511 | -1.209769 | 0.000 |
| site14 | 0.5010155 | 0.002 | 0.6674109 | 0.000 |
| s1rela | | | -0.2030949 | 0.001 |
| s2rela | | | -0.2556591 | 0.103 |
| s3rela | | | 0.5184294 | 0.000 |
| s4rela | | | -0.8167302 | 0.000 |
| s6rela | | | 22.51113 | 0.000 |
| s7rela | | | 11.61947 | . |
| s8rela | | | 0.4520611 | 0.000 |
| s9rela | | | -0.3049232 | 0.042 |
| s11rela | | | -0.026962 | 0.767 |
| s12rela | | | 0.0261532 | 0.763 |
| s13rela | | | 0.4103383 | 0.000 |
| s14rela | | | -0.83263 | 0.000 |
| s15rela | | | -0.5666284 | 0.000 |
| Constant | -1.669797 | 0.000 | -0.8429551 | 0.086 |
| Number of obs. | 436 | | 436 | |
| Log likelihood | -168.51925 | | -156.70697 | |
| Pseudo R2 | 0.2216 | | 0.2762 | |
| | | | 66 failures and 2 success completely determined | |

[1] Based on standard errors corrected for cluster design and heteroskedasticity.
[2] site5 and site10 predicted tenure insecurity perfectly, site5Rela
and site10Rela were dropped from the estimation due to collinearity.

The model with site-specific effects provides a more careful test of Hypotheses 1 and 2 in each site. In four of the sites (site3, site6, site8, site13), relative farm size was significantly and positively correlated with tenure insecurity, while in five other sites (site1, site4, site9, site14 and site15) it was significantly negatively associated with tenure insecurity. These variations could have arisen due to local historical, cultural, and demographic differences, which could give way to differences in the importance of local power structure and influence to counteract the tenure insecurity felt by the more land-rich households due to the past land redistribution policy. The area of perennials was significant at 5% level with a negative sign as we expected and the land renting dummy was significant at 10% level and with a positive sign consistent with our hypothesis and the model without site-specific effects.

Even though there is local variation as to how the land redistribution policy has affected tenure insecurity, it is possible that the policy has had a negative effect on input intensity in areas where it has contributed to tenure insecurity. We test this in the next section.

*Farm Input Intensity*

We present the results of the purchased farm input intensity models in Tables 3 and 4.

Table 3 presents the results for the first stage probit model on the decision to use purchased farm inputs or not. Model 1 in the table includes site dummies (fixed effects) while Model 2 divides sites in farming systems groups and has dummies for these instead. Some sites were eliminated in Model 1 because they predicted perfectly. Use of farming systems dummies instead of site dummies allowed us to include more observations in the analysis (496 instead of 326, see Table 3). It also allowed us to include a dummy for the sites with positive N*R relationship to test whether the redistribution policy has had an effect on the probability of using purchased farm inputs.

**Table 3--Probit Model: To Purchase or not to Purchase Farm Inputs**

| | Model 1 | | Model 2 | |
|---|---|---|---|---|
| **Variables** | **Coef.** | **P>\|z\|** | **Coef.** | **P>\|z\|** |
| hhhage | -0.0058846 | 0.440 | -0.0139778 | 0.037 |
| hhhsex | 0.0444259 | 0.878 | 0.2905118 | 0.208 |
| educ16th | 0.1751252 | 0.022 | 0.1183238 | 0.025 |
| educ6th | -0.0189476 | 0.642 | -0.0894163 | 0.104 |
| lnmlabop | -0.3223805 | 0.101 | -0.0536098 | 0.712 |
| lnflabop | 0.1060128 | 0.620 | 0.075352 | 0.659 |
| lntluop | -0.036476 | 0.834 | -0.0639398 | 0.689 |
| lnoxenop | -0.3891096 | 0.169 | -0.3302514 | 0.161 |
| lnequinop | -0.2131252 | 0.379 | -0.3294842 | 0.128 |
| doxenop | 0.118199 | 0.734 | 0.0058488 | 0.983 |
| dtluop | 1.169605 | 0.068 | 0.855782 | 0.149 |
| dequinop | 0.1202793 | 0.711 | 0.1127248 | 0.723 |
| relar | 1.228777 | 0.013 | 1.224742 | 0.000 |
| ownoprat | -0.0537858 | 0.747 | -0.2168751 | 0.304 |
| mrktdist | -0.0012664 | 0.002 | 0.0004461 | 0.750 |
| trans2 | -0.9694509 | 0.000 | 0.3813082 | 0.215 |
| trans3 | 0.033434 | 0.053 | -0.0999076 | 0.208 |
| trans4 | -0.1385082 | 0.000 | -0.0496163 | 0.317 |
| tenurepr | -0.1017202 | 0.791 | -0.2279833 | 0.403 |
| relinsec | -0.6945446 | 0.106 | -0.6131247 | 0.063 |
| dinsec | | | | 0.001 |
| site1 | -0.4569763 | 0.454 | | |
| site2 | -2.237816 | 0.000 | | |
| site5 | -1.233713 | 0.040 | | |
| site6 | -0.4274397 | 0.622 | | |
| site7 | -1.768967 | 0.000 | | |
| site8 | -0.1530245 | 0.884 | | |
| site11 | 0.3425019 | 0.438 | | |
| site12 | -1.340581 | 0.000 | | |
| site13 | -0.4719348 | 0.424 | | |
| D1 | | | 0.430902 | 0.599 |
| D2 | | | -1.206355 | 0.149 |
| D3 | | | -1.307679 | 0.038 |
| D4 | | | -1.119711 | 0.108 |
| D5 | | | 0.2748034 | 0.617 |
| Constant | 0.6108492 | 0.250 | 0.6452675 | 0.473 |
| Number of obs | 326 | | 496 | |
| Log likelihood | -103.07074 | | -115.13263 | |
| Pseudo R2 | 0.2878 | | 0.3171 | |

The results in both models indicate that tenure insecurity had no direct effect on whether households purchased farm inputs or not. Model 2 indicates that households were more likely to buy farm inputs in the sites with positive tenure insecurity – relative farm size relationship, indicating that the land redistribution policy may actually have had a positive impact on input intensity. This is contrary to the hypothesis that land redistribution has had a negative effect on input use. Overall, households with relative larger farm sizes were more likely to buy farm inputs (significant at 1 and 5% levels in Models 1 and 2). This is contrary to the Boserup-hypothesis. Local power structures, but also subsistence constraints and poverty, may undermine the Boserup-effect. Ability to produce a surplus for sale may be a necessary condition for purchasing farm inputs. The effect of the relative farm size was less pronounced in the areas with a positive insecurity-farm size relationship, however. This may indicate that the redistribution policy has contributed to improved access to purchased farm inputs among the land-poor households in these sites, which may in turn be because the poor have been more empowered in these sites.

We see that the market distance and the transportation method variables were significant in Model 1. Households far from the market were less likely to purchase farm inputs (1% level of significance), households using horse/donkey carts were more likely to use purchased farm inputs (Trans3 variable – 10% level of significance) and households (partly) using public transport (Trans2 and Trans4 variables – both 1% level of significance) were less likely to purchase farm inputs. In Table 4 we present the results of the (efficient but inconsistent) least squares model and the consistent CLAD model for the determinants of the level of use of purchased farm inputs.

**Table 4--Determinants of Intensity of Use of Purchased Farm Inputs**

| | Robust Least Squares | | Powell's CLAD | |
|---|---|---|---|---|
| | **Coef.** | **P>\|t\|[1)]** | **Coef.** | **P>\|t\|[2)]** |
| **Variables** | | | | |
| hhhage | -0.0176186 | 0.001 | -0.0198778 | 0.006 |
| hhhsex | 0.4609013 | 0.085 | 0.3974978 | 0.308 |
| educ16th | -0.0591137 | 0.066 | -0.0028694 | 0.943 |
| educ6th | 0.0282797 | 0.642 | -0.0337115 | 0.695 |
| lnmlabop | 0.3104104 | 0.029 | 0.1178655 | 0.580 |
| lnflabop | 0.3992296 | 0.005 | 0.293017 | 0.139 |
| lntluop | -0.0958011 | 0.321 | -0.0777087 | 0.653 |
| lnoxenop | 0.2010084 | 0.160 | 0.2353789 | 0.241 |
| lnequinop | 0.1674306 | 0.204 | 0.3644573 | 0.045 |
| dmlabop | -0.4836847 | 0.820 | -1.77685 | 0.041 |
| doxenop | -0.6491631 | 0.017 | -0.7867253 | 0.041 |
| dtluop | 0.2670351 | 0.441 | 0.5698135 | 0.298 |
| dequinop | -0.4517774 | 0.147 | -0.7867507 | 0.063 |
| relar | 0.0405859 | 0.845 | 0.2042746 | 0.548 |
| ownoprat | 0.1573518 | 0.329 | 0.109441 | 0.655 |
| mrktdist | 0.0014707 | 0.252 | 0.0013255 | 0.498 |
| trans2 | 0.0714059 | 0.738 | -0.0621111 | 0.832 |
| trans3 | -0.1785096 | 0.254 | -0.0951884 | 0.625 |
| trans4 | 0.011755 | 0.884 | -0.0398823 | 0.744 |
| tenurepr | 0.0570637 | 0.697 | 0.0746567 | 0.695 |
| relinsec | -0.0572131 | 0.775 | -0.2127527 | 0.529 |
| dinsec | -0.2003667 | 0.641 | 0.3628588 | 0.596 |
| site1 | -1.187289 | 0.011 | -0.5656832 | 0.412 |
| site2 | -2.276443 | 0.000 | (dropped) | |
| site3 | -0.3108558 | 0.334 | -0.3425306 | 0.462 |
| site4 | -0.8029462 | 0.032 | -0.5255961 | 0.338 |
| site5 | -1.194331 | 0.020 | -1.388324 | 0.145 |
| site6 | -0.9205846 | 0.110 | -0.8610676 | 0.271 |
| site7 | -1.589776 | 0.000 | -1.96156 | 0.034 |
| site8 | -0.4163927 | 0.353 | -0.6403366 | 0.376 |
| site9 | (dropped) | | (dropped) | |
| site10 | -2.064292 | 0.000 | -1.483293 | 0.061 |
| site11 | -0.5757453 | 0.216 | -0.578154 | 0.449 |
| site12 | -0.9615148 | 0.005 | -0.7733252 | 0.116 |
| site13 | -1.065599 | 0.020 | -0.7159062 | 0.277 |
| site14 | -0.9355083 | 0.018 | -1.106632 | 0.083 |
| _cons | 4.268178 | 0.000 | 3.982303 | 0.000 |
| Number of obs | 445 | | 432 | |
| F( 35,409) | 13.62 | | | |
| Prob > F | 0.0000 | | | |
| R-squared | 0.4767 | | Pseudo R2 | 0.1683 |
| Cook-Weisberg test for heterosked. | | | Bootstrap replications 1000 | |
| Ho: Constant variance | | | | |
| chi2(1) = | 4.33 | | | |
| Prob > chi2 = | 0.0375 | | | |

[1)] Based on robust HC3 standard errors
[2)] Based on bootstrapped standard errors

The tenure insecurity variable was insignificant and with a positive sign. There is therefore no apparent negative direct effect of tenure insecurity on intensity of use of purchased farm inputs. The relative farm size variable was insignificant and had a positive sign. We therefore see no Boserup effect in relation to the extent of use of purchased farm inputs within the communities. Furthermore, the Dinsec (DI) and Relinsec (DI*R) variables were insignificant as well. The ratio of own land to total operated land holding was also insignificant. We therefore found no significant inefficiency spilling over to the use of purchased farm inputs due to the share-tenancy arrangement (Marshallian inefficiency), or due to rented in land serving as a substitute for intensification on own land for those renting in land.

Households with older household heads were found to use less purchased inputs (1% level of significance). Many of the site dummies were significant and all with a negative sign, indicating that there was significantly higher purchased farm input use in the reference site (Hidi, Debre Zeit area) than in the rest of the sites. Some other variables were significant in the (efficient) least squares model but not in the (consistent but less efficient) CLAD model. We do not discuss these variables, as they are unimportant to the objectives of the paper.

*Planting of perennials*

The results of the probit models for factors correlated with the growing of perennial crops are presented in Table 5. In the model without site-specific farm size effects we find that the decision to plant perennials is highly dependent on the farming system favored in the different locations. The analysis could therefore be carried out only for the sites where some but not all households planted perennial crops. In these sites we could inspect what factors were correlated with the decision to plant perennials and whether the tenure insecurity variable had a significant impact on this. Table 5 shows that investment in perennials was more likely to take place on relatively larger farms.

**Table 5—Probit Model for Growing of Perennial Crops**

| | General Model | | Model with site-specific effects | |
|---|---|---|---|---|
| **Variables** | **Coef.** | **P>\|z\|** | **Coef.** | **P>\|z\|** |
| hhhage | -0.006449 | 0.722 | 0.020538 | 0.310 |
| hhhsexm1 | 0.0585258 | 0.843 | 0.252264 | 0.358 |
| educ16th | 0.1835886 | 0.000 | 0.145207 | 0.000 |
| educ6th | 0.0219591 | -0.841 | 0.021791 | 0.873 |
| lnmlabop | 0.4885521 | 0.021 | -0.089986 | 0.573 |
| lnflabop | 0.4370763 | 0.000 | 0.053994 | 0.788 |
| lntluop | 0.6324539 | 0.003 | 0.419357 | 0.081 |
| lnoxenop | 0.5074121 | 0.004 | 0.344251 | 0.018 |
| lnequinop | -1.431021 | 0.077 | -1.497181 | 0.107 |
| doxenop | -1.139253 | 0.070 | -0.730739 | 0.068 |
| dtluop | 6.980979 | . | 38.25907 | 0.000 |
| dequinop | 1.601279 | 0.069 | 1.652406 | 0.169 |
| relar | 1.581229 | 0.004 | | |
| ownoprat | -0.8163459 | 0.001 | 0.123875 | 0.791 |
| mrktdist | 0.0012739 | 0.771 | 0.001933 | 0.671 |
| trans2 | -0.6890541 | 0.083 | -1.165845 | 0.001 |
| tenurepr | -0.1856045 | 0.756 | -0.123228 | 0.855 |
| site1 | 8.82572 | 0.000 | 61.58649 | 0.000 |
| site7 | 0.4059959 | . | | |
| site12 | 6.755984 | 0.000 | 59.53498 | 0.000 |
| site13 | 5.437478 | 0.000 | 59.78863 | 0.000 |
| s1rela | | | 1.65663 | 0.000 |
| s7rela | | | 26.94277 | 0.000 |
| s12rela | | | 0.91161 | 0.016 |
| Constant | -8.304353 | 0.000 | -63.49886 | . |
| Log likelihood | -39.283546 | | -39.876033 | |
| Pseudo R2 | 0.6357 | | 0.5677 | |
| Number of obs | 167 | | 135 | |
| 63 failures and 0 successes completely determined | | | 30 failures and 0 successes completely determined | |

.Standard errors adjusted for clustering on site and heteroskedasticity.

This is contrary to the Boserup-hypothesis that land scarcity will stimulate investment. Some perennials, like cash crops, may be grown more by the wealthier households with better market access. Poverty and subsistence constraints (food insecurity) may prevent small farmers from investing in cash crops. The tenure insecurity variable was insignificant. We therefore see no significant negative effect of the redistribution policy such that large farms are less likely to plant perennials or that tenure insecurity is directly negatively correlated with planting of perennials.

Planting of perennials was found to be significantly and positively correlated with relative farm size, oxen ownership, livestock wealth, male and female labor force and basic education. Resource poverty, and not tenure insecurity, may therefore be the main reason for failure to invest in perennials.

## 6. CONCLUSION

We have assessed the impact of the land redistribution policy on tenure insecurity in Southern Ethiopia, and how this may affect the intensity of production, measured in form of purchased farm inputs. Overall, we may conclude that there is some tenure insecurity problem in the region as about 17% of the households stated that they were afraid that they may lose land due to possible future land redistributions. There was considerable variation in feeling of tenure insecurity across sites.

In the tenure insecurity model, we had set out to test Alemu's (1999) hypothesis that per capita farm size is directly related to tenure insecurity. When we made an undifferentiated test for the whole sample, we found that per capita farm size was insignificantly correlated with tenure insecurity. In the site-specific test, however, we found a significant positive correlation in four of the 15 sites, while the opposite sign was statistically significant in five other sites. Local historical, cultural, and demographic differences could have resulted in differences in local power structure's capacity to influence the implementation and enforcement of the redistribution policy, thereby shaping the distribution of tenure security. Site-specific studies would enable a more profound understanding of the factors affecting tenure insecurity.

Households renting out land felt more tenure insecure. Ability to cultivate the land you have received may therefore be important for the feeling of tenure security.

In the purchased farm input intensity model, tenure insecurity was not significantly affecting farm input intensity. This is according to our basic hypothesis that tenure insecurity has little or no impact on short-term production decisions. There is therefore no evidence of a negative effect from the land redistribution policy on input intensity through increased tenure insecurity. The effects through the rental market for land were also insignificant.

Larger farms were more likely to purchase farm inputs and this indicates that poverty and subsistence constraints may undermine the ability to intensify production through purchase of farm inputs. This may explain the lack of Boserup-effects in the areas studied.

Resource poverty; in land, male and female labor, oxen and basic education; were correlated with no investment in perennials while tenure insecurity was not significantly correlated with the decision to plant perennials. This is contrary to our basic hypothesis that tenure insecurity may affect long-term production decisions negatively. However, we do not know how the current feeling of tenure security relates to the feeling of tenure security in the past when the decisions to plant perennials were made. It appears that resource poverty rather than tenure insecurity may have undermined investment in perennials and purchase of farm inputs in the study areas. Alternatively, planting of perennials may also have been a strategy to secure land rights by the wealthier households. If there are any effects of the land redistribution policy, these are

- that it has improved the access to purchased farm inputs among all households in the areas where the policy has caused a significant positive correlation between relative farm size and tenure insecurity, and particularly so for the most land-poor households,
- that it has stimulated the more wealthy households to plant more perennials to protect their land rights in the sites where perennials are grown.

**Appendix 1--Some Information on the Survey Sites (averages).**

| Survey Sites* | Site | Farming System | HH[a] Size | Land holding (in Timad)[b] | | Total TLU[c] | Oxen Holding |
|---|---|---|---|---|---|---|---|
| | | | | Foodcrp | Cashcrp | | |
| Damot Waja-K.(Wollaita) | 1 | D1 | 6.88 | 2.06 | 0.09 | 2.84 | 0.50 |
| Abota-Olto (Boditi) | 2 | D1 | 8.49 | 2.03 | 0.00 | 2.75 | 0.83 |
| Amburse (Shone) | 3 | D1 | 8.41 | 4.03 | 0.06 | 4.60 | 1.03 |
| Chefasine (Sidamo) | 4 | D2 | 7.59 | 1.20 | 0.61 | 3.93 | 0.09 |
| Chuko (Wondo Genet) | 5 | D2 | 9.77 | 2.26 | 1.24 | 5.15 | 0.37 |
| Dobi-Gogot (Butajira) | 6 | D2 | 7.69 | 3.60 | 0.07 | 4.15 | 0.86 |
| Elka (Zway) | 7 | D3 | 7.53 | 10.72 | 0.27 | 7.3 | 1.78 |
| Woyo-Gebriel (Meki) | 8 | D3 | 6.66 | 13.06 | 0.37 | 5.11 | 1.94 |
| Beche (Mareko) | 9 | D4 | 7.44 | 2.26 | 1.02 | 2.34 | 0.76 |
| Gedeba (Alaba) | 10 | D4 | 6.97 | 5.84 | 1.46 | 5.68 | 1.69 |
| Kersa-Ilala(Arsi-Neghele) | 11 | D5 | 7.85 | 6.55 | 0.02 | 4.54 | 1.12 |
| Woyo Medhane A. | 12 | D5 | 9.37 | 7.30 | 0.72 | 4.92 | 1.27 |
| Koka-Neghewo (Koka) | 13 | D6 | 6.57 | 9.72 | 2.73 | 6.33 | 1.37 |
| Dekabora (Modjo) | 14 | D6 | 7.37 | 9.88 | 0.13 | 4.75 | 2.83 |
| Hidi (Debre Zeit) | 15 | D6 | 6.71 | 9.00 | 0.00 | 6.45 | 3.14 |
| **Over All Average** | | | **7.67** | **5.98** | **0.59** | **4.72** | **1.31** |

[a] HH = Household, [c] TLU = Livestock in Tropical Livestock Units.
[b] Timad is a local measure of land, equivalent to what an adult male can plough in a day using a pair of oxen; on the average it is approximately equal to 0.25 hectares of land.
D1-D6 show the farming systems groups the sites belong to, see appendix 2.

## Appendix 2--General Description of the Study Areas and Farming Systems

| Farming Systems Grouping | Sites Included in the Farming Systems Groups | General Description of the Farming Systems Groups |
|---|---|---|
| D1 (Wollaita & Shone) | 1.Damot Waja-Kero 2.Abota Olto 3.Amburse | Very densely populated, enset[1)]-maize-root crop producing areas with poor market access, and not much cash crop production. |
| D2 (Sidamo & Butajira) | 4.Chefasine 5.Chuko 6.Dobi Gogot | Densely populated, enset-maize-beans producing areas, with chat[2)] and coffee produced as important cash crops. |
| D3 (Zway & Meki ) | 7.Elka 8.Woyo Gebriel | Dry, less densely populated, maize-haricot beans producing areas with a lot of livestock. No major cash crop production. |
| D4 (Mareko & Alaba) | 9.Beche 10.Gedeba | Relatively dry, maize producing areas (with some teff[3)]) with a lot of livestock. Chili pepper produced as a major cash crop. |
| D5 (Arsi-Neghele) | 11.Woyo Medhane-Alem 12.Kersa Ilala | Grain (wheat, barley, maize) producing areas with a good amount of livestock. Some amount of onions and potatoes produced as cash crop. |
| D6 (Modjo & Debrezeit) | 13.Dekabora 14.Koka Neghewo 15.Hidi | High potential grain (teff, wheat, barley, pulses) producing areas with fairly large livestock holdings, and relatively good market access. |

[1)] Enset (E*nsete ventricosum*) is a tall banana-like fibrous perennial plant cultivated in Southern Ethiopia whose pseudo stem and tuber are processed for food (see Mehtzun and Yewelsew 1994).
[2)] Chat (*Catha edulis*) is a perennial shrub whose leaves are chewed as a stimulant (see Debebe 1997). It is an important cash crop for some farmers in Southern and Eastern Ethiopia.
[3)] Teff (*Eragrostis teff*) is an annual grass-like food crop, with tiny grains, produced in the Ethiopian highlands as major food crop.

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