Impacts of land redistribution on land management and productivity in the Ethiopian highlands

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Abstract

The increasing problem of landlessness in Ethiopia has put pressure on regional governments to redistribute land. In 1997 and 1998, a major land redistribution exercise was undertaken in the Amhara region, reducing landlessness where implemented. While the impacts of such redistributions have been hotly debated, little empirical evidence exists concerning the actual impacts of redistribution. We find that land redistribution in Amhara region has had a positive impact on land productivity, by increasing access to land of farmers who are more interested or able to use purchased inputs such as fertiliser and herbicides. Our results, however, do not show much effect of the recent land redistribution or expectations of future redistribution on land improvement and management. Thus, to the extent that investment in land improvement are necessary for conservation purposes, it appears that policy change to stop land redistributions is unlikely to have a substantial impact on reducing land degradation. Credit and extension programs and improving land rental markets, however, present better strategies for improving land management in this region of Ethiopia.

Key words: Ethiopian highlands, land redistribution, management and productivity.

1 Introduction

Reducing environmental degradation is a major challenge in the Ethiopian highlands. Land degradation, especially soil erosion (averaging 42 t/ha per year on cultivated lands (Hurni 1988)), low and declining soil fertility, soil moisture stress and deforestation are critical problems contributing to low agricultural productivity (which is reflected in cereal yields averaging less than one tonne per hectare), poverty and food insecurity in these areas (Fistum et al 1999; Lakew et al 2000).

Several government policies and strategies have been implemented, both in the past and present, to solve these problems. One of the major ones was the redistributive land reform in 1974, when the military government (Derg) took power and ended all forms of tenancy, nationalised all rural lands and redistributed land to the tillers. Individual land rights were restricted (i.e. land sales and leasing, using land as collateral and hiring labour were prohibited) to ensure that the tillers remained the beneficiaries of agricultural production. Land redistribution by the government was then established as the only means to improve access to land and reduce landlessness. Since the fall of the military government in 1991, the new Ethiopian government has allowed land leasing and hiring labour, but the prohibition on land sales has continued, codified in the new constitution. The increasing problem of landlessness has put pressure on regional governments to frequently redistribute land. For example, in 1997 and 1998, the Amhara regional government undertook a major land redistribution exercise. While the impacts of such land redistributions have been hotly debated in Ethiopia and elsewhere, little empirical evidence has been available concerning the actual impacts of land redistribution, however.

Although redistributive land reform is sometimes utilised as a deliberate policy instrument to improve agricultural productivity and reduce poverty,[1] it is argued that land redistribution erodes tenure security and that farmers will not undertake land-improving investments since they may not be able to claim fully the returns on their investment. Thus, to the extent that investments in land are required for conservative purposes and to increase productivity, land redistribution will further promote land degradation and reduce farm output. Currently, the Amhara regional government is considering a land policy that will end land redistributions. A critical question then is whether abolishing land redistribution will improve investments in land that will in turn reduce land degradation and increase productivity.

1. This policy stems from many case studies that show an inverse relation between farm size and productivity (Berry and Cline 1979; Prosterman and Riedinger 1987). The underlying argument is that by giving land to the actual tillers, the high transaction and monitoring costs associated with tenancy and using hired labour are eliminated.

In this paper, we present evidence and policy implications of the impacts on land management and productivity of land redistributions in the Amhara region of Ethiopia. We also investigate other factors (including agricultural potential, market access, population density, credit and extension programs, and education) that may affect land management and agricultural productivity.

The study is based on analysis of a community-level survey conducted in 98 villages (*gots*) in the highland areas (above 1500 metres above sea level (masl)) of the Amhara region in 2000. A stratified random sample of 49 Peasant Associations (PA's, usually consisting of three to five villages) and two villages randomly selected from each PA were selected from highland areas of the region. Using district (*wereda*) level secondary data, the stratification was based upon indicators of agricultural potential (whether the *wereda* is drought-prone or non drought-

prone/higher rainfall, as classified by the Ethiopian Disaster Prevention and Preparedness Commission), market access (access or no access to an all-weather road) and population density (1994 rural population density greater than or less than 100 persons per sq km). Two additional strata were defined for PA's where an irrigation project is present (in drought-prone vs. higher rainfall areas), resulting in a total of 10 strata. Five PA's were then randomly selected from each stratum (except the irrigated drought-prone stratum, in which there were only four PA's), for a total of 49 PA's and 98 villages. *Weredas* predominantly (more than 50% of total area) below 1500 masl were excluded from the sample frame. Information were collected at both PA and village level using group interviews with about ten respondents from each PA and village, selected to represent different genders, ages, occupations and in the PA level survey, different villages. Information collected includes changes in land investments, land management practices, input use and agricultural production since 1991 (the year when the current government replaced the former Marxist government). The data were supplemented by secondary information on population from the 1994 population census, geo-referenced maps of the boundaries of each sample PA and geographic attributes, including altitude and climate.

The next section of this paper examines the institution of land redistribution in Ethiopia and the Amhara region. The conceptual framework for examining the impacts of land redistribution and hypotheses are presented in Section 3. In Section 4, we present the empirical approach, results and discussion. Conclusions and policy implications are presented in Section 5.

2 Land redistribution

Land redistribution has been carried out in many developing countries, often as part of land reform in the wake of social and political revolution. Sometimes, however, land redistribution is utilised as a deliberate policy instrument to capture the efficiency benefits of the family farm, decrease urban food prices and reduce poverty (Prosterman and Riedinger 1987). The 1974 redistributive land reform in Ethiopia shared many similar attributes (e.g. prohibiting farmland sales and other transfers and hiring of labour to ensure that the actual farmers remained beneficiaries of the land) to Land-to-the-Tiller programmes implemented in other countries (e.g. Philippines in 1972). However, in the case of Ethiopia, redistribution of farmland was undertaken regularly (in many cases as often as every one to two years during the Derg regime; (Fistum et al 1999) to reduce landlessness and to equalise land holding and quality. Thus, those with larger fields had part of their land taken away and given to others that do not have land or have smaller fields. Local administrations, known as Peasant Associations, were set up and charged with the responsibility of land redistribution.

After the fall of the Derg in 1991, the new government constitutionalised state ownership of all rural lands. The new constitution, drawn in 1994, however, allows temporary leases and guarantees the rights of peasants of free access to land and the right to improvements they make on land including the right to bequeath, transfer, remove or claim compensation for such improvements when the right to use the land expires. In principle, farmers now have the right to use the land indefinitely, lease it out temporarily to other farmers and transfer it only to their children. However, they still cannot sell or mortgage their lands. Although the constitution has resolved some issues, it seems to create other ambiguities and does not address some important issues (Fistum et al 1999). For example, given land scarcity, it is not clear how farmers' rights of free access to land can be assured in practice and how much land they are entitled to.[2] Regional governments have been charged to resolve those issues and there have been significant differences across the regions with respect to development of a regional land policy and redistribution of land.

> 2. In principle, peasants are entitled to farmland when they reach the age of 18, and the maximum allowable holding is set at 10 hectares.

For example, in the Tigray region, land redistribution was stopped in 1991, and the policy of no future redistribution was made official by a new land policy in 1997. In the Oromiya region too, there has not been a land redistribution for more than 10 years (Bezuayehu et al 2000), although the regional government has not made any official statement about abandoning it.

In the Amhara region, however, land redistribution has been very common, with a recent and major one undertaken in 1997 and 1998. Although there is no regional land policy per se, administration and use of land in the region have been guided by the provisions made in the national constitution. In 2000, the regional government passed a land policy document that will determine the administration and use of rural land in the region. The document is yet to be made public or proclaimed, however. The provisions in that document are similar to those provided in the national constitution, including: the right of peasants to free and indefinite use of land, transfer to dependents, consolidate holdings and rent out; right to use, sell, exchange or transfer the wealth cultivated on their land; but not the right to sell or exchange the land. Other important issues such as registration of the timing and limitations of renting out land, maximum land holding and plot size to be used for rainfed and irrigated agriculture have been relegated to by-laws that will be decided in the future. On the issue of land redistribution, the draft document states:

> *So long as giving a land free to farmers is maintained, land redistribution shall not be effective unless otherwise the land division does not affect the productive capacity required by the community and unless decided by law* (ANRSC 2000: Section 3, Article 10).

Although the document is yet to be proclaimed, the above statement suggests that land redistribution in the future is not completely ruled out.

Examining the incidence of land redistribution in the Amhara region, the survey conducted in the region shows that every community has experienced at least one redistribution since 1974, and nearly half have had a land redistribution since 1991, mainly in the recent redistribution in 1997 and 1998. The average number of land redistributions is three, with one village experiencing as many as fourteen since 1974. About four-fifths of the communities expect redistribution in the future; most within the next few years. Informal discussions with some of the farmers in the region revealed that although they do not fully support land redistribution, it is seen as a necessary tool by which landless farmers gain access to farmland, especially since land sales are prohibited and other transfers are restricted.

In the next section, we examine the conceptual framework for analysing the impacts of land redistribution on land investments, land management, input use and productivity.

3 Conceptual framework and hypotheses

The conceptual framework and hypotheses about how land redistribution may influence land-improving investments, land management, input use and productivity draw from the literature on property rights and investment incentives (Barrows and Roth 1990; Migot-Adholla et al 1991; Feder and Feeny 1993; Place and Hazell 1993; Besley 1995; Gavian and Fafchamps 1996; Quisumbing et al 1999; Pender and Kerr 1999; Place and Swallow 2000). Although land redistributions cause tenure insecurity, they may have mixed impacts on farmers' land management and productivity, through short and long term effects of redistribution. On the one hand, expectations of land redistribution may undermine farmers' incentive to invest in land improvements and soil fertility, since farmers' ability to reap the benefits of such investments are undermined (Feder and Feeny 1993). On the other hand, redistribution may improve access to land of households that have relative surpluses of other important factors of production, such as labour, oxen or cash to purchase inputs, particularly in the context of prohibited land sales and restricted lease markets as exist in Ethiopia. Therefore, land redistribution may increase input intensity, which may in turn increase productivity. Furthermore, the threat of redistribution may encourage farmers to invest if investments reduce the perceived likelihood of losing access to a given piece of land (Snyder 1996; Quisumbing et al 1999). Thus, land redistribution may either increase or decrease investments in land improvement, the intensity of land management, use of purchased inputs and productivity.

4 Econometric approach and results

4.1 Econometric approach

Econometric analysis was used to investigate the effects of recent (1997 and 1998) land redistribution and expectations and of future redistribution on:

1. Farmers' land investments (construction of stone terraces, soil bunds, check dams, drainage ditches, waterways and irrigation canals; and planting of trees and live barriers) since 1991;
2. Farmers' land management practices (use of burning to prepare fields, traditional fallow, improved fallow, contour plowing, crop rotation, mulching, manuring, composting, plowing in crop residues, soil burning and minimum tillage) in 1999;
3. Farmers' use of purchased inputs (fertilizer, pesticides, herbicides and improved seeds) in 1999; and
4. Crop yields (barley, wheat and teff) in 1999.

Summary statistics of these variables are presented in Table 1.

Table 1. *Summary statistics of data (number of observations (N), means and standard errors).*

Variable	N	1991	1999
Dependent variables			
Proportion of households investing since 1991			
Stone terrace	94	na	0.387 (0.061)
Soil bund	94	na	0.157 (0.048)
Check dam	94	na	0.273 (0.048)
Drainage ditch	94	na	0.776 (0.049)
Irrigation canal	93	na	0.113 (0.049)
Waterway	94	na	0.549 (0.081)
Tree planting	94	na	0.096 (0.035)
Live barriers	94	na	0.440 (0.069)
Proportion of households practicing			
Burning to clear field	94	0.365 (0.075)	0.336 (0.079)
Traditional fallow	92	0.165 (0.043)	0.050 (0.020)
Improved fallow	94	0.075 (0.033)	0.039 (0.027)
Contour plowing	94	0.918 (0.043)	0.934 (0.033)
Mulching	94	0.068 (0.035)	0.069 (0.036)
Manuring	94	0.335 (0.061)	0.369 (0.060)
Composting	94	0.021 (0.015)	0.056 (0.029)
Plowing in crop residues	94	0.478 (0.077)	0.459 (0.079)
Soil burning	94	0.051 (0.032)	0.005 (0.005)

Minimum tillage	94	0.260 (0.057)	0.231 (0.054)
Proportion of households using			
Fertiliser	93	0.246 (0.056)	0.519 (0.061)
Pesticides	94	0.164 (0.050)	0.191 (0.046)
Herbicides	94	0.040 (0.034)	0.142 (0.046)
Improved seed	93	0.018 (0.010)	0.341 (0.063)
Average cereal yield (100 kg per hectare)			
Local varieties of barley	72	9.872 (1.509)	7.427 (1.432)
Local varieties of teff	76	7.547 (1.127)	6.582 (0.710)
Local varieties of wheat	56	8.129 (0.748)	6.302 (1.069)
Improved varieties of wheat	41	7.967 (1.019)	12.55 (1.895)
Explanatory variables			
If land redistribution since 1991	98	na	0.488 (0.067)
If land redistribution in 1997 or 1998	98	na	0.447 (0.057)
If expect land redistribution in the future	98	na	0.814 (0.057)
Average annual Rainfall (1000 mm)	98	1.218 (0.031)	1.218 (0.031)
Altitude (meters above sea level (1000 masl))	98	2.182 (0.081)	2.182 (0.081)
Proportion of area irrigated	98	0.001 (0.001)	0.002 (0.001)
Proportion of land with good soil	98	0.533 (0.039)	0.380 (0.045)
Distance (100 km) to wereda town	98	0.374 (0.057)	0.374 (0.057)
100 households per hectare	98	0.351 (0.054)	0.453 (0.063)
Proportion of landless households	98	0.206 (0.033)	0.169 (0.026)
Proportion of households receiving credit and associated extension from:			
Bureau of Agriculture	98	0.055 (0.030)	0.254 (0.060)
Amhara Credit and Savings Institution	98	na	0.089 (0.030)
Other formal sources	98	0.001 (0.001)	0.189 (0.072)
Proportion of adult literates	98	0.388 (0.035)	0.533 (0.035)
Notes: Standard errors are in brackets. Sample means and standard errors are adjusted for stratification, weighting and clustering of sample. na = not available			

With the exception of drainage ditches, which seem to be part of normal cultural practices, the other investments since 1991 have been undertaken by less than 50% of the households. Most of the management practices have not changed since 1991, except for fallowing and soil burning, which have declined by more than 50%. Use of fertilisers, herbicides and improved seeds have increased by more than 50%, with use of improved seeds almost doubling. Although yields of local varieties of barley, teff and wheat are less than one t/per hectare, they have declined between 1991 and 1999, while yields of improved varieties of wheat has increased by about 40%.

The analysis also investigated other factors that may affect these responses and outcomes, including indicators of agricultural potential, access to markets, population pressure, credit and extension programs and adult literacy. Agricultural potential, access to markets and population pressure are hypothesized to be especially important in determining comparative advantages (Pender et al 1999). We estimate the econometric model given by:

$$(1) \quad y_v = a + b_1 x_v^1 + b_2 x_v^2 + cz_v + e_v$$

where g_n is the proportion of farmers in village n that have invested in land conservation and improvement since 1991, undertaken land management practice or used purchased inputs in 1999 or g_n is the average crop yield in village v in 1999;[c1] v is a dummy variable equal to one if there was a land

redistribution in village v in 1997 or 1998; c_v is a dummy variable equal to one if land redistribution is expected in village n in the future; z_n is a vector of observed factors that affect g_n; and *e* are unobserved factors that affect g_n.

Table 1 also shows a description of the explanatory variables and their means and standard errors. About 45% of the villages have had land redistribution in 1997 or 1998 and slightly more than 80% expect redistribution in the future. Agricultural potential is measured by average annual rainfall (with a mean of 1218 mm), altitude (2182 masl), proportion of area irrigated in 1999 (0.02%), and proportion of farmland with good soil (38%). Access to markets is measured by distance to the *wereda* town (37km). The other factors are population pressure, which is measured by the number of households per hectare in 1991 (35) and proportion of landless households in 1999 (17%), proportion of households obtaining credit and associated extension in 1999 from the Bureau of Agriculture (BoA) (25%), Amhara Credit and Savings Institution (ACSI) (9%) and other formal sources (19%) and proportion of adult literates in 1999 (53%).

An econometric problem to address in this model is that land investment and management and input use dependent variables are censored, since they are based on proportions data. For example, if the proportion of households using fertiliser was either 0 or 1, then the dependent variable was left or right censored, respectively. We, therefore, used a maximum likelihood censored regression model (or 'two-limit Tobit model') to estimate the model specified in equation 1 for these three types of dependent variables, taking into account both left and right censoring. Ordinary least squares was used to estimate the model for cereal yields.

There is also a conceptual problem with the model as specified in equation 1 in the sense that it may bias the estimate of the impact of recent land redistribution in 1997 and 1998. That is, equation 1 does not control for dynamic processes such as changes in agricultural potential, market access, population pressure, access to credit and extension and education that may be important in influencing investment in land management and input use, which may in turn affect agricultural productivity. This is because these dynamic processes influence the awareness, availability, risks, costs and benefits associated with investment in land improvement and input use. Therefore, we also estimate the first difference model given in equation 2:[3]

$$(2) \quad \Delta y_v = a_2 - a_1 + bx_v + c^1(z^1_{v2} - z^1_{v1}) + (c^2_2 - c^2_1)z^2_v + e_{v2} - e_{v1}$$

where Dg_n represents the dependent variable in village n , c_n is a dummy variable equal to one if there has been land redistribution in village n since 1991; z^1_{n1} is a vector of observed time-varying factors affecting Dg_n ; z^2_n is a vector of observed fixed factors affecting Dg_n, and e_{nt} is a vector of unobservable factors affecting Dg_n. The observed fixed factors, z^2_n, will have an impact only if the marginal effect of such factors has changed over time.

3. The first difference model eliminates unobservable fixed factors as a source of omitted variable bias.

The dependent variables in this model are: 1) proportion of farmers undertaking land investments since 1991; 2) changes between 1999 and 1991 in proportion of farmers adopting land management practices; and 3) change between 1999 and 1991 in proportion of farmers using purchased inputs.[4] The time-varying factors are changes between 1999 and 1991 in the proportions of area irrigated, farmland with good soil, landless households and households obtaining credit and extension from BoA, ACSI[5] and other formal sources and households per hectare and adult literacy. The fixed factors are average annual rainfall, altitude and distance to the *wereda* town.

4. The change in average cereal yields between 1999 and 1991 could not be estimated due to insufficient number of observations, as cereals were not grown in both years in some of the villages.

5. ACSI started operating in the Amhara region in 1995 and so we used the proportion of households participating in 1999 to represent the change.

The problem of censoring associated with the dependent variables, as discussed with the previous model, also applies here and so maximum likelihood censored regression is used to estimate equation 2. Another econometric problem to address in equation 2 is that the time-varying explanatory variables may be endogenous. Population growth and changes in participation in credit and extension programs, proportion of area irrigated, proportion of farmland with good soil and adult literacy may respond to or be affected by changing opportunities in agriculture and changes in land management and productivity. We therefore tested for exogeneity of those potentially endogenous explanatory variables using a Hausman test (Hausman 1978; Greene 1993).[6] We failed to reject exogeneity of those explanatory variables in the regressions, except the ones for changes in proportion of households undertaking drainage ditches and using herbicides. Nevertheless, we report the robustness of the significant coefficients to using predicted values of those potentially endogenous variables.

6. The instrumental variables used to predict the potentially endogenous explanatory variables, in addition to the exogenous variables in the regressions,

include the values of each those endogenous variables in 1991, walking time to nearest bus station in 1991 and change since 1991, walking time to the nearest grain mill in 1991 and change since 1991, walking time to the nearest primary school in 1991 and change since 1991, walking time to the nearest all weather road in 1991 and change since 1991. The instruments predicted most of the potentially endogenous variables fairly well: R2 = 0.87 for change in proportion of landless households, 0.65 for change in proportion of households obtaining credit from BoA, 0.61 for change in household density, 0.55 for change in proportion of households obtaining credit from other formal sources, 0.40 for proportion of households obtaining credit from ACSI, 0.32 for change in proportion of farmlands with good soil, 0.32 for change in adult literacy and 0.22 for change in proportion of area irrigated.

4.2 Results

The results of both model estimations are corrected for sample stratification and clustering. We present only those results in which the overall estimated model was statistically significant at the 10% level of significance. Tables 2 and 3 show results of the cross-section model given in equation 1 while Tables 4 and 5 show results of the first-difference model given is equation 2.

Table 2. *Regression results of the proportion of households undertaking land investments since 1991 and practicing traditional fallow in 1999 in the highlands of Amhara region.*

Explanatory variable	Stone terraces	Drainage ditches	Irrigation canals	Live barriers	Traditional fallow
If land redistribution in 1997 or 1998	–0.3663	0.5487	–0.2926	–0.0539	–4.3456***
If expect land redistribution in the future	0.0229	0.7261	0.2968	–0.3382	0.4956
Annual rainfall (1000 mm)	–0.9759	2.3301	0.2218	1.2157	–2.8608**
Altitude (1000 masl)	–0.0354	0.6575	0.1258	–0.3907*	0.7329***
Proportion of area irrigated in 1999	0.7652	–5.5610	55.767***	0.4559	–6.0512
Proportion of land with good soil in 1999	–1.0533***	–2.1236**	0.1202	0.2729	0.9224
Distance (100 km) to *wereda* town	–0.0583	–0.6087	–0.5548**	0.3099	–0.3012
100 households per hectare in 1991	0.3170	–0.7547*	–0.0201	0.6860***	–0.2683
Proportion of landless households in 1999	–0.2309	–3.2133***	0.0233	–0.5857	2.3019***
Proportion of households in 1999 receiving credit and associated extension from:					
Bureau of Agriculture	–0.3681	0.5509	–0.0032	–0.0484	–2.4718
Amhara Credit and Savings Institution	–0.0665	–0.1035	–2.4381*	–0.3363	–6.7829*
Other formal sources	0.0103	3.7158***	–0.1544	0.3404	1.2285**
Proportion of adult literates in 1999	–0.4609	1.6538	0.6853	0.0106	0.5564
Intercept	2.1043***	–1.9234	–0.5932	–0.8000	0.3394
F	2.72**	2.23**	3.10***	2.61**	4.04***
Uncensored observations	52	18	22	37	10
Left-censored observations	25	16	59	24	78
Right-censored observations	17	60	12	33	4
Total observations	94	94	93	94	92

Notes: Coefficients and standard errors are adjusted for stratification, weighting and clustering of sample.
* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

Table 3. *Regression results of the proportion of households using purchased inputs in 1999 and average cereal yields (100 kg/ha) in 1999 in the highlands of Amhara region.*

Explanatory variable	Fertilisers	Pesticides	Improved seeds	Local barley	Local wheat	Local teff	Improved wheat
If land redistribution in 1997 or 1998	0.4990***	–0.2292	–0.1277	4.2782*	3.6424***	3.3351***	5.9116***
If expect land redistribution in the future	0.0002	–0.2470	0.1004	4.0881***	0.8567	1.2362	–12.129***
Annual rainfall (1000 mm)	–0.5901***	1.3798**	–0.5067	–13.879***	8.0569	0.0414	36.872***

Altitude (1000 masl)	–0.0696	–0.6035**	–0.0854	–1.2004	–0.6495	0.7090	–3.0108
Proportion of area irrigated in 1999	5.7691	24.411*	6.9681	166.59	358.35	10.337	–134.64
Proportion of land with good soil in 1999	0.1119	–0.3406	0.3256	5.6830***	4.3948*	1.9026	10.178*
Distance (100 km) to *wereda* town	0.0909	0.5889	0.1754*	–0.0899	0.0997	0.2162	–1.5547
100 households per hectare in 1991	0.1579*	–0.0280	0.2295***	8.0390***	–1.5155	3.1070***	–7.0553***
Proportion of landless households in 1999	–0.5076*	2.2316***	0.1906	–3.1299	–3.1865	1.0942	7.0550
Proportion of households in 1999 receiving credit and associated extension from:							
Bureau of Agriculture	0.6183***	0.9043***	0.7266***	3.1056*	6.1616***	3.4812***	–1.4537
Amhara Credit and Savings Institution	0.7438***	–0.0721	–0.1489	4.4021	–0.6375	1.1109	–3.7549
Other formal sources	0.6435***	0.4751*	0.9323***	3.0146*	–2.6232	3.4949***	–1.6295
Proportion of adult literates in 1999	0.7679***	0.7939	0.4146	–0.5081	–0.2544	–1.2662	–6.1071
Intercept	0.3404	–1.4565	0.0348	8.8989*	–4.6839	–3.4329	–11.421
F	9.76***	4.06***	6.49***	30.82***	16.66**	15.58***	15.94***
R^2				0.73	0.77	0.68	0.77
Uncensored observations	61	30	53				
Left-censored observations	13	51	25				
Right-censored observations	19	13	15				
Total observations	93	94	93	70	53	74	41

Notes: Coefficients and standard errors are adjusted for stratification, weighting and clustering of sample.
* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.

Table 4. *Regression results of changes between 1999 and 1991 in the proportion of households undertaking land investments and land management practices in the highlands of Amhara region.*

Explanatory variable	Drainage ditches	Waterways	Burning to clear field	Traditional fallow	Crop rotation
If land redistribution since 1991	0.0588	0.3139	–0.0079	–0.0029	–0.0027
Annual rainfall (1000 mm)	2.3969	0.6498	–0.0832	0.1048	0.0249
Altitude (1000 masl)	0.4107	2.1741**[R]	0.0353*	–0.0325	–0.0038
Change in proportion of area irrigated	–307.83***	277.43*[R]	7.9136	–1.8864	–2.8411
Change in proportion of land with good soil	–2.0329	–6.3835***	–0.1033	–0.1154	0.1519
Distance (100 km) to *wereda* town	–1.2034	–2.4818**[R]	0.0039	0.0591	0.0339
Change in 100 households per hectare	–0.2866	3.9424	0.0956	–0.5133	0.2413
Change in proportion of landless households	–2.2026*	–0.3353	0.1668	0.5879***[R]	–0.2125*
Change in proportion of households receiving credit and associated extension from					
Bureau of Agriculture (BoA)	0.1853	–0.9965	0.0981***[R]	0.1115	0.0218
Amhara Credit and Savings Institution (ACSI)	0.8221	4.4849***	0.0963*	0.1832	0.0072
Other formal sources	4.2091**	1.3322	0.0290	–0.0573	–0.0207
Change in proportion of adult literates	–3.2162	–1.1446	–0.1342	–0.4488*	–0.1253
Intercept	–1.8479	–5.5691	–0.0463	–0.1091	–0.0151
F	4.51***	1.90*	3.59***	2.44**	1.92*
Uncensored observations	16	18	86	83	86
Left-censored observations	15	34	0	2	0
Right-censored observations	55	34	0	0	0

Total observations	86	86	86	85	86

Notes: Change in explanatory variable refers to difference between 1999 and 1991 levels. Coefficients and standard errors are adjusted for stratification, weighting and clustering of sample. * Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.
R = coefficient of same sign and significant at 10% level when predicted values used for changes in proportions of area irrigated, farmlands with good soil, landless households, households obtaining credit and extension from ACSI, BoA and other formal sources adult literates, and change in household density.

Table 5. *Regression results of the changes between 1999 and 1991 in the proportion of households using purchased inputs in the highlands of Amhara region.*

Explanatory variable	Fertilisers	Pesticides	Herbicides	Improved seeds
If land redistribution since 1991	0.2763*	–0.1173	0.1991***R	–0.0177
Annual rainfall (1000 mm)	–1.0309***R	0.2863	0.0962	0.1641
Altitude (1000 masl)	0.0848	0.0461	–0.0378	–0.0930
Change in proportion of area irrigated	32.871*	28.854***R	–1.2785	65.557***
Change in proportion of land with good soil	0.1892	–0.0049	–0.0774	0.3957
Distance (100 km) to *wereda* town	–0.0606	0.0389	–0.0994	0.1315
Change in 100 households per hectare	0.6766	0.5353	0.2492	–0.7160**
Change in proportion of landless households	–0.1098	–0.0556	0.2296**	0.1902
Change in proportion of households receiving credit and associated extension from:				
Bureau of Agriculture (BoA)	0.1519	–0.0754	0.0818	0.5291***R
Amhara Credit and Savings Institution (ACSI)	0.0677	–0.0739	0.2667*R	–0.1963
Other formal sources	0.3055***	0.2323***R	–0.0787*	0.9303***R
Change in proportion of adult literates	0.2989	0.1148	0.1998	–0.1690
Intercept	1.0639***R	–0.5059*R	–0.0871	0.2166
F	3.62***	2.28**	5.01***	70.68***
Uncensored observations	82	82	86	75
Left-censored observations	0	3	0	0
Right-censored observations	3	1	0	10
Total observations	85	86	70	85

Notes: Change in explanatory variable refers to difference between 1999 and 1991 levels. Coefficients and standard errors are adjusted for stratification, weighting and clustering of sample.
* Statistically significant at the 10% level.
** Statistically significant at the 5% level.
*** Statistically significant at the 1% level.
R = coefficient of same sign and significant at 10% level when predicted values used for changes in proportions of area irrigated, farmlands with good soil, landless households, households obtaining credit and extension from ACSI, BoA and other formal sources, adult literates and change in household density.

4.2.1 Investments in land improvement

We find that land redistribution and expectations of future land redistribution have a statistically insignificant and usually small association with land investments since 1991 (Tables 2 and 4). Of the other explanatory variables, we find that increased use of credit and extension from other formal sources is associated with higher and increasing investments in drainage ditches. Increased use of credit from ACSI, however, has mixed impacts: it is associated with lower investments in irrigation canals, but increasing investments in waterways. Increase in the proportion of poor soils is associated with more investments in stone terraces, drainage ditches and waterways. This is probably because the returns to soil and water conservation are higher on more degraded soils (Herweg 1993).

As expected, increase in the proportion of area irrigated increases investment in irrigation canals and waterways. Poor market access (increase in

distance to the wereda town), however, is associated with lower investment in irrigation canals and waterways. This is probably because the profitability (through increased output) of investment in irrigation is reduced by the high transaction costs associated with distant markets. More densely populated areas are associated with higher investments in live barriers, but lower investments in drainage ditches. In addition, increase in proportion of landless households is associated with lower and declining investments in drainage ditches. Landless households also tend to renters and sharecroppers and so they may not have incentive to invest in land improvement, especially given the short leases (usually one season long) as exist in most of Ethiopia.

4.2.2 Land management practices

With the exception of traditional fallow, we did not find any statistically significant association between land redistribution or expectations of future redistribution and the proportion of farmers undertaking land management practices. The reduction in the proportion of farmers practicing traditional fallow where there has been a recent redistribution (Table 2), suggests that farmers may be farming more intensively to compensate for the reduction in plot sizes (usually less than one hectare per household), as farmers cannot afford to fallow part of their already small fields.

Of the other explanatory variables, we find that the practice of traditional fallow increases with altitude and declines with rainfall (Table 2), while the practice of burning to clear fields increases with altitude (Table 4). Higher altitude areas tend to be more degraded and may require more fallow to replenish lost nutrients, due to more burning and/or lower use of fertility-improving technologies. Participation in credit and extension programs has mixed impacts. Higher participation in credit from ACSI is associated with lower practice of traditional fallow, due probably to ACSI offering credit in the form of fertiliser, whose use reduces the need for fallowing. Higher participation in credit from other formal sources, on the other hand, is associated with higher practice of traditional fallow. This is probably because there are several non-governmental organisations in the region providing credit for small enterprises that generate non-farm income, which may allow more farmers to fallow their fields. We also find that increase in participation in credit and extension from BoA and ACSI is associated with more practice of burning to clear fields. With increase in use of credit in the form of fertilizers, more farmers can afford to burn their fields as a quicker and cheaper method of clearing, and then utilise the fertilisers to replenish the lost nutrients from burning.

Higher incidence of landless households is associated with higher and increasing practice of traditional fallow, but associated with declining practice of crop rotation. Landless also tend to be renters and sharecroppers who may mine the soil, requiring more fallow to replenish lost nutrients. Furthermore, with short leases of one season long, there is little incentive and opportunity for practicing crop rotation. Increase in adult literacy is associated with declining practice of traditional fallow. It may be that better educated people are more likely to employ other fertility-improving technologies (i.e. fertiliser) and engage in more intensive agriculture. This hypothesis is discussed further in the next sub section relating to use of purchased inputs.

4.2.3 Use of purchased inputs

In contrast to the limited impacts on land investment and management practices, increased use of fertilisers in 1999 is strongly associated with recent land redistribution in 1997 or 1998 (Table 3). It might be hypothesised that this is because the credit and extension programs focused more attention on areas where the land redistribution occurred. However, we find a negative and relatively small correlation between the presence of extension and credit programs and where land redistribution has occurred. Thus, it appears that land redistribution has contributed to greater input intensity by increasing access to land among households with greater proclivity or ability to use inputs. This may be because the younger farmers who gain access through redistribution are more educated or have access to off-farm sources of income with which to finance input purchases. Increased use of fertilisers is also consistent with our finding of a reduction in the practice of fallow where there has been recent land redistribution. With more intensive and continuous cropping, there is the need to maintain (or improve) fertility through fertilisers and other fertility-improving practices. We do not find any statistically significant association between expectations of future land redistribution and use of purchased inputs.

We also find that land redistribution since 1991 has a statistically significant positive impact on change in proportion of households using fertilisers and herbicides (Table 5). This finding reinforces the discussion above.

Of the other explanatory variables, we find that higher participation (and growth) in credit and extension programs have statistically significant positive association with use of most of the purchased inputs. The only exception is the use of herbicides, which declines with increased participation in credit and extension from other formal sources, although the coefficient measuring this impact is not robust (Table 5). As expected, increase in area irrigated is associated with higher use of pesticides, and increasing use of fertilisers, pesticides and improved seeds. Higher altitude areas are associated with lower use of pesticides, probably because of the lower incidence of pests at higher altitudes. Rainfall and population density have mixed impacts on use of purchased inputs. While higher rainfall is associated with higher use of pesticides, it is associated with lower and declining use of fertilisers. The latter may be due to the active promotion by the government of fertilisers in the lower rainfall areas under the previous extension system within the last decade.

More densely populated areas are associated with higher use of fertilisers and improved seeds (Table 3), but population growth is associated with a decline in use of improved seeds, although the coefficient measuring this impact is not robust (Table 5). More densely populated areas also tend to have smaller plots and thus, farmers here may need to farm more intensively. On the other hand, land-labour ratios may be low enough to induce more labour-intensive, modern cultural practices (Boserup 1965). We also find that areas with higher proportion of landless households are associated with lower use of fertilisers, but higher use of pesticides. As mentioned earlier, landless households also tend to be renters and sharecroppers and so they may have little incentive (given short leases) to use fertilisers, which may have long-term fertility improving effects of which they may not be able to reap the benefits.

4.2.4 Cereal yields

Consistent with the positive impacts of land redistribution on fertiliser use, we also find that yields of barley, wheat and teff in 1999 are higher in communities where there has been a recent redistribution (Table 3). Yields of local varieties of these crops are about 400 kg per hectare higher and yields of improved wheat are about 600 kg per hectare higher where there has been a recent redistribution.

We also find that expectations of future redistribution have a positive association with yields of the local cereal varieties (although it is statistically significant in the case of barley only), but a negative association with yields of improved varieties of wheat. The positive association may indicate soil mining on those plots that farmers anticipate will be redistributed in the future. On the other hand, it may indicate that farmers increase their productivity if they believe that higher yields will prevent their plots from being redistributed. Further research is needed to test these hypotheses. The negative association between expectations of future redistribution and improved wheat yield is not apparent. Therefore, while the impact of redistribution on the yields of the local varieties is uniformly positive, that on the improved varieties is not and depends on expectations about the future.[7]

7. We estimated a Probit model of expecting land redistribution in future as a function of recent redistribution (with a positive and significant coefficient), number of redistributions in the past (negative), population density (positive), proportion of landless households (positive and significant) and proportion of households that have their land registered (negative).

Of the other explanatory variables, we find that areas with higher rainfall, better, soils, and higher participation in credit and extension programs have higher yields in one or more of the cereals. While more densely populated areas are associated with higher yields of local varieties of teff, they are associated with lower yields of improved varieties of wheat. The model for the change in average cereal yields between 1999 and 1991 could not be estimated due to insufficient number of observations, as the cereals were not grown in both years for some of the villages.

5 Conclusions and implications

Overall, these results suggest that the recent land redistribution in Amhara has had a positive impact on land productivity, at least in the near term, by increasing access to land of farmers who are more interested or able to use purchased inputs such as fertilisers. This does not mean that land redistribution must be continued and used as a tool to improve access to land, as the longer-term impacts of such redistributions depend upon how these may affect farmers' perceptions of tenure security and incentives to invest in land improvement.

Nevertheless, it is difficult to continue to use redistribution as a tool to address landlessness because of the very small size of farm holdings in the Ethiopian highlands. Improving access to farmland through other means such as development of land rental markets may present a more sustainable and only strategy to improving agricultural productivity, especially since land sales are prohibited and other transfers restricted.

For the most part, however, our results do not show much effect of land redistribution or expectations of future redistribution on land improvement. In addition, almost all farmers expect future redistributions. Although the regional government is considering a policy that may end land redistributions, we find that respondents' expectations of future redistributions are also significantly affected by landlessness, which also tend to negatively affect use of several of the land-improving technologies analysed here. Thus, to the extent that investments in land improvement are necessary for conservation purposes, it appears that as long as landlessness is prevalent, the intended policy change to end redistributions is unlikely to have a substantial impact on reducing land degradation in this region of Ethiopia. However, since landless households tend to be renters and sharecroppers who have little incentive in investing in rented land, improving land rental markets, especially to encourage longer leases, will have a positive impact on land management by reducing soil mining and by increasing use of fertilisers and crop rotation.

Furthermore, given that other factors such as participation in credit and extension programs were more important determinants of land investment and management, these factors may present better strategies for reducing land degradation in the Ethiopian highlands. For example, improving credit for non-farm income generating activities will allow more farmers to fallow their (marginal) lands or provide them with cash to purchase and use fertilisers.

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