Essays on Impact Evaluations of Land Registration and Certification Program in East Africa

A Dissertation

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by

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Abstract

Historically, land tenure security in Ethiopia was known for restricted land transactions in the form of land renting, selling, mortgage, and sharecropping. Specifically, the land was in the hands of few elites, feudal landlords, collective descendants, church, and high-ranking military officers before 1975. Following the governmental reform in 1975, land owned at hands of a few was redistributed frequently to farmers through local administration units. Even though there was a government change in 1991, the land was frequently redistributed by taking land from land-rich households and giving it to the landless due to increasing population size. This frequent land redistribution created land tenure insecurity which limits land transferability and decreases long-term land investment that also increases the risk of land expropriation. To increase land tenure security and agricultural productivity, the land administration and use proclamation was approved in 1997 at the federal level and regional states have taken the responsibility to implement the land registration and certification program. The land certification program was initiated after the approval of land proclamation from federal and regional states and the rolling out of the program was determined based on non-economic criteria. Within each village, a land use and administration committee (LAC) was appointed to be responsible for the administration and certification process.

This dissertation includes two main chapters. The first chapter, chapter 2, examines the impacts of the land certification program on migration using 10-year interval household panel data in Ethiopia using the difference-in-differences (DID) approach. On average, our estimation results indicate that the land certification program

has not precisely estimated zero impacts on the participation of seasonal, non-seasonal migration, and rural wage earners. However, for households with the initial expectations of land redistribution prior to the program, the certificate has a negative effect on non-seasonal migration. This suggests the importance of complementary efforts to change people's perceptions of land tenure security when implementing a land registration and certification program. Furthermore, the land certification program was found to have a positive impact on per capita expenditure owing to enhanced agricultural income and cereal productivity by increasing chemical fertilizer use.

The second main chapter of the dissertation, chapter 3, examines the effects of weather shocks on household consumption in Ethiopia and how the household responses to weather shocks differ depending on whether they receive land certification. Using the difference-in-differences (DID) approach, we find that weather shocks negatively affected household consumption expenditure. As expected, households are not able to protect themselves from weather shocks. However, land certification can help insure households against weather shocks. Households with land certification tend to smooth out their consumption expenditure by obtaining credit.

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DEDICATION

Dedicated to my little princesses Nolawit and Ephrath, and my wife Rigbe Nuguse

And

My mother Belaynesh Hagos and my brothers Tsegay and Kindhaw

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Chapter One

Introduction

1.1 Overview

Agriculture is the predominant economic activity in East Africa with about 80 percent of the population living in the region relying on agriculture that is mainly dominated by smallholder farmers; with limited economic diversification (Deininger et al., 2008). Hence, the issue of land security is crucial in the region due to the existence of inequitable land access to rural households and insecure land rights that led to conflict (Lund, et al., 2016). Land tenure is not secure in this region mainly due to lack of formal land rights and an existence of frequent land reallocation to accommodate increased population growth. To strengthen land security, the Ethiopian government introduced a pro-poor land registration and certification program, one of the largest land administration programs in Africa. The Ethiopian Land certification program was rapid, participatory, and effective. The program covered a large area, encouraged gender equality through the provision of joint certification of husband and wives, and was the lowest cost program in Africa with slight differences in the land registration and certification process across regions in the country (Bezu and Holden 2014; Holden et al. 2009; Deininger et al. 2015; Deininger et al. 2008).

Increased tenure security resulting from land certification increased agricultural productivity by encouraging land-related investment; enhanced gender equality and bargaining power for women; improved governance; reduced land conflict potential; and

lowered transaction costs for productivity-enhancing land transfers (Deininger *et al.*, 2008; Holden et al., 2011b; Deininger et al., 2011; Bezabih et al., 2016). Ghebru and Holden (2015) also found that households with land certification increased farm productivity as compared with households without land certification by increasing long-term investment and adoption of technology. However, it has not been studied whether the program that enhanced tenure security activated labor market participation, and mitigated the negative impact of shocks by enabling access to credit. In this dissertation, we provided a conceptual framework for the impact of land certification on agricultural productivity based on the idea discussed by Besley (1995), and Ghebru and Holden (2015), as shown in Figure 1.1. This figure highlights the pathways that have been examined by other studies so far and shows also what have not been examined by including the linkage of land certification with migration and using it as mitigation against weather shock. Land certification created an interpersonal mutual trust within the community and trust towards formal institutions (Bezabih et al., 2011). Therefore, the program can activate migration as well as the credit market to mitigate against weather shock.

Increased tenure security from land certification increased agricultural productivity by encouraging land-related investment; and activating productivity-enhancing land transfers (Deininger et al. 2015; Deininger et al. 2008; Ghebru and Holden, 2015). However, whether such a positive impact on agricultural productivity and the land rental market leads to the release of family labor from agriculture to nonagricultural activities has not been fully explored. If land markets are activated due to an improved land tenure system by providing land certification program it can release excess labor.

This is because labor input is too high compared with the land used. This issue is relevant to Ethiopia due to long history and frequent land redistribution experience. Therefore, using the dataset collected in 2004, 2006, and 2014 by the Foundation for Advanced Studies on International Development (FASID) and the National Graduate Institute for Policy Studies (GRIPS) in Japan under the Research on Poverty, Environment, and Agricultural Technology (RePEAT) project we will test if whether holding a formal land ownership document activates the labor, land market, farming activities and household welfare.

In our second main study, chapter three, an extension and deepening of the first study, examines the role of land certification in reducing the effect of shocks on household welfare. Adverse weather shocks have a negative effect on household welfare in both developed and developing countries. However, due to the existence of limited insurance markets, the impact is more severe in developing countries where their economy mainly depends on rainfed agriculture (Dercon and Christiaensen, 2011; Islam and Maitra, 2012; Porter, 2012). Ethiopia is among the bottom economies in the world and is exposed to frequent drought which worsens the level of poverty. As a risk management mechanism, some household sells their livestock and assets in response to weather shocks at the expense of the long-term household income (Dercon and Christiaensen, 2011; Islam and Maitra, 2012; Porter, 2012; Wossen, Di Falco and Berger, 2016). Hence, the second main study of this dissertation is to test if land certification has an insurance role against the negative effect of weather shock on household consumption expenditure.

In our dissertation, we covered two broad research questions. The first research question discussed in chapter two of this dissertation examines whether enhanced land

tenure resulting from providing a land certificate to rural farm households in Ethiopia activated labor market participation through seasonal and nonseasonal migration and rural nonagricultural labor markets. The second research question incorporated in chapter three of the dissertation examines the role of land certification in insuring households against weather shock.

1.2 Main findings

1.2.1 Main findings of Chapter 2

On average, an estimation reported in chapter two of our dissertation indicates not precisely estimated zero impacts of the land certification program that activated the labor market. However, the land certification program found a positive effect on per capita expenditure owing to increasing agricultural income and cereal productivity by increasing chemical fertilizer use. We examined the heterogeneous effect of the land certification program based on the differences in the household expectation of land redistribution. However, households with the expectation of land redistribution have shown a negative effect of the program on non-seasonal migration.

1.2.2 Main findings of Chapter 3

An estimation result reported in chapter 3 shows that households are not able to protect themselves from weather shocks using informal risk mitigating mechanisms. However, the land certification has an insurance role against weather shocks. Households with land certification smoothen consumption expenditure mainly by obtaining formal and informal credit.

Our study also examined the heterogenous analysis on the effect of land certification

against weather shock across land size, and household head age. We found that households with land certification are enabling to increase non-food consumption expenditure for households that owned large land sizes and for household with older household head in response to weather shocks. Similarly, the land certification increased food consumption for younger household heads and for households with smaller land size.

1.3 Roadmap to the Dissertation

The remaining part of the dissertation is organized as follows: Chapter 2 examines the impact of the land certificate on seasonal, nonseasonal migration and rural nonagricultural labor markets. Chapter 3 analyzes the role of land certification in mitigating the negative impact of weather shocks. the final section in chapter 4 summarizes the main findings and identifies some policy implications and indicates some possible extensions of this research.

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Figure 1. 1: Conceptual framework for land registration and certification

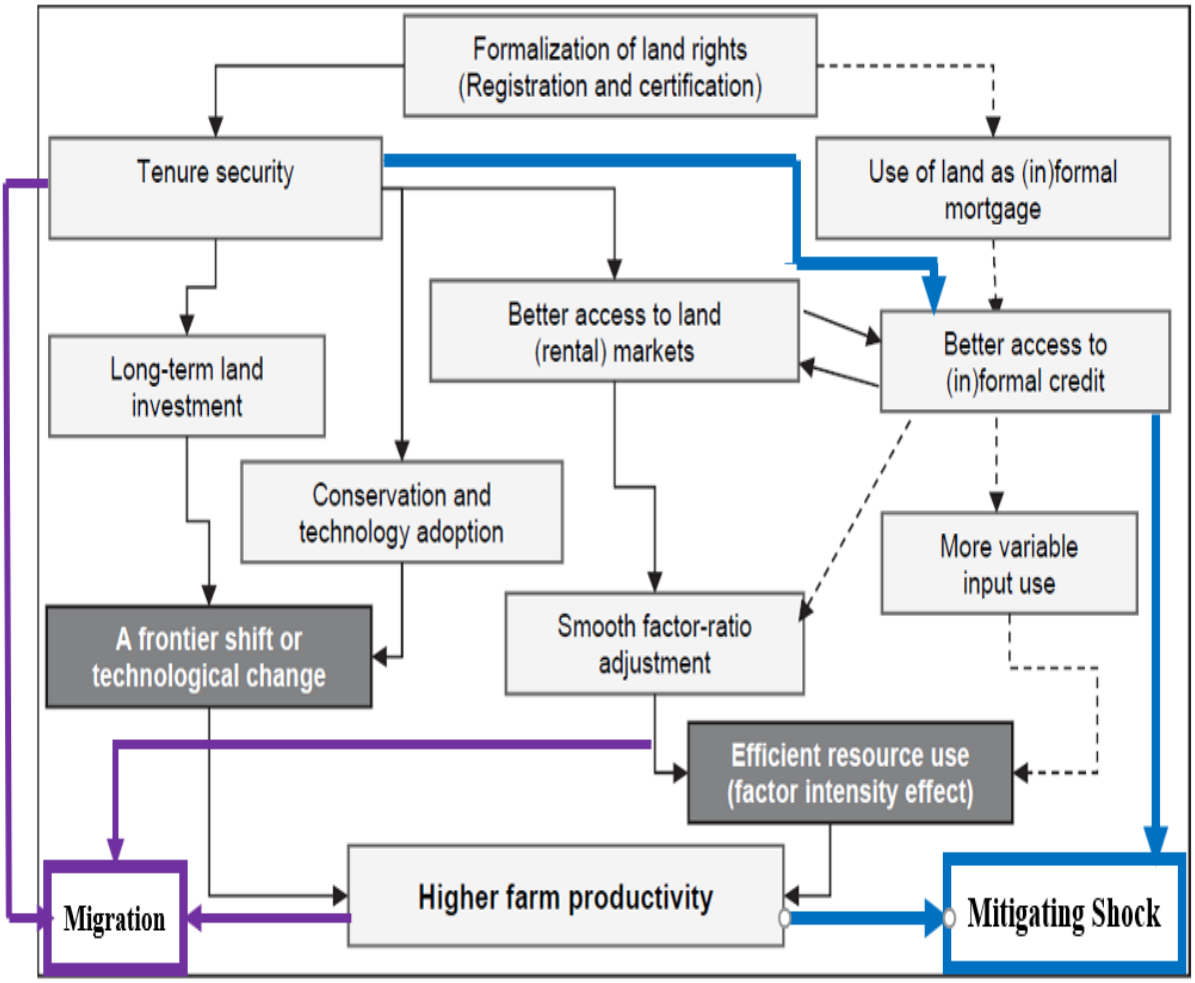

Fig 1- Source: Ghebru and Holden, (2015): a broken line shows an uncovered section in the conceptual framework due to the limited usage of land certificates to sell and mortgage the land in Ethiopia, land certification can only provide use rights.

Chapter Two

The Effect of Land Certification Program on Migration

2.1 Introduction

The agricultural sector is the main source of income for families in many sub-Saharan African countries (SSA), where 70% of households depend mainly on agriculture for their livelihood. The agricultural sector's growth is considered key not only to food security but also to industrialization. This is because increased agricultural productivity releases excess labor from agriculture into other sectors through rural–urban migration. However, agricultural productivity in SSA remains low (Food and Agriculture Organization, 2001), preventing the acceleration of economic development. Therefore, enhancing agricultural productivity is a central research topic in development economics.

In SSA, low agricultural productivity is attributable to insecure land rights, which weaken claims to investment yields and hinder land transactions (Besley and Ghatak, 2010; Fenske, 2011). Some countries have introduced land certification programs to enhance agricultural productivity. Empirical studies have found that secured land tenure enhances agricultural productivity and participation in land rental markets (Deininger et

al. 2011; Holden et al. 2011). However, whether these programs enhance labor mobility through migration has not yet been fully explored.

Migration is key in improving the well-being of society (De Brauw and Harigaya, 2007; Mueller and Lim Lee, 2019). Barriers to and risks of migration exist (World Bank, 2012). Empirical studies have established how important migrant networks are in destinations (Mckenzie and Rapoport, 2010; Munshi and Rosenzweig, 2016; Mahajan and Yang, 2020) and financial and informational support for domestic migration (Bryan et al. 2014; Bryan and Morten 2019; Card et al. 2007). However, such support does not increase international migration (Beam 2016; Beam et al. 2016). Land tenure insecurity is another factor limiting migration. Issuing land certificates and land titling programs increased both international migration from Mexico to the USA (Valsecchi, 2014; De Janvry *et al.*, 2015) and domestic migration in the 19th century in Russia (Chernina et al. 2014). There is, however, no study examining the effect of land certification on migration in the African context and on seasonal migration.

This study examines whether enhanced land tenure resulting from providing a land certificate to rural households in Ethiopia activated labor market participation through seasonal and nonseasonal migration and rural nonagricultural labor markets. In Ethiopia,

land is owned by the state, and households have usufruct rights. Until 2000, rural land was redistributed periodically by local leaders to accommodate young and newly arriving families. Thus, the risk of land being confiscated (land expropriation risk) remains (De Brauw and Mueller, 2012). Hence, in 2003[1], the Ethiopian government introduced a land registration and certification program on a massive scale, which is one of the largest land administration programs in Africa (Holden et al. 2009). Thereafter, agricultural productivity increased by encouraging land-related investment, particularly through increased application of chemical fertilizer and lowered transaction costs for productivity-enhancing land transfers (either rental or sale) (Mequanint and Erwin, 2015), and by shifting from subsistence crops to long-term and perennial cash crops (Goldstein *et al.*, 2018). However, whether such a positive impact on agricultural productivity and the land rental market leads to the release of family labor from agriculture to nonagricultural activities has not been studied. This issue is particularly relevant for Ethiopia as the rural agricultural labor market does not function well, and frequent land redistribution in the absence of formal land ownership documents limits land transferability and also increases the land expropriation risk (Brauw and Mueller 2012; Dillon and Voena 2018).

[1] The land registration and certification program were initially launched in 1998 in Tigray region.

Our analysis of 2004, 2006, and 2014 panel data showed that the land certification program decreased nonseasonal migration in villages where land redistribution was believed to occur before the program was launched. This suggests that for those who perceived redistribution, issuing the certificate does not help increase tenure security significantly enough for non-seasonal migration. on average, there is not precisely estimated zero impact that the program enhances migration in Ethiopia.

Previous studies have examined the impact of land certification programs on land rental markets and agricultural productivity (Deininger et al. 2008; Deininger et al. 2011; Holden et al. 2009; Holden et al. 2011). In this study, we are using a dataset collected more recently to examine the impact of land certification program on participation in land rental markets, agricultural productivity, and household welfare in a more comprehensive manner. Our estimation results show that the land certification program had a positive impact on per capita expenditure owing to enhanced agricultural income and cereal productivity by increasing chemical fertilizer use.

The chapter is organized as follows: the following section presents selected literature on the Ethiopian land certification program, the third section describes the dataset used and presents descriptive statistics, the fourth section presents the estimation

model used, and the fifth section summarizes the main findings and presents conclusions.

2.2 Background

Historically, Ethiopian land policies can be summarized into three regimes: The imperial period (pre-1975), the Derg regime (1975 - 1991), and the initial periods of the Ethiopian People's Republic Democratic Parties (EPRDF) (1991-1997) (Kebede, 2002). In the imperial regime, land was in the hands of a few elites, feudal landlords, high-ranking officials, and the church. This high concentration of land created tenure insecurity in the tenant and landlord relationship, which led to the government change because of the "land to the tiller" movement. The military force under the Derg regime took the power and land owned by a few elites and feudal landlords were redistributed to landless and new families through the local administration units. However, land rental, selling, and sharecropped contracts were restricted. Land redistribution continued even after the change in government in 1991 by EPRDF, but the new land reform in this regime lifted some of the land transfer restrictions. Additionally, to improve the productivity of smallholder farmers the then government of Ethiopia introduced the pro-poor and low-cost land registration and certification program under the 1997 Land use and administration proclamation (Holden et al., 2011b).

Land is state-owned and households hold usufruct rights in Ethiopia, and rural land is occasionally reallocated, decreasing land rights security. The Ethiopian land certification program was launched in 1998 in Tigray and 2003 in Amhara region to mitigate the low productivity resulting from this land insecurity (Deininger et al. 2008; Holden et al. 2009). The land certification process comprised the following procedures: first, community-level meetings were held to publicize the land demarcation and certification program; second, a land use and administration committee (LAC) was appointed to be responsible for the administration and certification process; and third, certificates were issued by the *woreda* (district offices).

Although the land remained state-owned under this program, the usufruct rights to the plots already allocated to households were registered under the names of current users. In the Tigray region, where the land certification program began in 1998, only the household head's name was stated on the certificate. Conversely, in other regions where the survey for this study was conducted, certificates were issued in the names of both head and spouse (joint certification). This difference in registration with and without a spouse's name has had a differential impact on intra-household resource allocation and the bargaining power of spouses (Bezabih et al. 2016; Muchomba 2017). Even under joint certification, a slight difference exists. In the Oromia region, the household head's photo

was attached to the certificate while in the Amhara region and the Southern Nations; Nationalities; and People's Region (SNNPR), both the head's and spouse's photos were attached. In addition, there were slight differences in the implementation of land registration and certification process. In the Amhara and Oromia, initial training on the procedure of implementation was provided by woreda officials, but in SNNPR it was offered by the training centers at the village level. Written manuals were required to implement smoothly and consistently but there was also a slight difference in this regard. In the Oromia region, proclamations and books were provided to the LAC while there were no manuals provided in the SNNPR as there is no common language used in SNNPR. There were also some delays in providing posters in the Amhara region. Moreover, the process of land registration and certification was supervised by woreda survey team and land administration team in the Amhara region. In the Oromia region, LAC was responsible for some technical advice from the woreda officials on the supervision of the process. While in SNNPR, the supervisor of the land registration and certification process was exclusively by village-level rural development agents. Hence, the registration process was more intensive in the Amhara region through more involvement of the woreda officials even post-registration meetings in addition to the responsibility of LAC in the implementation of the program.

Under the program, more than 20 million plots were certified in 7 years (Deininger et al. 2008). The land registration and certification processes involved locating, measuring, and registering farm plots belonging to rural farm households. Moreover, land registration and certification programs did not use skilled surveyors. Rather, staff with short-term training registered the land at a low cost and in minimum time (Bezu and Holden, 2014).

2.3 Tenure security and Migration

As explained in the previous section, land distribution was nearly equal within the village in Ethiopia when the land was reallocated occasionally. Since land redistribution by the local government had not been implemented for a while, newly formed households and households with more children face a smaller land-labor ratio while aged and weak households have more land that they can cultivate effectively. Thus, there is small room for adjusting land allocation from land-abundant households to land-scarce households via the land rental market even within the village. However, the total cultivable land is fixed and population growth is rapid, land allocation via the land rental market may not be enough for households to reach an efficient land-labor ratio. Labor-abundant households, therefore, allocate labor to non-agriculture or off-farm activities including non-seasonal migration based on the paths shown in figure 1.1.

Land certification can increase long-term investment in their land and adoption of productivity-enhancing technology (Ghebru and Holden, 2015). Such households may rent more land, increase agricultural production, and decrease off-farm labor including migration. However, for some households, increased tenure security due to land certification can result in renting the land out for a longer term (Deininger et al. 2015; Deininger et al. 2008; Ghebru and Holden, 2015) and increase their engagement in off-farm activities. In some areas, off-farm activities can be found locally, and finding a job and migration is uncertain and costly. Furthermore, the perception of land security (risk of losing land due to land redistribution) can be different across communities. Even when households receive the land certificate, they would keep cultivating their land if they believe that land will be redistributed soon and taken away unless they cultivate the land. The effect is more pronounced when they engaged in non-seasonal migration. This is because migrating for longer periods as a non-seasonal migrant implies less use of land which might have a risk of land expropriation by local leaders. Therefore, whether improving land tenure security increases migration depends on initial endowments and easiness of labor movement, local land, and labor market conditions as well as the communities' beliefs or perceptions about the likelihood of land redistribution.

2.4 Materials and methods

2.4.1 Data

The dataset used in this study was collected in 2004, 2006, and 2014 by the Foundation for Advanced Studies on International Development (FASID) and the National Graduate Institute for Policy Studies (GRIPS) in Japan under the Research on Poverty, Environment, and Agricultural Technology (RePEAT) project. Forty-two rural villages (known as peasant associations, PA), the lowest administrative units in rural Ethiopia, were randomly selected within a 400-km radius from Addis Ababa, covering three regions: Amhara, Oromia, and SNNPR. In each village, 10 households were randomly selected, with a total sample size of 420 households (Matsumoto et al. 2006). In the 2014 survey, one tablet device failed, and data for 21 households were lost. Additionally, survey teams were unable to track 23 households owing to relocation and/or dissolution of households between 2004 and 2014. Thus, 376 households were interviewed in all three rounds. To mitigate panel attrition bias, attrition probability was estimated using household- and village-level covariates in 2004 (Table 2.A.1). Moreover, an estimated attrition weight was used to estimate the impact of the program and presented in the appendix Table 2. A.24 to Table 2. A.30. While an estimation result without attrition weight is presented as the main analysis in Table 2.4 to Table 2.10. For

a robustness check, I also included the lagged assets and livestock value as a control variable in our analysis. However, to avoid reporting many tables I only reported without controlling lagged asset and livestock.

The RePEAT survey contained comprehensive village- and household-level data. In the 2006 and 2014 surveys, households were asked whether they had land certificates and, if so, when they had been received. The land certification program was implemented at the village level, and whether a household received a certificate was not a household decision. Hence, in 2006, we found that 23.7 percent of the sample households received land certification. Conversely, in the 2014 survey, 81.4% of the sample households received land certification. The distribution of years of land certification since the households in a treated village received land certification is depicted in Figure 2.1 and in Figure 2.2. Even so, we found variations in certificate acquisition within a village. With the help of informants, village survey respondents, and information from the household survey, we identified villages where the land certification program was implemented and confirmed that most households had a land certificate in the program villages. Some households within communities where the program was implemented did not receive land certificates, mainly owing to the capacity limitations of woreda administration staff, such as a shortage of certificates at hand (Deininger et al. 2008; Holden et al. 2009).

In this study, migrants were defined as household members who had left the community where they lived to find a job or work elsewhere. In the survey, a household member was defined as one who shared resources and was part of a household for at least one month in the last 12 months. However, under this definition, servants and visitors could be included in the number of household members, as our purpose was to establish whether the original household members change their labor allocation if given a land certificate, we did not consider servants and visitors as "migrants." We defined a seasonal migrant as one who left their residence for 1–6 months. The most common activity of seasonal migrants is casual wage labor. As the survey did not consider those who left home for more than 1 year and had not returned at all in the last 12 months as a household member, we defined "household with nonseasonal migrant" as "a household with remittance from a family member who lives somewhere else in the last 12 months and is other than a seasonal migrant as defined above." Most remittance senders were children of household heads who lived in Arab countries. Owing to data limitations, we could not identify when these remittance senders migrated or how long they intended to stay away. Thus, we referred to them as "nonseasonal migrants."

2.4.2 Empirical models and identification strategy

We applied the difference-in-differences (DID) approach to examine the effects of the land certification program on labor reallocation (both seasonal and nonseasonal migration). Villages wherein households had received the land certification program at the time of the follow-up survey were considered the treatment group. We defined the treatment group as those who were exposed to the treatment in the second period but not in the first period and the control group as those not exposed to the treatment in either period.

For the DID model to identify the effect of a program on migration decisions, the program rollout to villages should be exogenous to the outcome variables. If villages wherein households have a higher demand for the land certificate that eases them to migrate had the program earlier, the DID estimate is confounded by these unobserved preferences on migration. However, as explained earlier, the Ethiopian land certification program was initiated after federal and regional approval of the land proclamation. Hence, the village-level program rollout is plausibly exogenous (Muchomba, 2017). Moreover, the land certification process was undertaken at the regional level, and the rollout of the program was determined at the woreda level. This creates exogenous variation in the timing of the arrival of certification to households.

Even under exogenous variation, some observable differences between program and non-program villages in attributes such as total land size (Bezabih et al. 2011; Congdon Fors et al. 2019) were found. Like other studies, we found that the initial conditions differed in the treatment and control villages (Table 2.A.3). We controlled for woreda-year fixed effects to consider migration changing over time owing to different woreda characteristics correlated with the timing of land certification. This addresses some weaknesses of our identification strategy. Additionally, for our main analysis, the 2004 and 2006 waves were used to show that the trends between treated and control households are parallel, at least in those 2 years, using the 2014 treatment status (Appendix Table 2.A.5 Table 2.A.9). As most program beneficiaries obtained the land certificate after 2006, this result shows that the parallel trend assumption will likely hold.

We estimated the following model for the effects of land certification on migration:

$$Y_{hvt} = \beta_1^L Post_t \times Treat_v^L + \beta_2^L Treat_v^L + \beta_3^L Post_t \times H_w + \beta_4^L X_{hvt} + \theta_h + \varepsilon_{hvt} - - - (1)$$

Here, Y_{hvt} is an outcome variable of interest (e.g., an indicator variable that takes the value of 1 if in household *h,* living in village *v,* has a seasonal migrant in year *t*). *Treat*$_v$ takes 1 if village *v* received the land certification program by 2014 and 0 if

otherwise. $Post_t$ is a dummy variable with a value of 1 for the 2014 survey and zero for the 2004 survey; H_w is a set of woreda dummies; X_{hvt} is a vector of household-level covariates; θ_h is the household fixed effect to control for unobserved time-invariant household characteristics; ε_{ht} is the error term; βs are coefficients to be estimated; and β_1^L, a coefficient of interest, captures the effect of land certification on labor reallocation through migration. Standard errors are clustered at the village level. To mitigate panel attrition bias, we used attrition weights. Non-attrition probability is estimated using a probit model (Table 2.A.1), which explains whether a household remains in the follow-up survey. The inverse of the predicted probability provides greater weight to households with a lower probability of remaining in the sample than those resurveyed (Moffit et al. 1999).

In addition to migration decisions, we examined their effect on participation in the land rental market, farming activities (agricultural productivity and chemical fertilizer use), and household welfare (consumption and income). For this purpose, we ran equations (1) shown above.

2.5 Results

2.5.1 Descriptive Statistics

Tables 2.1, 2.2, and 2.3 show the household characteristics separately before and after the program (2004 and 2014) and for the treatment and control villages. Table 2.A.3 shows descriptive statistics by survey periods (not divided into treatment and control villages).

Table 2.1 shows household demographics and migration status. We can see that labor market participation increased slightly between 2004 and 2014. No differences were found in the labor market participation in the pre-program period between treatment and control villages except for nonseasonal migration, which was more active in the control villages than in the treatment village. Seasonal migrants were away from home for 3 months on average. Around half of these were male and most were children of the household head. Seasonal migrants had 6 years of formal education and were more educated than household heads.

Table 2.2 shows the land owned and participation in the land rental market. The average size of the land owned by households was larger in treatment villages than in control villages (2.6 ha vs. 1.2 ha). Participation in the land rental market was either via

a fixed rental contract or a sharecropping contract. Participation in the land rental market was more active in treatment villages than in control villages even before the program. Approximately 28% of households participated in the land rental market in 2014 reflecting little change from 2004 (25%). In treatment villages, the share of households who rented out land via fixed rental contract and those who rented in via sharecropping contract increased. The average area of land rented out (in) via fixed rental contract was 1.02 (0.91) ha, which accounted for around 37% of the area cultivated. Similarly, the average area of land share cropped out in treatment villages increased from 1.3 ha in 2004 to 2.3 ha in 2014.

Although the difference is not statistically significant, the share of households with land disputes over 10 years increased in both the control and treatment villages and reached 7–9% between 2004 and 2014 (Table 2.2). We are uncertain whether this increase was induced by the land certification program. The last variable was the perception of the likelihood of land redistribution before the program started, which was collected by a village-level survey in 2004. In 81% of the treatment villages in 2004 (before the land certification program), people perceived that it was likely that land would be redistributed within 10 years. This shows how insecure the land tenure was prior to the certification program.

Table 2.3 shows the descriptive statistics of households' farming activities (area cultivated, chemical fertilizer use, production of main crops, and agricultural income), income, consumption expenditure, and assets. In farming activities, the average area under cultivation was 1.8–2.0 hectares, and the share of land left fallow remained around the 2% mark. The area under fallow increased only in the treatment villages. The share of households applying chemical fertilizer doubled in 10 years and was higher in the treatment villages than in the control villages. The application of chemical fertilizers has increased over time from 1.6 to 3 kg per hectare, which remains inadequate. The average yields of the main cereals (teff and maize) were approximately the same in the treatment and control villages before and after the program.

No difference was found in the per capita household income between the treatment and control villages before the program. However, after the program, households in the treatment villages earned a higher income than those in the control villages. Similar patterns were found for per capita consumption expenditure and the value of livestock owned.

2.6 Estimation Results

The main results are reported in four parts: the effects of land certification on (a) the labor market (seasonal migration, nonseasonal migration, and rural wage earners), (b) the land rental market, (c) farm activities, and (d) household welfare (per capita household income and consumption expenditure).

2.6.1 Effect of land certification on labor market

Table 2.4 lists the estimated impacts of land certification on the labor market. We found a negative coefficient but not statistically significant evidence of the certification program on seasonal, non-seasonal migration and rural wage employment at the 90% confidence interval. One possibility is that farm households increased their commitment and resource allocation to their agricultural activity instead of sending their family member to migrate after receiving the land certification. Another possibility is that households may have different perceptions of land redistribution in the future, which differs from the effects of certificates on migration decisions (Kosec et al., 2017). If one had a higher expectation of future land redistribution, and the land certification could not change this expectation of redistribution (the risk of losing land), having the certificate would not de facto increase tenure security or migration. Conversely, the certificate program would have a positive effect on migration for those who had lower expectations of land redistribution. In this thesis, I want to test how initial expectations regarding land redistribution affected the impact of the land certification program on migration. Therefore, I used the perception of land redistribution measured at the village level if they do expect to have re-distribution of land in the future. Hence, the possibility of land redistribution is likely from a rational expectation because people usually answer this

kind of question based on their experience and all the information they have by the time of the survey.

We tested how initial expectations regarding land redistribution affected the program's impact on migration decisions by splitting them into subgroup analyses using equation (1).

Table 2.5 and Table 2.6 lists the subgroup estimation results for households who live in villages with a higher expectation of land redistribution and lower expectation of land redistribution, respectively. In Table 2.5, Column 6 shows, that households in villages with the expectation of land redistribution before the program and received the certification program has shown no statistically significant effect of the program on seasonal and rural wage earner; however, the effect of villages that did expect redistribution is negatively and significantly affecting non-seasonal migration, it decreased non-seasonal migration by 19.9. Improving land tenure security through providing land certification could enable farm households to get more involved in their agriculture activity, which in turn would reduce the non-seasonal migrants. On top of that, non-seasonal migration could be reduced because migrating for more than six months as a non-seasonal migrant might lead to the risk of land expropriation by local leaders. In Table 2.6, households in villages with no expectation of land redistribution before the program haven't significantly increased seasonal, non-seasonal, and rural wage earners. This could be due to more involvement of farm households in their agricultural activities because of enhanced land security. These differential treatment effects by the initial expectation of future land redistribution suggest that not only land certificates (*de jure* land tenure security) but also changes in perception (de facto) of land tenure security affect migration decisions.

2.6.2 Effect of land certification on the land rental market

We now examine the program's impact on participation in the land rental market. On the one hand, providing a land certificate was expected to increase land security and decrease the possibility of conflicts between landowners and tenants, which may increase the land rented out (fixed rent contracts or sharecropping contracts). However, landowners who obtain land certificates may change farming practices from extensive to intensive by increasing land-related investment in their plots, suggesting that the certification program has no effect on the probability of renting land. Therefore, we examine the effect of the land certification program on land rental market participation separately for renting out and renting in.

Our results are presented in Table 2.7. Households who had land certificates did not show a significant effect on both the intensive margin (area of land rented out) and the extensive margin (the probability of households renting out land). Similarly, there is not precisely estimated zero impact that the program increased the probability that households rented land in. This result is consistent with another study conducted in the Amhara region soon after the program, where the issue of land certificates decreased the likelihood of renting land (Deininger et al. 2011).

Table 2.8 shows the estimation results separately for fixed rental and sharecropping contracts. Columns 1-4 of Table 2.8 suggest that there is no statistically significant effect of the land certification program on activating the land rental market in terms of fixed rental contracts. As land rents under sharecropping are based on the outputs harvested by tenants, landlords need to monitor the harvest of the tenants more closely than those under a fixed rental contract. However, there is no significant effect of the

program even on sharecropping land rental markets. Therefore, if there are some barriers to activating the land rental market even with the land certificate, labor mobility can also be restricted, which may explain why there are not precisely estimated zero impacts that the land certification program increases migration.

2.6.3 Effect of land certification on-farm activities

On average, we found no statistically significant evidence of land certification activating seasonal and nonseasonal migration and land rental market participation. We have seen a negative coefficient of land and labor markets participation, though it is not significantly and precisely estimated zero impacts. These findings seem consistent with the possibility that a household allocates more labor and other inputs to own farm activities, given the higher land security. In this section, we examine the impact of the land certification program on-farm activities such as the area under cultivation and fallow, input use (chemical fertilizer application), agricultural productivity on main crops (maize and teff), and agricultural income.

Table 2.9 presents the estimation results. The productivity of the main cereal crop (teff) and per capita agricultural income increased for households with land certification (Column 7). We examined whether the land certificate changed crop choice to crops with longer maturity and high value, which would boost agricultural income. However, it is not precisely estimated zero impacts that support this possibility (Table 2.A.4). Therefore, the increased agricultural income was mainly explained by an increase in productivity in teff cultivation, which was likely owing to the higher chemical fertilizer application and an increased area of land cultivated. This is because the land certification program makes farm households intensify in own farm activities. Similar to earlier studies examining

short-term impacts (Dillon and Voena 2018; Goldstein et al. 2018; Holden et al. 2009; Mequanint and Erwin 2015), we found that the land certification program enhanced investment in land and agricultural productivity.

2.6.4 Effect of land certification on household welfare

Table 2.9 shows that the land certification program has had a positive impact on agricultural income. However, this could result in a negative effect of the program on household total income if income from other sources such as off-farm and livestock income decreased more than increased agricultural income. As an additional welfare measure, consumption expenditure was used to test the effect of the program on household welfare. We applied the same model as the main analyses explained in the previous section.

Columns 1–3 in Table 2.10 present the estimation results for per capita off-farm, livestock, and total income. Thus, there is not precisely estimated zero impact that the land certification program decreased the income from other sources.

The certification program increased the per capita total, food and non-food consumption expenditure by 44.8%, 35.1%, and 13.3%, respectively (Columns 4, 5, and 6). These changes can be explained by the increased household income from agriculture. This impact is similar to that found in Mexico, where the land certification program increased non-food consumption expenditure by 17% (De Janvry *et al.*, 2015).

2.6.5 Common trend analysis

The major assumption of a difference-in-differences design is the parallel trends assumption that the trend in outcomes in the comparison group is good counterfactual for what the trend in the treatment group would be in the absence of treatment. The Ethiopian land registration and certification takes about two or three years to distribute land certification to households (Ayalew et al., 2021). Hence, we use the 2004 and 2006 waves to show that the trends between treated and control households are parallel at least in those two years based on the treatment status of an end-line survey in 2014.

In the appendix (Table 2.A.5 to Table 2.A.9), we examined the effect of the land certification program on migration, land rental market, farm activities, and household welfare using the 2004 and 2006 waves based on the treatment status of the 2014 wave. As reported in Table 2.A.5, Table 2.A.6, and Table 2.A.7 there are no precisely estimated zero impacts that the program activated labor and land rental markets which shows that the trends between households in a treated and control village are parallel at least in those two years. In contrast, the trend for households in a treated village decreased area of land cultivated, the likelihood and amount of chemical fertilizer used (see Table 2.A.8 in the appendix). In Table 2.A.9, the trends between treated and controlled groups are parallel except in column 5 in which households in a treated village shown a positive trend on food consumption expenditure. Hence, the parallel trend assumption is satisfied for most outcome variables reported in Table 2.A.5 to Table 2.A.9 in the appendix.

2.7 Discussion and Conclusion

This study estimates the effect of the Ethiopian land registration and certification program on labor market participation and migration decisions by applying a DID approach to two-year periods of household-level panel data. On average, there is no statistically significant evidence that the land certification program increases seasonal and non-seasonal migration and rural wage employment. This could be because the demand for seasonal migrants was not very high in Ethiopia in 2014 (Dillon and Voena, 2018). However, we found a negative effect of the program on non-seasonal migration for households in villages with expectations of land redistribution before the program. Conversely, the land certification has not shown any statistically significant effect on migration among those who resided in villages where people perceived land redistribution in the future to be unlikely. Therefore, this study highlights the importance of initial perceptions of future land tenure security. Future research could deepen our understanding of how people's perceptions would change, how long it takes for the change to be updated after receiving formal certification, why the mobility rate to find jobs is low, identify these barriers, and quantify the benefits that would be generated by relaxing the constraints to migration.

To understand the total effects of land certification in poor rural areas, where multiple markets tend to fail simultaneously, this study examined the effects on participation in land rental markets and farming activities. This study separately examined renting in and out, as well as fixed rental and sharecropping contracts, given that, in Ethiopia, poor households also rent out land in which both fixed rental and sharecropping contracts coexist. However, we found that the land certification program has not

significantly increased participation in the land rental market.

As the enhanced tenure security from the issue of certificates changed not only labor and land market participation but also farmers' incentives to invest in farmland, we examined the impact on farming activities. We found that the program had a positive effect on chemical fertilizer use, the productivity of the main cereal, and per capita agricultural income. Consequently, the program enhanced per capita consumption expenditure (from an increase in food consumption expenditure). Overall, the land certification program enhanced agricultural intensification and increased productivity and income. Compared with prior studies (the short-term impacts), it shows the impact of the program has a larger magnitude relative to other similar studies. Specifically, the likelihood of chemical fertilizer users increased by about 82% in this paper while in Ghebru and Holden, (2015) it increased by only 3%. Because of this, the productivity of main cereals increased by about 196% in this paper, but in Mequanint and Erwin (2015) paper it increased by 35%. Subsequently, total consumption, food consumption, and non-food expenditure increased by 44.8%, 35.1%, and 13.3% respectively in this paper, while in De Janvry et al. (2015) non-food consumption expenditure increased by 16.7%.

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Table 2. 1: Household characteristics by village-level program status (2004 vs. 2014)

	Before the program			After the program		
	Treated	Controlled		Treated	Controlled	
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Number of household members+	6.008[0.158]	6.904[0.245]	*	8.012[0.180]	9.176[0.260]	*
Number of adult male household members (age 15–age 70)	1.558[0.070]	1.800[0.134]		2.255[0.087]	2.144[0.122]	
Number of adult female household members (age 15–age 70)	1.534[0.053]	1.824[0.105]	*	2.247[0.086]	2.264[0.130]	
=1 if household head is male	0.861[0.022]	0.872[0.030]		0.797[0.025]	0.832[0.034]	
Household head's age/100	0.460[0.010]	0.427[0.016]		0.512[0.013]	0.466[0.018]	*
Average years of education among adult members	1.177[0.126]	1.626[0.225]		2.518[0.207]	2.643[0.320]	
Distance to the nearest town (km)	10.87[0.454]	10.01[0.638]		10.51[0.451]	10.78[0.821]	
=1 if HH has at least one rural wage earner	0.032[0.011]	0.032[0.016]		0.076[0.017]	0.056[0.021]	
=1 if HH has at least one nonseasonal migrant	0.036[0.012]	0.096[0.026]	*	0.028[0.010]	0.121[0.029]	*
=1 if HH has at least one seasonal migrant	0.008[0.006]	0.032[0.016]		0.036[0.030]	0.032[0.016]	
Number of seasonal migrants in households	0.008[0.006]	0.040[0.021]		0.044[0.015]	0.040[0.021]	
Length of seasonal migrations (months)	0.028[0.024]	0.144[0.076]		0.120[0.045]	0.080[0.046]	
ln(real income of seasonal migrants) (USD)	0.000[0.000]	0.005[0.004]		0.032[0.018]	0.058[0.043]	
Averages among households with at least one migrant:						
Number of seasonal migrants with ++	1.000[0.000]	1.250[0.250]		1.222[0.147]	1.250[0.250]	
Length of seasonal migration for migrants (months) ++	3.500[2.500]	4.000[2.000]		3.333[0.624]	2.500[0.866]	
ln(real income for seasonal migrant) (USD)++	0.000[0.000]	0.152[0.101]		0.898[0.439]	1.803[1.159]	
=1 if migrants are head++	0.000[0.000]	0.250[0.250]		0.222[0.024]	0.500[0.289]	
=1 if migrants are children ++	1.000[0.000]	0.750[0.250]		0.778[0.147]	0.750[0.250]	
=1 if migrants are male ++	1.000[0.000]	1.000[0.000]		0.556[0.176]	0.500[0.289]	
Age of migrants++	-	-		30.67[8.269]	32.28[3.249]	
Migrant years of education completed++	-	-		6.000[3.933]	5.286[1.911]	
Number of households	251	125		251	125	

+ Household members comprise individuals' people have lived and shared resources with for at least 1 month in the last 12 months. * indicates that the difference in the means is significant at the 5% level. ++ indicates households where at least one of the household family members has migrated. The figures in brackets represent the standard deviations.

Table 2. 2: Household characteristics by village-level program status (2004 vs. 2014)

	Before the program			After the program		
	Treated	Controlled		Treated	Controlled	
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Land size (hectares)	2.550[0.144]	1.227[0.104]	*	2.929[0.188]	1.184[0.104]	*
Land size per adult member	0.895[0.051]	0.424[0.048]	*	0.723[0.044]	0.330[0.033]	*
=1 if either fixed rent or sharecropping or both	0.251[0.027]	0.088[0.025]	*	0.279[0.028]	0.088[0.025]	*
=1 if either rented out or rented in or both via fixed rental	0.036[0.012]	0.016[0.011]		0.048[0.013]	0.024[0.014]	
=1 if rented out via fixed rent	0.044[0.013]	0.008[0.008]		0.060[0.015]	0.016[0.011]	
=1 if rented in via fixed rent	0.032[0.011]	0.016[0.011]		0.068[0.016]	0.024[0.014]	*
Area rented out via fixed rent (ha)+	1.646[1.388]	-		1.022[0.634]	1.5 [-]	*
Area rented in via fixed rent (ha)+	2.203[1.124]	0.703[0.052]		0.909[0.734]	0.833[0.707]	
=1 if sharecropped out or sharecropped in or both	0.048[0.013]	0.008[0.008]	*	0.116[0.020]	0.024[0.014]	*
=1 if sharecropped out	0.024[0.010]	0.008[0.008]		0.044[0.013]	0.016[0.011]	
=1 if sharecropped in	0.024[0.010]	0.000[0.000]		0.072[0.016]	0.008[0.008]	*
Area sharecropped out (ha)+	1.302[0.522]	1.333[-]		2.258[1.369]	1.216[1.249]	
Area sharecropped in (ha)+	1.146[0.476]	-		1.277[0.722]	0.167[-]	
=1 if had land dispute within 10 years	0.004[0.004]	0.024[0.014]		0.092[0.018]	0.072[0.023]	
=1 if expect to have redistribution of land in the next 10 years	0.809[0.025]	0.584[0.044]	*			

* indicates that the difference in the means is significant at the 5% level. + indicates households that participated in the land rental market. The figures in brackets represent the standard deviations.

Table 2. 3: Household characteristics by village-level program status (2004 vs. 2014)

	Before the program			After the program		
	Treated	Controlled		Treated	Controlled	
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Area cultivated (ha)	2.117[0.120]	1.076[0.090]	*	2.438[0.148]	1.043[0.075]	*
Area fallowed (ha)	0.043[0.015]	0.023[0.013]		0.092[0.023]	0.027[0.022]	
=1 if used chemical fertilizer	0.474[0.032]	0.264[0.040]	*	0.829[0.024]	0.488[0.045]	*
ln(Chemical fertilizer used per hectare cultivated land) (kg/ha)	1.986[0.139]	1.012[0.157]	*	3.451[0.111]	2.104[0.201]	*
ln(maize production per hectare) (kg/ha)	7.591[0.116]	7.518[0.121]		8.000[0.184]	8.024[0.152]	
ln(teff production per hectare) (kg/ha)	6.817[0.087]	6.647[0.145]		7.219[0.153]	8.107[0.386]	
ln(real per capita agricultural income) (USD)	0.098[0.015]	0.084[0.028]		0.951[0.048]	0.612[0.069]	*
ln(real per capita off-farm income) (USD)	0.014[0.005]	0.008[0.003]		0.213[0.034]	0.198[0.041]	
ln(real per capita livestock income) (USD)	0.036[0.005]	0.027[0.008]		0.410[0.035]	0.280[0.035]	*
ln(real per capita Household income) (USD)	0.147[0.016]	0.118[0.029]		1.343[0.050]	0.969[0.073]	*
ln(real per capita total consumption expenditure) (USD)	0.112[0.011]	0.064[0.007]	*	0.892[0.024]	0.645[0.026]	*
ln(real per capita food consumption expenditure) (USD)	0.052[0.006]	0.026[0.004]	*	0.532[0.018]	0.389[0.020]	*
ln(real per capita non-food consumption expenditure) (USD)	0.063[0.009]	0.039[0.005]		0.466[0.019]	0.300[0.016]	*
ln(value of livestock owned 12 months ago) (USD)	0.028[0.004]	0.019[0.004]		2.863[0.083]	2.127[0.111]	*
ln(value of other asset# owned 12 months ago) (USD)	0.082[0.009]	0.063[0.008]		1.034[0.056]	0.952[0.072]	

#Household assets such as mobile phones and TVs, as well as agricultural tools such as plow sets and hoes, $ Price level in 2014, and * indicates that the difference in means is significant at the 5% level. Income and consumption expenditure were measured yearly. The figures in brackets represent the standard deviations.

Table 2. 4: Estimation results on labor market

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member
Treat x Post	-.01	-.048	-.041	-.282	.012	-.075
	(.043)	(.045)	(.045)	(.251)	(.035)	(.066)
Confidence interval	[-.096 .076]	[-.138 .0424]	[-.1318 .0500]	[-.789 .225]	[-.058 .082]	[-.208 .057]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	752	752	752	752	752	752
R-squared	.569	.597	.579	.587	.539	.597

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** $p<0.01$, * $p<0.05$

Table 2. 5: Heterogeneous effects on labor market (Initial expectation land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	.034	-.041	-.005	-.395	.034	-.199**
	(.051)	(.049)	(.073)	(.291)	(.048)	(.084)
Confidence interval	[-.0703 .1374]	[-.1417 .0593]	[-.1531 .1436]	[-.9896 .2005]	[-.064 .132]	[-.371 -.026]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	552	552	552	552	552	552
R-squared	.583	.631	.617	.611	.553	.581

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2. 6: Heterogeneous effects on labor market (NOT expecting land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	-.088	-.026	-.027	.003	-.017	.046
	(.094)	(.052)	(.081)	(.137)	(.064)	(.053)
Confidence interval	[-.2922 .1160]	[-.1399 .0884]	[-.2024 .1487]	[-.2957 .3009]	[-.1557 .1213]	[-.069 .161]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	200	200	200	200	200	200
R-squared	.621	.597	.58	.55	.551	.67

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2. 7: Estimation results on land rental market

	1	2	3	4
	=1 if household rented out land	Area (ha) of land rent out	=1 if household rented in land	Area (ha) of land rented in
Treat x Post	-.03	-.244	-.091	-.184
	(.035)	(.226)	(.111)	(.229)
Confidence interval	[-.1016 .0417]	[-.700 .2117]	[-.315 .1321]	[-.646 .279]
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	752	752	752	752
R-squared	.54	.589	.562	.541

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to the nearest town (in km). Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2. 8: Estimation results on land rental market (fixed rent and sharecropping)

	Fixed rental contract				Sharecropping contract			
	1	2	3	4	5	6	7	8
	=1 if fixed rent out	Area (ha) of land fixed rent out	=1 if fixed rent in	Area (ha) of land fixed rent in	=1 if sharecropped out	Area (ha) of sharecropped out	=1 if sharecropped in	Area (ha) of land sharecropped in
Treat x Post	-.023	-.085	-.01	-.025	-.004	-.16	-.023	-.085
	(.024)	(.082)	(.03)	(.055)	(.024)	(.2)	(.024)	(.082)
Confidence interval	[-.0706 .0253]	[-.250 .081]	[-.070 .051]	[-.136 .087]	[-.052 .0443]	[-.563 .243]	[-.304 .125]	[-.523 .205]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752	752	752
R-squared	.554	.562	.543	.542	.543	.591	.554	.562

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to the nearest town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2. 9: Estimation results on farm activities

	1	2	3	4	5	6	7
	Cultivate area (ha)	Area (ha) with fallowed	=1 if used chemical fertilizer	ln(Chemical fertilizer used per cultivated land) (kg)	ln(Maize production in kg per hectare)	ln(Teff production in kg per hectare)	ln(per capita agricultural income)
Treat x Post	.378*	-.01	.821***	3.296***	.528	1.965**	.403***
	(.22)	(.033)	(.102)	(.536)	(.764)	(.819)	(.079)
	[-.065 .821]	[-.077 .056]	[.615 1.026]	[2.213 4.379]	[-1.032 2.087]	[.292 3.63]	[.244 .562]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	752	752	752	746	270	266	752
R-squared	.888	.672	.744	.772	.845	.905	.699

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since land was acquired, and distance to the nearest town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.* For maize and teff production (Columns 5 and 6), only households that cultivated these crops were used in the analyses.

Table 2. 10: Estimation result on per capita income and expenditure

	1	2	3	4	5	6
	ln(per capita off-farm income)	ln(per capita livestock income)	ln(per capita Household income)	ln(per capita total consumption expenditure)	ln(per capita food consumption expenditure)	ln(per capita non-food consumption expenditure)
Treat x Post	.026	.283	.657**	.448***	.351***	.133**
	(.054)	(.257)	(.274)	(.112)	(.083)	(.054)
Confidence interval	[-.0837 .1358]	[-.2365 .8034]	[.1042 1.209]	[.2215 .6736]	[.182 .519]	[.0248 .241]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.598	.673	.78	.876	.835	.804

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05*

List of Figures

Figure 2. 1: **Distribution on Year of land certification received at village level (for all households)**[2]

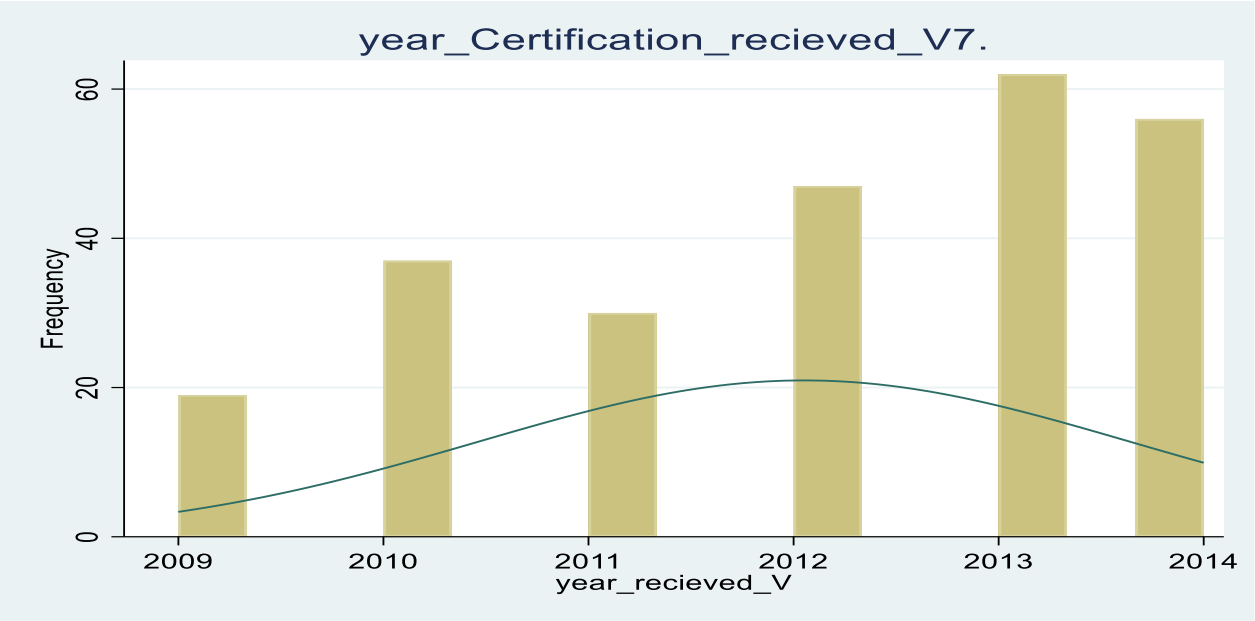
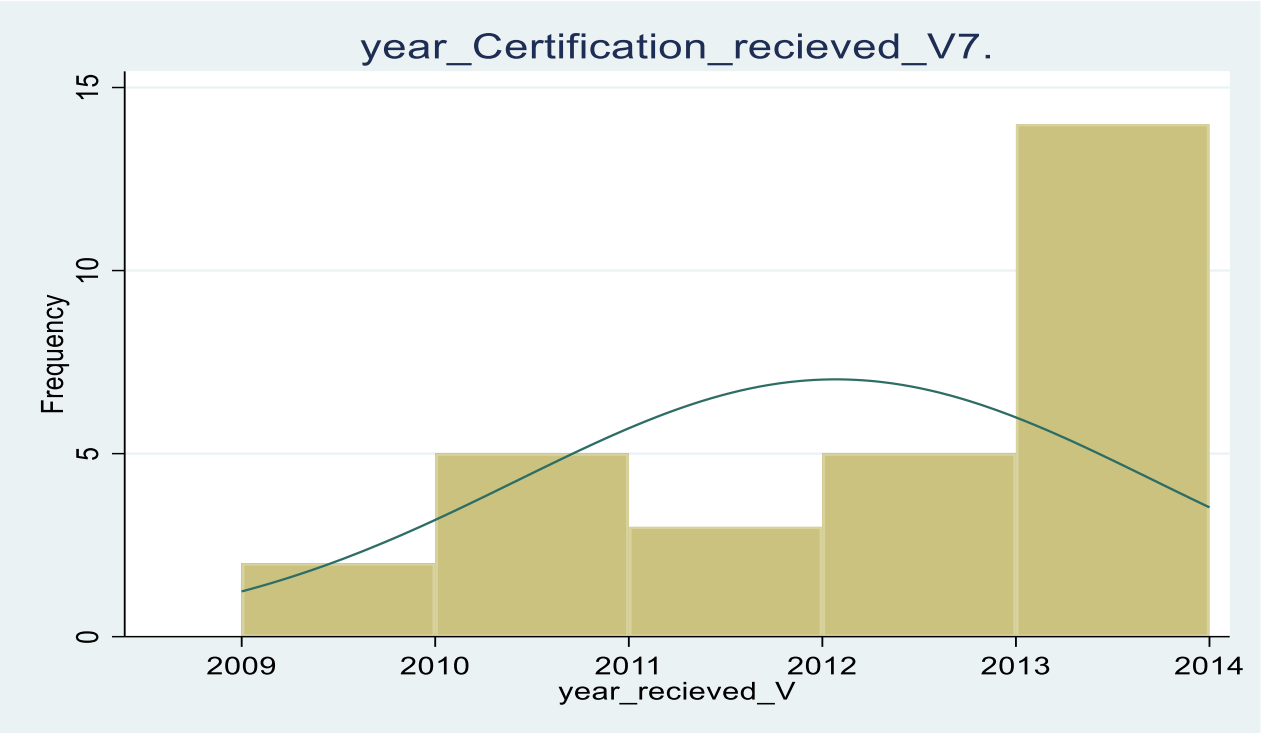


Figure 2. 2: **Distribution on Year of land certification received at village level (at village level)**



[2] The years indicate here are converted from Ethiopian calendar to Gregorian calendar. Converting Ethiopian calendar into Gregorian calendar is not straight forward as first month of the year in Ethiopian calendar starts from September. This histogram shows the distribution for the years since the last treated household (7th household (7 out of 10 = 70%) got certificate) in a village received land certification.

List of Appendix: Tables 2.A

Table 2.A. 1: Non- attrition probability

Variable	1 if Not-attrited
Number of household members+	.207**
	(.061)
Share of adult male household members (age 15 – age 70)	-.016
	(.512)
Share of adult female household members (age 15 – age 70)	.981
	(.678)
=1 if household head is male	.281
	(.176)
Household head's age/100	-.184
	(.629)
Household head's average years of education	.08*
	(.039)
Land size per adult member	.063
	(.144)
ln(value of livestock owned 12 months ago) (USD)	1.54
	(1.668)
ln(value of other asset# owned 12 months ago) (USD)	.165
	(1.066)
Distance to the nearest town (Km)	1.838
	(1.37)
=1 if villagers think redistribution takes place near future	.581*
	(.244)
Years since the last land redistribution took place	-.003
	(.012)
Observation	419
Pseudo R^2	.169
Percent correctly predicted	89.71

The probit model was used to estimate panel attrition probability, where the dependent variable was a dummy variable taking 1 if a household was interviewed in the follow-up survey and remained in the sample (not attrited). Marginal effects have also been reported. Figures in parentheses are the Standard errors clustered at the village level. ** $p<0.01$, * $p<0.05$

Table 2.A. 2: Balance test

	=1 treatment
Number of household members	-0.032**
	(0.013)
Share of adult male household members (age 15–70)	-0.064
	(0.176)
Share of adult female household members (age 15–70)	-0.097
	(0.230)
=1 if household head is male	0.022
	(0.100)
Household head's age/100	0.160
	(0.218)
Household head's average years of education	-0.015
	(0.013)
Land size per adult member	0.133**
	(0.051)
ln(value of livestock owned 12 months ago) (USD)	0.034
	(0.470)
ln(value of other asset owned 12 months ago) (USD)	0.413**
	(0.202)
=1 if had land dispute within 2 years	-0.221
	(0.228)
Distance to the nearest town (km)	0.001
	(0.009)
=1 if villagers think redistribution takes place near future	0.206
	(0.164)
Joint test (p-value)	0.0010

Each column was estimated using OLS, where the dependent variable is an indicator variable taking 1 if a household is in the treatment village, and 0 if otherwise. Standard errors in parentheses are clustered at the village level. ** $p<0.01$, * $p<0.05$

Table 2.A. 3: Household characteristics by year

Variable	2004 (1)	2006 (2)	2014 (3)	Diff (2-1)	Diff (3-1)
Number of household members+	6.306	7.202	8.399	*	*
Number of adult male household members (age 15 – age 70)	1.641	1.883	2.218	*	*
Number of adult female household members (age 15 – age 70)	1.636	1.819	2.253	*	*
=1 if household head is male	0.864	0.856	0.809		*
Household head's age/100	0.449	0.468	0.497		*
Average years of education among adult members	1.306	1.457	2.560		*
Distance to the nearest town (km)	10.463	10.463	10.601		
=1 if HH has at least one rural wage earner	0.035	0.056	0.069		*
=1 if HH has at least one non-seasonal migrant	0.056	0.074	0.059		
=1 if HH has at least one seasonal migrant	0.016	0.005	0.035		
Number of migrants in households	0.019	0.005	0.043		
Length of migrations (months)	0.066	0.013	0.106		
ln(real income of seasonal migrants) (USD)	0.002	0.002	0.041		*
Averages among households with at least one migrant:					
Number of migrants in households with at least one migrant++	1.167	1.000	1.231		
Length of migrations for migrants (months) ++	4.167	2.500	3.077		
ln(real income for seasonal migrants) (USD)++	0.101	0.336	1.177		
=1 if migrants are head++	0.167	0.000	0.308		
=1 if migrants are children or otherwise++	0.833	1.000	0.769		
=1 if migrants are Male or otherwise++	1.000	0.500	0.538		*
Age of migrants++	24.875	-	31.538		
Migrant years of education completed++	2.250	-	5.615		
Land size (hectare)	2.110	2.209	2.348		*
Land size per adult member	0.738	0.654	0.593		*
=1 if either fixed rent or sharecropping or both	0.197	0.247	0.215		
=1 if either rented out or rented in or both via fixed rental	0.029	0.059	0.040		*
=1 if rented out via fixed rent	0.016	0.008	0.011		
=1 if rented in via fixed rent	0.013	0.051	0.029		
Area rented out via fixed rent (ha)+	1.646	0.1	1.142		
Area rented in via fixed rent (ha)+	1.603	0.922	0.895		
=1 if sharecropped out or sharecropped in or both	0.035	0.101	0.085		*
=1 if sharecropped out	0.019	0.056	0.035		
=1 if sharecropped in	0.016	0.045	0.051		*
Area sharecropped out (ha)+	1.306	0.565	2.098		
Area sharecropped in (ha)+	1.146	0.977	1.218		
=1 if had land dispute within 2 years	0.011	0.008	-		
=1 if had land dispute within 10 years	0.011	-	0.085		*
Area cultivated (ha)	1.771	0.833	1.975	*	
Area followed (ha)	0.046	0.070	0.074		
=1 if used chemical fertilizer	0.404	0.348	0.715		*
ln(Chemical fertilizer used per cultivated land) (kg)	1.661	1.715	3.008		*
ln(maize production per hectare) (kg/ha) +	7.559	7.281	8.015		*

ln(teff production per hectare) (kg/ha) +	6.790	6.664	7.315		*
ln(real per capita agricultural income) (USD)	0.094	0.082	0.838		*
ln(real per capita off-farm income) (USD)	0.012	0.027	0.208	*	*
ln(real per capita livestock income) (USD)	0.033	0.054	0.366	*	*
ln(real per capita Household income) (USD)	0.137	0.158	1.219	*	*
ln(real per capita total consumption expenditure) (USD)	0.096	0.165	0.810	*	*
ln(real per capita food consumption expenditure) (USD)	0.044	0.082	0.485	*	*
ln(real per capita non-food consumption expenditure) (USD)	0.055	0.084	0.411	*	*
ln(value of livestock owned 12 months ago) (USD)	0.025	0.078	2.619	*	*
ln(value of other asset# owned 12 months ago) (USD)	0.076	0.144	1.007	*	*
=1 if HH receive land certification	0.000	0.237	0.814	*	*
=1 if >30% of the sample HHs in a village receive land certification	0.000	0.237	0.955	*	*
=1 if >50% of the sample HHs in a village receive land certification	0.000	0.166	0.929	*	*
=1 if >70% of the sample HHs in a village receive land certification	0.000	0.142	0.669	*	*
Number of households	376	376	376		

+ Household members comprise individuals people have lived and shared resources with for at least 1 month in the last 12 months. #Household assets include mobile phones and TVs and agricultural tools including plough sets and hoes, $ Price level in 2014 * indicates that the difference in means is significant at 5% level. Treatment village is defined as more than 70% of HHs with certification.
++ indicates households where at least one of the household family members has migrated.

Table 2.A. 4: Estimation result on share of land under crop categories

	1	2	3	4	5	6
	Share of land under cereals	Share of land under Legumes	Share of land under root/tubers	Share of land under industrial crops	Share of land under vegetables	Share of land under Feed stuffs
Treat x Post	-.014	.009	-.008	.006	.002	.005
	(.052)	(.049)	(.029)	(.017)	(.014)	(.009)
	[-.120 .0914]	[-.0907 .1091]	[-.0658 .0498]	[-.0288 .0399]	[-.0264 .0298]	[-.0122 .0227]
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	741	741	741	741	741	741
R-squared	.805	.763	.876	.789	.656	.727

The dependent variables are the share of cultivated land under a crop type over total cultivated land. Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to the nearest town in km. Standard errors, clustered at the village level, are shown in parentheses. ** $p<0.01$, * $p<0.05$.

Table 2.A. 5: Test for parallel trend assumption: labor market[3]

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one non-seasonal migrant member
Treat x Post	.076	-.083	-.087	-.498	-.002	-.057
	(.1)	(.067)	(.067)	(.405)	(.003)	(.045)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.638	.569	.571	.572	.54	.584

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** p<0.01, ** p<0.05*

Table 2.A. 6: Test for parallel trend assumption: **land rental market**

	1	2	3	4
	=1 if household rented out land	Area (ha) of land rent out	=1 if household rented in land	Area (ha) of land rented in
Treat x Post	.038	-.015	-.078	-.135
	(.078)	(.189)	(.081)	(.139)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	752	752	752	752
R-squared	.64	.597	.638	.618

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** p<0.01, ** p<0.05*

[3] Common trends analysis from Table 2.A.5- Table 2.A.9. I used the 2004 and 2006 waves to show that the trends between treated and control households are parallel at least in those two years based on the treatment status of an end line survey in 2014

Table 2.A. 7: Test for parallel trend assumption: land rental market (fixed rent and sharecropping)

	Fixed rental contract				Sharecropping contract			
	1	2	3	4	5	6	7	8
	=1 if fixed rent out	Area (ha) of land fixed rent out	=1 if fixed rent in	Area (ha) of land fixed rent in	=1 if sharecropped out	Area (ha) of sharecropped out	=1 if sharecropped in	Area (ha) of land sharecropped in
Treat x Post	.044	-.073	.011	.003	-.005	-.007	-.085	-.138
	(.081)	(.143)	(.01)	(.013)	(.022)	(.022)	(.084)	(.148)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752	752	752
R-squared	.618	.587	.626	.657	.653	.598	.65	.543

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** p<0.01, ** p<0.05*

Table 2.A. 8: **Test for parallel trend assumption:** farm activities

	1	2	3	4	5	6	7
	Cultivate area (ha)	Area (ha) with fallowed	=1 if used chemical fertilizer	ln(Chemical fertilizer used per cultivated land) (kg)	ln(Maize production in kg per hectare)	ln(Teff production in kg per hectare)	ln(per capita agricultural income)
Treat x Post	-.607***	-.059	-.147**	-.508**	-.679	-.514	-.013
	(.123)	(.062)	(.055)	(.219)	(.655)	(3.413)	(.029)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	738	216	222	752
R-squared	.89	.603	.703	.718	.947	.911	.586

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** p<0.01, ** p<0.05*

Table 2.A. 9: Test for parallel trend assumption: per capita income and expenditure

	1	2	3	4	5	6
	ln(per capita off-farm income)	ln(per capita livestock income)	ln(per capita Household income)	ln(per capita total consumption expenditure)	ln(per capita food consumption expenditure)	ln(per capita non-food consumption expenditure)
Treat x Post	.009	-.005	-.009	-.016	.029***	-.046
	(.012)	(.009)	(.024)	(.06)	(.006)	(.063)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.588	.611	.604	.67	.647	.622

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, ** $p<0.05$

Table 2.A. 10: Estimation results on labor market[4]

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one non-seasonal migrant member
Treat x Post	-.001	-.038	-.026	-.247	.03	-.061
	(.05)	(.038)	(.041)	(.219)	(.055)	(.07)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.567	.594	.575	.583	.54	.599

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, * $p<0.05$*

[4] Estimation for Household level certification presented from Table 2.A.10 to Table 2.A.16

Table 2.A. 11: Heterogeneous effects on labor market (Initial expectation land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	.052	-.007	.044	-.282	.059	-.205**
	(.063)	(.05)	(.088)	(.315)	(.055)	(.098)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	552	552	552	552	552	552
R-squared	.579	.632	.618	.608	.554	.583

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2.A. 12: Heterogeneous effects on labor market (NOT expecting land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	-.102	-.021	-.02	.006	.003	.068
	(.072)	(.043)	(.054)	(.108)	(.064)	(.063)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	200	200	200	200	200	200
R-squared	.614	.594	.583	.551	.55	.674

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2.A. 13: Estimation results on land rental market (both fixed rent and sharecropping)

	1	2	3	4
	=1 if household rented out land	Area (ha) of land rent out	=1 if household rented in land	Area (ha) of land rented in
Treat x Post	-.043	-.256	-.083	-.192
	(.043)	(.211)	(.107)	(.234)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	752	752	752	752
R-squared	.606	.604	.56	.549

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05*

Table 2.A. 14: Estimation results on land rental market (fixed rent)

	Fixed rental contract				Sharecropping contract			
	1	2	3	4	5	6	7	8
	=1 if fixed rent out	Area (ha) of land fixed rent out	=1 if fixed rent in	Area (ha) of land fixed rent in	=1 if sharecropped out	Area (ha) of sharecropped out	=1 if sharecropped in	Area (ha) of land sharecropped in
Treat x Post	-.041	-.105	-.009	-.037	-.003	-.151	-.087	-.155
	(.036)	(.093)	(.029)	(.069)	(.021)	(.179)	(.105)	(.171)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752	752	752
R-squared	.566	.564	.531	.544	.585	.603	.586	.585

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05*

Table 2.A. 15: Estimation results on farm activities

	1	2	3	4	5	6	7
	Cultivate area (ha)	Area (ha) with fallowed	=1 if used chemical fertilizer	ln(Chemical fertilizer used per cultivated land) (kg)	ln(Maize production in kg per hectare)	ln(Teff production in kg per hectare)	ln(per capita agricultural income)
Treat x Post	.367	-.009	.892***	3.529***	.465	2.163**	.429***
	(.236)	(.036)	(.086)	(.446)	(.703)	(.82)	(.089)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	746	270	266	752
R-squared	.886	.67	.754	.775	.821	.916	.697

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, ** $p<0.05$*

Table 2.A. 16: Estimation result on per capita income and expenditure

	1	2	3	4	5	6
	ln(per capita off-farm income)	ln(per capita livestock income)	ln(per capita Household income)	ln(per capita total consumption expenditure)	ln(per capita food consumption expenditure)	ln(per capita non-food consumption expenditure)
Treat x Post	.046	.258	.668**	.457***	.355***	.14***
	(.052)	(.271)	(.262)	(.101)	(.08)	(.049)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.597	.668	.778	.876	.836	.805

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, ** $p<0.05$*

Table 2.A. 17: Estimation results on labor market[5]

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one non-seasonal migrant member
Treat x Post	-.043	.016	.017	.047	.025	-.072*
	(.034)	(.016)	(.018)	(.046)	(.025)	(.038)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.662	.534	.532	.527	.537	.557

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05*

[5] Estimation for using the survey periods of 2006 and 2014 from Table 2.A.17 to Table 2.A.23

Table 2.A. 18: Heterogeneous effects on labor market (Initial expectation land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	-.084**	.04*	.047*	.098	.034	-.108
	(.032)	(.02)	(.024)	(.069)	(.049)	(.069)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	552	552	552	552	552	552
R-squared	.684	.547	.547	.54	.542	.575

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2.A. 19: Heterogeneous effects on labor market (NOT expecting land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	-.047	.026	.039	.13	.11	-.069
	(.06)	(.034)	(.036)	(.154)	(.139)	(.093)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	200	200	200	200	200	200
R-squared	.657	.587	.583	.567	.571	.576

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2.A. 20: Estimation results on land rental market (both fixed rent and sharecropping)

	1	2	3	4
	=1 if household rented out land	Area (ha) of land rent out	=1 if household rented in land	Area (ha) of land rented in
Treat x Post	-.095	-.187*	-.018	-.057
	(.082)	(.101)	(.032)	(.107)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	752	752	752	752
R-squared	.612	.613	.646	.574

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** $p<0.01$, * $p<0.05$

Table 2.A. 21: Estimation results on land rental market (fixed rent)

	Fixed rental contract				Sharecropping contract			
	1	2	3	4	5	6	7	8
	=1 if fixed rent out	Area (ha) of land fixed rent out	=1 if fixed rent in	Area (ha) of land fixed rent in	=1 if sharecropped out	Area (ha) of sharecropped out	=1 if sharecropped in	Area (ha) of land sharecropped in
Treat x Post	-.094	-.045	-.015	-.029	-.008	-.072	-.017	-.029
	(.103)	(.053)	(.033)	(.087)	(.029)	(.074)	(.02)	(.032)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752	752	752
R-squared	.536	.53	.633	.582	.641	.608	.606	.536

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** $p<0.01$, * $p<0.05$

Table 2.A. 22: Estimation results on farm activities

	1	2	3	4	5	6	7
	Cultivate area (ha)	Area (ha) with fallowed	=1 if used chemical fertilizer	ln(Chemical fertilizer used per cultivated land) (kg)	ln(Maize production in kg per hectare)	ln(Teff production in kg per hectare)	ln(per capita agricultural income)
Treat x Post	1.058***	.052	.914***	3.574***	-2.729	1.039	.334***
	(.266)	(.044)	(.118)	(.651)	(5.411)	(1.413)	(.061)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	740	138	142	752
R-squared	.842	.612	.764	.751	.992	.999	.729

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, ** $p<0.05$*

Table 2.A. 23: Estimation result on per capita income and expenditure

	1	2	3	4	5	6
	ln(per capita off-farm income)	ln(per capita livestock income)	ln(per capita Household income)	ln(per capita total consumption expenditure)	ln(per capita food consumption expenditure)	ln(per capita non-food consumption expenditure)
Treat x Post	.036	.281	.602*	.42*	.307**	.144
	(.058)	(.298)	(.332)	(.227)	(.117)	(.145)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.631	.694	.81	.872	.825	.803

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, ** $p<0.05$*

Table 2.A. 24: Estimation results on labor market[6]

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one non-seasonal migrant member
Treat x Post	-.011	-.048	-.042	-.27	.015	-.059
	(.043)	(.042)	(.043)	(.232)	(.037)	(.063)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.567	.592	.575	.582	.538	.603

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, ** $p<0.05$*

[6] Estimation with attrition weight from Table 2.A.24 to Table 2.A.30

Table 2.A. 25: Heterogeneous effects on labor market (Initial expectation land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	.03	-.031	.002	-.331	.036	-.194**
	(.049)	(.048)	(.069)	(.278)	(.05)	(.084)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	552	552	552	552	552	552
R-squared	.58	.628	.614	.608	.552	.581

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** $p<0.01$, * $p<0.05$.

Table 2.A. 26: Heterogeneous effects on labor market (NOT expecting land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	-.086	-.026	-.026	-.006	-.026	.046
	(.086)	(.05)	(.076)	(.135)	(.065)	(.052)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	200	200	200	200	200	200
R-squared	.614	.59	.573	.546	.55	.678

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** $p<0.01$, * $p<0.05$.

Table 2.A. 27: Estimation results on land rental market (both fixed rent and sharecropping)

	1	2	3	4
	=1 if household rented out land	Area (ha) of land rent out	=1 if household rented in land	Area (ha) of land rented in
Treat x Post	-.028	-.204	-.085	-.173
	(.033)	(.186)	(.099)	(.208)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	752	752	752	752
R-squared	.538	.588	.564	.541

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05*

Table 2.A. 28: Estimation results on land rental market (fixed rent)

	Fixed rental contract				Sharecropping contract			
	1	2	3	4	5	6	7	8
	=1 if fixed rent out	Area (ha) of land fixed rent out	=1 if fixed rent in	Area (ha) of land fixed rent in	=1 if sharecropped out	Area (ha) of sharecropped out	=1 if sharecropped in	Area (ha) of land sharecropped in
Treat x Post	-.021	-.078	-.01	-.024	-.004	-.126	-.021	-.078
	(.023)	(.075)	(.028)	(.05)	(.022)	(.161)	(.023)	(.075)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752	752	752
R-squared	.555	.56	.542	.541	.538	.591	.585	.555

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05*

Table 2.A. 29: Estimation results on farm activities

	1	2	3	4	5	6	7
	Cultivate area (ha)	Area (ha) with fallowed	=1 if used chemical fertilizer	ln(Chemical fertilizer used per cultivated land) (kg)	ln(Maize production in kg per hectare)	ln(Teff production in kg per hectare)	ln(per capita agricultural income)
Treat x Post	.406*	-.009	.827***	3.286***	.43	1.961**	.4***
	(.204)	(.032)	(.103)	(.563)	(.809)	(.821)	(.075)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	746	270	266	752
R-squared	.886	.672	.746	.771	.841	.909	.7

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, * $p<0.05$*

Table 2.A. 30: Estimation result on per capita income and expenditure

	1	2	3	4	5	6
	ln(per capita off-farm income)	ln(per capita livestock income)	ln(per capita Household income)	ln(per capita total consumption expenditure)	ln(per capita food consumption expenditure)	ln(per capita non-food consumption expenditure)
Treat x Post	.029	.275	.648**	.438***	.347***	.127**
	(.048)	(.253)	(.267)	(.109)	(.081)	(.053)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.597	.67	.778	.876	.835	.804

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** $p<0.01$, * $p<0.05$*

Table 2.A. 31: Estimation results on labor market[7]

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one non-seasonal migrant member
Treat x Post	-.007	-.046	-.039	-.258	.016	-.062
	(.046)	(.039)	(.041)	(.21)	(.038)	(.067)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.567	.594	.576	.583	.539	.599

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05*

[7] Estimation for alternative thresholds (more than 30% of the household proportion that received land certification in the village) Table 2.A.31 to Table 2.A.37

Table 2.A. 32: Heterogeneous effects on labor market (Initial expectation land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	.034	-.023	.018	-.283	.039	-.202**
	(.054)	(.053)	(.079)	(.308)	(.048)	(.084)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	552	552	552	552	552	552
R-squared	.579	.631	.616	.608	.553	.583

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2.A. 33: Heterogeneous effects on labor market (NOT expecting land redistribution)

	1	2	3	4	5	6
	=1 if HH has at least one rural wage earner	=1 if HH has at least one migrant member in the last 12 months	Number of migrant members in the last 12 months	Length of migration in months (number of months migrated)	ln(per capita migrant income)	=1 if HH has at least one nonseasonal migrant member)
Treat x Post	-.1	-.025	-.027	-.007	-.004	.066
	(.075)	(.043)	(.056)	(.103)	(.059)	(.062)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
# of Observations	200	200	200	200	200	200
R-squared	.613	.598	.593	.548	.547	.676

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01,* * *p<0.05.*

Table 2.A. 34: Estimation results on land rental market (both fixed rent and sharecropping)

	1	2	3	4
	=1 if household rented out land	Area (ha) of land rent out	=1 if household rented in land	Area (ha) of land rented in
Treat x Post	-.041	-.236	-.08	-.169
	(.036)	(.181)	(.102)	(.212)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Observations	752	752	752	752
R-squared	.606	.604	.559	.549

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** p<0.01, ** p<0.05*

Table 2.A. 35: Estimation results on land rental market (fixed rent)

	Fixed rental contract				Sharecropping contract			
	1	2	3	4	5	6	7	8
	=1 if fixed rent out	Area (ha) of land fixed rent out	=1 if fixed rent in	Area (ha) of land fixed rent in	=1 if sharecropped out	Area (ha) of sharecropped out	=1 if sharecropped in	Area (ha) of land sharecropped in
Treat x Post	-.032	-.088	.002	-.022	-.011	-.148	-.089	-.147
	(.027)	(.081)	(.02)	(.057)	(.021)	(.152)	(.104)	(.16)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752	752	752
R-squared	.564	.563	.529	.545	.583	.604	.586	.564

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. *** p<0.01, ** p<0.05*

Table 2.A. 36: Estimation results on farm activities

	1	2	3	4	5	6	7
	Cultivate area (ha)	Area (ha) with fallowed	=1 if used chemical fertilizer	ln(Chemical fertilizer used per cultivated land) (kg)	ln(Maize production in kg per hectare)	ln(Teff production in kg per hectare)	ln(per capita agricultural income)
Treat x Post	.39*	-.004	.818***	3.25***	.329	2.022**	.393***
	(.213)	(.039)	(.115)	(.619)	(.593)	(.8)	(.076)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	746	270	266	752
R-squared	.886	.67	.747	.769	.829	.91	.696

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01, * p<0.05*

Table 2.A. 37: Estimation result on per capita income and expenditure

	1	2	3	4	5	6
	ln(per capita off-farm income)	ln(per capita livestock income)	ln(per capita Household income)	ln(per capita total consumption expenditure)	ln(per capita food consumption expenditure)	ln(per capita non-food consumption expenditure)
Treat x Post	.031	.275	.645**	.437***	.344***	.127**
	(.047)	(.257)	(.275)	(.112)	(.086)	(.054)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752	752	752	752	752	752
R-squared	.597	.667	.778	.875	.835	.804

Other controls are average years of education per adult, household head age, adult women and men, land per adult, years since the land was acquired, and distance to near town in km. Standard errors, clustered at the village level, are shown in parentheses. ** *p<0.01, * p<0.05*

Chapter Three

The Role of Land Certification in Mitigating the negative impact of Weather Shocks

3.1 Introduction

Weather shocks have an adverse effect on the income and consumption of households in both developed and developing countries. Due to limited insurance markets, the impact is more severe in developing countries (Dercon and Christiaensen, 2011; Islam and Maitra, 2012; Porter, 2012) where many households are exposed to frequent shocks, such as drought and flood, which damage agricultural production and affect health conditions. This is more severe in areas where most households rely on rainfed agriculture. Hence, droughts not only have a negative effect on agricultural production and consumption but also have a deep-rooted negative impact on household resources, particularly assets and livestock (Dercon and Christiaensen, 2011; Islam and Maitra, 2012; Porter, 2012; Wossen, Di Falco and Berger, 2016). In this light, the main function of this study is to test a potential coping strategy from the perspective of agricultural policy in a society where most households heavily depend on agriculture. Specifically, this study analyzes the effect of a land certification program on the impact of weather shocks on consumption expenditure.

Many studies have investigated the impact of the shock on consumption; however, their findings are mixed. Some have identified a significant decrease in food and non-food

consumption as a result of adverse shocks (Dercon, 2004; Dercon and Christiaensen, 2011; Jack and Suri, 2014; Wossen, Di Falco and Berger, 2016), while others found that food consumption smoothens against shocks when food is produced by the household, income generated through labor markets, and informal insurance strategies (Townsendi, 1994; Kochar, 1995; Asfaw and von Braun, 2004; Harrower and Hoddinott, 2005; Skoufias and Quisumbing, 2005; Porter, 2012). Hence, the differential effect of shocks depends on how insured (formally or informally) households are. Surprisingly, Porter (2012) found that idiosyncratic shocks in Ethiopia (specifically shocks related to health, and individual crop shocks) have a positive impact on consumption; however, the study failed to provide any empirical evidence on the mechanisms. Intuitively, what Porter (2012) found could be due to existence of a strong social network, so that households affected by the shock can receive support from individuals. In Ethiopia, it is common for people to share what they have with their neighbors and social formal/informal networks when someone faces any hardship (Dercon et al., 2006).

Existing literature and observations from the field suggest that the effect of shock mainly depends on the capacity of individuals to protect against it and the strength of their social network. However, it is unclear if formal mechanisms, such as obtaining credit, can be activated by providing land certificates to farm households used to mitigate the negative effect of shocks. Hence, this study fills this research gap by estimating the role of land certification program in mitigating the negative effects of weather shocks on households

consumption through the acquisition of credits[8]. Our study explores the role of land certification in consumption smoothing as a response to weather shocks and the mechanisms that can facilitate the role that land certification plays in serving as insurance against shocks. We use two waves (2011 and 2015) of nationally representative panel household data from the Ethiopia Living Standards Measurement Study (LSMS). Following Ahmed and Cowan (2021) and Jack and Suri (2014), our study employs a difference-in-difference approach by including household fixed effects.

This study examines the capacity of land certification in insuring households against shocks. The findings suggest that consumption is not insured against natural shocks; rather, natural shocks reduce food and non-food consumption, as would be expected. However, households with a land certificate managed to cope with the negative effect of a natural shock. The results examining the mechanisms show that a land certification program can enhance access to credit when they were affected by natural shocks. The findings indicate that agricultural land policy reform not only has a direct effect on land investment and agricultural productivity (Deininger et al., 2011; Holden et al., 2011), but can also be used to smoothen consumption by improving access to credit.

An additional analysis, in the appendix, is undertaken to analyze the differential response of land certification across land size (smaller or larger land owners), and household

[8] Obtaining credit is defined if a member of the household borrowing cash or inputs on credit from someone outside the household or from an institution for business or farming purposes, over the past 12 months.

head's age (younger or older). In addition, we split up the combined measure of natural shock into a separate entity (drought, flood, and landslide) to analyze if each shock has a different impact and the differential mitigating effect of land certification on each and all types of shocks.

The remainder of the paper is organized as follows. Section 2 presents the Ethiopian land certification process. Section 3 provides a brief literature review on the effect of shock on consumption with their alternative coping mechanisms. Section 4 describes the data, model specification, and identification strategy. Section 5 presents the descriptive statistics and estimation results. Section 6 presents the conclusion.

3.2 Ethiopian land certification program

In Ethiopia, the land is state-owned and usufruct rights are given to households. In rural areas, farmland had occasionally been reallocated by the government. In 2003, the Ethiopian land certification program began to enhance agricultural productivity by securing land tenure (Deininger et al., 2008; Holden et al., 2009). Under this program, the usufruct rights of the plots were registered under the names of current users. Public meetings were held at villages to inform people about the program, and the local-level administration and certification were done by a land use and administration committee (LAC) while certificates were issued by the district offices.

LAC and current users, as well as their neighbors, made agreement by resolving the land border conflict with the neighbors and then completed measuring and registering the

plots for each household. Although the program was meant to cover all households, some did not receive land certificates. This is mainly owing to the capacity limitations of woreda administration staff, shortages of forms, transportation problems, shortage of certificates at hand, and a seasonal based certification process (Deininger et al., 2008; Holden et al., 2009; Deininger et al., 2011; Ayalew et al., 2021).

The land registration and certification process were implemented in a decentralized approach at a regional level as the mandate for the land policy was given to regions by the federal proclamation in 1997. As a result, the implementation process varies in different entities. In the Tigray region where the land certification program was started in 1998, only the household head's name was stated on the certificate while in other regions such as Amhara, Oromia, and SNNP certificates were issued in the names of both head and spouse (joint certification). This difference in registration with and without a spouse's name has had a differential impact on intra-household resource allocation and the bargaining power of spouses[9] (Bezabih et al. 2016; Muchomba 2017). Even under joint certification, there is a slight difference: in the Oromia region only, the household head's photo was attached to the

[9] Bezabih et al. (2016) found a gender heterogeneous effect of land certification on productivity. The marginal productivity of land certification is higher for Female-headed households as compared with male-headed households heads. While Muchomba, (2017), assessed the impact of land certification issued for only household heads in Tigray and land certification issued jointly for household heads and spouses in the regions of Amhara, Oromia, and SNNP. The findings show that joint land certification increased health consumption and home-grown food consumption, and decreased expenses of education as compared with the certification issued only to the household head. Hence, empowering women through providing a joint certification has a positive impact on the income of the household.

certificate while in the Amhara and the South regions, both the head and spouse's photos were attached. In the Amhara region, supervision was undertaken more closely by the woreda survey team and land administration team to monitor how the land registration and certification process was implemented than in the other regions. Written materials provided to LAC also vary: the limited copies of the land policy proclamation were provided in the Tigray region, while posters were provided in the Amhara region though there were some delays. In the Oromia region, both posters and proclamations were given, while no written material was used in the SNNP region due to a lack of common language to be used in the region. As a fee for obtaining a land certificate, households in the Amhara region paid nothing while households in the SNNP, the Tigray, and the Oromia region paid 2-birr[10], 3-birr and 5-birr, respectively. In addition, households living in remote areas have an extra cost of transportation to travel to the office. Moreover, the costs of land certification also vary across regions. For instance in the Amhara region, due to the engagement of the woreda survey team and land administration team in monitoring the land certification process, the cost of the land certification process is higher than in the other regions (Deininger et al., 2008).

3.3 Shock, consumption, and coping strategies

Ethiopia's vulnerability is caused by frequent droughts, unexpected shocks, and diseases; epidemic diseases affect humans, crops, and livestock (Lautze et al., 2003). These unexpected shocks have a depleting effect on household income, which aggravates the level

[10] With an exchange rate of 1USD=8.78 birr by referencing an exchange rate of 2006.

of poverty (Dercon, 2004; Pan, 2009; Ulimwengu, 2009; Dercon and Christiaensen, 2011; Isaac et al., 2013). In this section, we review the findings of the literature on the effect of shock on consumption and the alternative strategies and policy measures taken to reduce the negative effect of idiosyncratic and covariate shocks. Some of the most common coping strategies that served as insurance against shocks: self-financing (using savings, obtaining credits, selling assets), assistance from others in their social networks, and government programs, such as food aid, food-for-work, and cash-for-work programs (Islam and Maitra, 2012; Jack and Suri, 2014; Wossen *et al.*, 2016; Takahashi et al., 2019; Ahmed and Cowan, 2021). An existing informal risk-sharing mechanisms are complementary to the introduction of formal insurance (Takahashiet al., 2019; Berg et al., 2022)

One of the strategic responses to idiosyncratic shocks is social capital. Social capital, as defined in Wossen et al. (2016) from Ethiopia, is when a household has membership in Iddir (funeral association) or has potential supporters when faced with troubles. They found that households with social capital were able to sustain and smoothen consumption in Ethiopia, while those without were not able to smooth consumption against unexpected shocks (Wossen et al., 2016). This is due to shared norms in the country. In Ethiopia, it is common to help each other when someone faces health problems or any other shock (Di Falco and Bulte, 2013). Similarly, Attanasio and Krutikova, (2020) stated that households in a family network in Tanzania were less likely to be exposed to idiosyncratic shocks. Conversely, the role of social capital as a coping strategy did not work well with an Indonesian family. There is no evidence that households with social capital (measured in terms of civic participation, norms of cooperation, relationship with the community, ethnic

diversity, and the existence of an extended family) benefited more compared to households without (Gertler et al., 2006). Hence, using social capital as a coping mechanism differs based on the shared norms of the community in times of hardship.

In addition to self-protection through the use of one's own savings, own production, and formal/informal social networks, the introduction of mobile money transfer technology in the last two decades also served as insurance in consumption smoothing in Kenya and Tanzania against idiosyncratic and covariate shocks (Jack and Suri, 2014; Riley, 2018; Ahmed and Cowan, 2021). The digital economy reduced the transaction costs for money transfers and enabled people to gain more access to financial institutions, which has a positive effect on poverty reduction. It has also protected households against unexpected shocks (Gertler et al., 2009; Susan and Nino-Zarazua, 2011; Islam and Maitra, 2012). Mobile money transfer technology has been used as a coping mechanism to protect from the severe effect of the shocks on schooling, consumption, and health care expenditures (Jack and Suri, 2014; Riley, 2018; Tabetando and Matsumoto, 2020; Ahmed and Cowan, 2021). Those who have access to microfinance institutions do not sell their assets and livestock to smoothen consumption (Islam and Maitra, 2012). Apart from mobile money technology, other types of programs or policy interventions that can enhance the functions of the credit market and facilitate economic activities is other important research question that needs to be investigated.

Attanasio *et al.*, (2022) also found that consumption is less insured against idiosyncratic and covariate shock in regions with less contribution from an agricultural sector

to the economy. This implies that economic transformation from agricultural to the non-agricultural institution has negatively affected in ensuring consumption against shocks. Hence, rural land reforms that increase agricultural productivity might contribute to ensuring consumption against idiosyncratic and covariate shocks.

In this study, we take the land certification program as a potential measure for enhancing access to credit when households are hit by weather shocks. Theoretically, it is believed that land certificates can be used as collateral, which increases access to credit. However, in existing empirical studies conducted in developing countries, such evidence is lacking. This could be due to the lack of a system in formal financial institutions that evaluate rural farmland and the prohibitively high transaction costs. However, as access to informal credit, the land certificate can be attractive enough to be used as collateral for them to provide credits. Increased tenure security from land certification increased agricultural productivity by encouraging land-related investment; and activating productivity-enhancing land transfers (Deininger et al. 2015; Deininger et al. 2008; Ghebru and Holden, 2015). There are several advantages of having formal land titling for a farm household. It can increase long-term investment by improving land security (Gebremedhin and Swinton, 2003; Deininger and Jin, 2006; Holden et al., 2009; Deininger et al., 2011), activate the land rental markets, which increases agricultural productivity (Deininger et al., 2008; Deininger et al., 2011; Holden et al., 2011b). However, it has not been studied whether the program that enhanced tenure security mitigated the negative impact of shocks by enabling access to credit.

In the Ethiopian context, farmers cannot sell or mortgage plots of land—land

certification provides them with land use rights. However, farm households with a land certificate might have a better chance to use their land as a guarantee for informal credit. This is because land certification reduces land border disputes (Holden et al., 2011a), which in turn enhances land transferability (Deininger et al., 2008; Deininger et al., 2011; Holden et al., 2011b). Hence, a farm household with a land certificate can have more confidence to rent out their land even in a country where there is frequent land redistribution and risk of land expropriation (De Brauw and Mueller, 2012). Moreover, the land certification enables farm households to return their mistrust of the state, which was created for the existence of frequent land redistribution, by improving the tenure insecurity by providing land certification. Land certification also created an interpersonal mutual trust within the community (Bezabih et al., 2011), allowing its members to help each other when faced with any hardship by reducing mistrust of their tenants and improving renting out of the land (Teraji, 2008; Bezabih et al., 2011)[11]. Therefore, a land reform providing a formal land certificate can bring about trust within the society, which activates an informal credit market.

[11] Bezabih et al. (2011) examined that improving land tenure security creates a trust of an individual over government and non-government institutions, it also increased cooperative behavior in the society through the increased trust of an individual over other individuals. Moreover, land certification improved agricultural productivity by increasing the engagement and effort of a farm households on their land. Agricultura income improved when household exert their efforts towards their farm activities. However, sometimes even exerting similar efforts may not increase agricultural income for some reason. In this situation, their effort can create a cooperative behavior through borrowing as a credit from households who have higher agricultural income (Jain and Lay, 2021).

Ethiopia is experienced frequent land redistribution, and farm households were reluctant to rent out their land for fear of land expropriation through administrative redistribution (Deininger et al., 2008; Ghebru and Holden, 2015). The formalization of land rights improves productivity by facilitating the smooth functioning of the land rental market (Ghebru and Holden, 2015). Poorer households are renting out land in Ethiopia to get cash. So, it is part of the mechanism of how a land certificate can mitigate the shock's negative effect on consumption as shown in Figure 1.1.

3.4 Methodology

3.4.1 Data and variables

This study uses a panel dataset from the Ethiopian Socioeconomic Survey (ESS)[12] collected in 2011/12, and 2015/16. The sample households were selected using two-stage probability sampling. In the first stage, 333 enumeration areas (EAs) were randomly selected from the sample of an Annual Agricultural Sample Survey (AgSS). Therefore, the population included households in rural and small-town areas. In the second stage, 12 households were randomly selected in each EA (Central Statistics Agency, 2017). However, 137 households were excluded from the database of the 2011 survey sample due to the wrong calculation of consumption expenditures and a wrongly reported value of consumption. Thus, we have a balanced panel of 7398 households for two wave surveys with attrition of about 7.4%.

[12] A collaborative project between the Central Statistics Agency (CSA) of Ethiopia and the World Bank Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) project.

The ESS contained comprehensive village- and household-level data. Our main outcome variables are annual per capita food consumption expenditure, annual per capita non-food consumption expenditure, annual per capita education expenditure, and annual per capita total consumption expenditure[13]. Food consumption is measured by the last week's consumption. The timing of the food consumed can be before shock occurred. Hence, this is a limitation of this paper. However, to handle the issue of inflation, I used a price index provided in the data set. They considered a regional spatial price index from the Ministry of Finance and Economics Development (MoFED) of Ethiopia that was calculated from the Household Consumption and Expenditure Survey (HCEI). A set of indicator variables used as a mitigating mechanism are: borrowing money from formal/informal institutions as a credit, receiving assistance and gifts from friends and relatives, receiving aid in the form of food or cash for work from the government and development partners of the government, and selling assets in the last 12 months.

The main policy variable is an indicator variable if a village received a land certification by year t. In the 2011 and 2015 surveys, households were asked whether they had land certificates and, if so, when they received it. We found that 39.1% of the sample households had land certificates in 2011 and before, and the proportion of households who received land certification increased to 53.3% by 2015. Hence, villages, where more than 40% of households had received the land certificate at the time of the follow-up survey, were

[13] Per capita education expenditure is defined as the total education expenditure per school age (used from age 6 to 18) while per capita food and non-food consumption expenditure are divided by the number of household members.

considered the treatment group. For the robustness checks, we provided the results with an alternative threshold of treatment.

Due to the lack of objective rainfall data, which can be matched with sample villages as the dataset do not contain GPS coordinates of village location, the weather shock variable that I employed for this study is self-reported by the households. Shock in our main analysis is measured using a dummy variable indicating if 70% and more of the sample household living in the enumeration area is exposed to weather shock; thus, the enumeration area is an area where the sample household was randomly selected. For robustness check, we also included a self-reported household level weather shock in Table 3.A.16 and Table 3.A.17. In which, shock is defined using a dummy variable taking a value of 1 if the household were affected by at least one of the top ranked severe natural shocks, such as droughts, floods, and landslides during the last 12 months of the survey. Although this is a self-reported measure, it is not correlated with household characteristics such as education and assets, which ascertains that this variable does not suffer from serious self-report bias.

3.4.2 Descriptive statistics

Table 3.1 shows the descriptive statistics of exposure to shocks, consumption expenditure, and mitigating measures using two-year pooled data for total sample households and across each region. Four main categories of regional representations are considered in Table 3.1 (Tigray, Amhara, Oromo, and SNNP).

The share of households who received land certification differs across regions, which ranges from 72.3% in Tigray to 57.6% in Oromia. This may be partly because of the

difference in the year when the land certification program was first introduced. Regarding the exposure to shocks, it shows that 24.2% of the total sample households were affected by weather shocks, out of which 22.4% are mainly affected by drought. 2.2% is affected by flood and 0.4% is affected by landslides. The top mitigation mechanisms against the negative effect of weather shock are accessing formal/informal credit and receiving gifts from friends and relatives. When we see across regions, the percentage of households who did not use mitigation methods is higher in SNNP (1-0.217-0.152-0.024-0.046=0.561) and lower in Tigray (1-0.217-0.152-0.024-0.046=0.4). There is also a difference across regions in their consumption expenditure; with the highest per capita consumption expenditure in Oromia and the lowest per capita consumption expenditure in the Amhara region.

Given the heterogeneity across regions, we examine the role of land certification program as insurance varies from region to region based on differences in their regional land certification process and experiences. The descriptive statistics for consumption expenditure and other household variables, by survey year and by land certification treatment, are shown in Table 3.A.1 and Table 3.A.2 in the Appendix.

Table 3.2 shows the descriptive statistics separately by shock status if households were affected by natural shocks in the last 12 months. We pooled two-year data. There is a statistical difference in consumption expenditure and mitigation measures between households that were and were not exposed to natural shocks. Households who were affected have a lower value for consumption expenditure than those who were not. Compared to households who did not experience any shocks, those who did receive more gifts from friends

and relatives, as well as more assistance in the form of food/cash for work mitigate the negative effect of shocks on consumption. However, no differences were found in the amount of asset sales between households that were and were not affected by natural shocks. The summary statistics for each survey period are replicated separately and reported in Appendix Table 3.A.2 and Table 3.A.3. The results are like those presented in the statistical report shown in Table 3.2.

Table 3.3 displays the differences in consumption and coping mechanisms over time, based on four possible occurrences of shocks: a) households exposed to shocks in both 2011 and 2015; b) households only exposed to shocks in 2011; c) households only exposed to shocks in 2015, and; d) households who were not exposed to shocks in both years. In all four groups, consumption expenditure increased over time. However, Group (c), which was only affected by shocks in 2015, saw the lowest increase in consumption as expected. In comparison with Groups (b) and (c), we can confirm that access to credit and assistance (food and cash for work) increased in Group (c), but no difference is found in Group (b) over time. We also present the statistical differences among the four groups for each survey period in Table 3.A.4 and Table 3.A.5 of the Appendix.

In Table 3.4, we compare the four groups categorized by both exposures to natural shocks and the land certification program. Group (1) consists of households that were affected by natural shocks and did not receive land certification. Group (2) consists of households who were affected by natural shocks and received land certification. Group (3) consists of households that were not affected by natural shocks and received land certification.

Group (4) consists of households that were not affected by natural shocks and did not receive land certification. By comparing households who did not and did receive land certification given a natural shock (columns 1 and 2, respectively), we can see that, on average, consumption expenditure is greater for those that received land certification than for those who did not when households were affected by natural shocks. As expected, the share of households that obtained credit is higher for households that received land certification than those that did not. Next, we compare two groups of households that received land certification, but only one was exposed to natural shocks (columns 2 and 3). There was not much difference in food consumption and education expenditures for the group of households who were exposed to natural shocks and who was not, given the group of households that received that land certification. But, there is a significant difference in non-food consumption expenditure between these groups when they were affected by natural shocks than when those who were not. In contrast, a higher share of households with land certification obtained credit, gifts, and assistance when they were affected by natural shocks than when they were not. Lastly, we compare households without land certification who were affected by natural shocks to those who were not (columns 1 and 4, respectively). Like the second comparison, natural shocks affected the consumption of both groups, and the difference is in the credits obtained. The likelihood of obtaining credit did not increase for these households without land certification when they were affected by natural shocks, which suggests that land certificates make it easier for households to obtain credits.

3.4.3 Empirical models and identification strategy

Following Ahmed and Cowan (2021) and Jack and Suri (2014), we apply the difference-in-differences (DID) approach by including household fixed effects to examine how the land certification program helps households against shocks. In Jack and Suri (2014), they used a simple difference-in-differences approach to examine the role of mobile transfer technology on risk sharing against self-reported income shocks by comparing the consumption of mobile transfer technology users and nonusers. During the survey, the households were asked to report unexpected shocks among the lists of potential shocks that happened to them. Even though they used a self-reported income shock, they considered only unexpected self-reported covariate and idiosyncratic shocks; additionally, they examined that the self-reported shocks are not systematically correlated with a household-level variable. To support this idea, they also examined that the expansion of mobile technology agents is not correlated with observable characteristics, and performed a falsification test using a data prior to the introduction of mobile technology.

First, we examine the effect of natural shock on per capita consumption expenditure using the following estimation model:

$$Cons_{hvt} = \alpha_0 + \alpha_1 S_{et} + \alpha_4 X_{hvt} + \theta_h + (\theta_V \times \gamma_t) + \varepsilon_{hvt} \quad ---------- (1),$$

where $Cons_{hvt}$ is the annual per capita consumption expenditure for household h in village v in period t for different consumption categories transformed into inverse

hyperbolic sine; S_{et}[14] is an indicator variable taking a value of 1 if 70% and more of the sample household living in the enumeration area is exposed to weather shock; thus, the enumeration area is an area where the sample household was randomly selected; X_{hvt} is a vector of household-level covariates; θ_h is the household fixed effects to control for unobserved time-invariant household characteristics; $(\theta_V \times \gamma_t)$ is a set of the village by time dummies that control for time-variant village-level heterogeneity; ε_{ht} is the error term, and; α is a coefficient to be estimated. Standard errors are clustered at the village level. Given the limited access to weather insurance, we expect $\alpha_1 < 0$. To examine in further detail which consumption items were most affected by the shocks, we estimate the same model with different dependent variables, such as food consumption, non-food consumption, and education expenditure instead of total consumption expenditure.

Second, we examine the potential role of land certification on consumption smoothing against natural shocks by estimating the following equation:

$$Cons_{hvt} = \alpha_0 + \alpha_1 S_{et} + \alpha_2 C_{vt} + \alpha_3 S_{et} \times C_{vt} + \alpha_4 X_{hvt} + \theta_h + (\theta_w \times \gamma_t) + \varepsilon_{hvt} - - - -(2)$$

where C_{vt} takes 1 if a household lives in a village with a land certification program; $(S_{et} \times C_{vt})$ is an interaction term between shock and land certification, and; α_3 is the coefficient of interest that identifies whether land certification programs help households

[14] Household level self-reported measure of weather shock is also included in the appendix Table 3.A.16 and Table 3.A.17. by using S_{hvt}as an indicator variable taking a value of 1 if the household was affected by severe weather shocks during the last 12 months, and 0 otherwise.

recover from the negative effects of natural shocks.

Third, we examine the potential mechanisms of how land certification programs mitigate the negative effect of natural shocks on consumption. Potential mechanisms are credit obtained from formal and informal institutions; gifts received from friends, relatives or formal/informal institutions; assistance received in the form of food or cash for work; income from non-farm business; and asset sales. Following Ahmed and Cowan (2021), the following equation is estimated:

$$M_{hvt} = \alpha_0 + \alpha_1 S_{et} + \alpha_2 C_{vt} + \alpha_3 S_{et} * C_{vt} + \alpha_4 X_{hvt} + \theta_h + (\theta_w * \gamma_t) + \varepsilon_{hvt} ----(3)$$

where M_{hvt} is an indicator variable taking 1 if a household obtained credit, gifts, assistance, non-farm income, or asset sales, and 0 otherwise.

However, our model specification has two concerns that need to be dealt with: (1) the exogeneity of shocks; and, 2) the endogeneity of land certification. Regarding the first concern, we test if land certification and other household covariates affect natural shocks or not by following Ahmed and Cowan (2021) and Jack and Suri (2014). We run the following model:

$$S_{hvt} = \alpha_0 + \alpha_1 C_{vt} + \alpha_1 X_{hvt} + \theta_h + (\theta_w \times \gamma_t) + \varepsilon_{hvt} ----------(4)$$

As reported in column 1 of Table 3.A.9, there is no evidence that a land certification program and other household variables affect natural shocks.

In terms of the second concern, columns 2 of Table 3.A.9 show that land certification

users and non-users do not differ by the status of the shocks. Moreover, the land certification process in Ethiopia was implemented using a top-down approach; the program was initiated from a federal-level administration to the village level (a lower unit of administration). The implementation of the program was determined based on non-economics criteria (Deininger et al., 2008; Deininger et al., 2011; Muchomba, 2017; Ayalew et al., 2021).

3.5 Results

3.5.1 Estimation Results

This section presents examination results based on equations 1-3.

3.5.1.1 Effect of Natural Shocks on Consumption Expenditure

Table 3.5 shows the results from equation 1. Column 1 shows that natural shocks significantly reduced household food consumption expenditure by 6%, while column 2 shows a decrease of 12.1% in non-food consumption expenditures during natural shocks. On average, per capita consumption expenditure decreased by 6.6% because of natural shocks. The results are consistent with those of other studies (Jack and Suri, 2014; Wossen *et al.*, 2016; Nguyen et al., 2020). There is no evidence that education expenditure was negatively affected by natural shocks.

3.5.1.2 Role of land certification program in consumption smoothing

In the previous subsection, we found a negative impact of the natural shock on consumption expenditure. Now, we examine if land certification plays a role in mitigating

the negative effect of natural shocks on per capita consumption expenditure (equation 2). The estimation results are found in Table 3.6 using the village-level land certification indicator. Column 1 of Table 3.6 shows that natural shocks decrease the food consumption of households without land certification by 25.1%. However, for households with land certification, natural shocks decreased their per capita food consumption expenditure by only 1.1% (-0.251 + 0.262). I also incorporated a joint test (wald test p-value) for a sum of the coefficient is significant. Hence, households with a land certificate were able to protect themselves against such shocks. The remaining columns do not show any evidence that natural shocks have a differential marginal effect on households with and without land certificates. Additionally, we separately measured natural shock as drought, flood, and landslides to see the differential effect of each shock and if differences in mitigation mechanisms. We have found that land certification has a differential impact on drought, flood, and landslides, and there are also differences in the mitigation mechanisms as shown in Table 3.A.10 and in Table 3.A.11.

The results are consistent with those obtained using an alternative definition of treatment for land certification (see Table 3.A.12 and Table 3.A.14). This estimation result suggests that households with land certificates can reduce the negative effect of shocks on food consumption expenditure.

3.5.2 Mechanisms

In the previous subsection, we saw that households with land certificates managed to avoid the negative effect of natural shocks, unlike those without. In this subsection, we report

the results on the mechanisms specifically focusing on obtaining credit.

Table 3.7 shows the effect of land certification on the likelihood of obtaining credit, receiving gifts, receiving assistance in the form of food or cash for work, selling assets, and fixed land rental out. Column 1 in Table 3.7 suggests that households with land certification managed to increase their probability of obtaining credit when they were affected by natural shocks. The joint test also shows that sum of the effect of shock and interaction with certification is significantly different from zero. In contrast, there is not precisely estimated zero impact that access to credit increases when households without land certification were affected by the shocks. This implies that land certificates can help to access credit when households were affected by natural shocks. One may, however, have a concern that this result is due to a confounding factor as certification might proxy for something else, e.g. social capital. To test this possibility, instead of the land certification program, I used membership of local association (i.e. Iddir) as a proxy measure of social capital and run the same model as equation 3. As shown in Table 3.A. 20 and Table 3.A.21, social capital was not helping to mitigate the effect of weather shock on food consumption expenditure. Moreover, I also controlled social capital to see if the land certification program remains playing the role of mitigation against weather shock. I have reported the result in Table 3.A.22 and Table 3.A.23, thus, it is the land certification, not social capital that played a role in mitigating the negative effect of natural shocks on consumption smoothing.

Column 2 in Table 3.7 reports the results of households that received gifts/assistance from their friends and relatives when they faced natural shocks. Unlike our expectations,

households that were affected by natural shocks are less likely to receive gifts. However, the effect of shocks is different for those who have land certificates and land certificates increase the probability that households who were affected by natural shocks receive gifts from others. The joint test also supports this analysis. Receiving gifts from friends and relatives could be literally in terms of helping someone at the time of hardship. Another implication of giving a gift may also depend on creating cooperative behavior with the receiver of the gifts to use at a time of need. Hence, someone with land tenure security can be more trusted and likely to receive gifts when they became affected by the shock.

Column 3 reports the mitigating mechanism in the form of receiving aid in the form of food or cash for work program. Households who were affected by natural shocks are likely to increase in receiving aid in the form of food or cash for work programs. This may be because the food for work program tends to be provided for drought-prone areas by the government and development partners. However, there is no evidence that households with land certificates increase such likelihood when affected by shocks.

Column 4 shows the results of another coping mechanism—the sale of one's own assets. Since the dependent variable is a dummy variable, we cannot estimate the intensive margin of the heterogeneous effect of natural shocks on asset sales by land certificate. At least for the extensive margin, there is no evidence that land certification makes a difference.

Column 5 reports if fixed land rental out can be a mitigating mechanism against weather shock. However, there is not precisely estimated zero impact that households with land certification increased fixed land rental market participation. In our analysis, we

considered if households who were affected by shock in the previous survey round are likely to rent out land in the next survey round. But, we could not see a significant impact of the land certification program on land rental market. This may be due to the data we have to measure the land rented out is not immediate after the affected year.

An alternative thresholds of village level land certification are also presented in the Table 3.A.13 and Table 3.A.15, which shows a consistent result.

3.5.3 Heterogeneity analyses

In the previous sections, we found a negative impact of the weather shock on consumption expenditure, and households with a land certificate was able to protect themselves against such shocks. In this section, our study presents a further implication of the main results. Hence this study investigates the heterogeneity (using equations 1-3) on the impact of land certification on consumption smoothing against shocks based on the differences in land size (smaller or larger land owners), and household head's age (younger or older).

We examined the heterogenous treatment effect of land certification by estimating separately for smaller vs. larger land owners (see Table 3.8). Columns 1-4 of Table 3. 8 shows an estimation results that the land certification program plays a mitigating role on the negative effect of weather shocks on non-food consumption expenditure for households owning larger than median land size (0.89 hectares). Columns 5-8, the land certification program increased food and total consumption expenditure among smaller land owners. Thus,

the land certification program increased non-food consumption expenditure for households with larger land sizes, while for households with the small land sizes the certification increased food and total consumption expenditure. As reported in Table 3.9, we examined the channels for the heterogenous effect of land certification on mitigating against the negative effect of weather shock on consumption by land size. Column 1-4, however, there is not precisely estimated zero impact that the land certification activated credit for larger land size owners. Column 5-8, households with land certification obtained credit and received assistance from relatives and friends for households owned smaller land sizes. This is because, owners of small land sizes are not self-sufficient and become less likely to have enough wealth to mitigate the shock.

The difference in household characteristics might also create a difference in the effectiveness of land certification in reducing the negative effect of shock. For instance, younger household heads are not expected to own more assets and wealth that can be used to mitigate shocks. Hence, the impact of land certification becomes more pronounced for younger household heads and pro-poor households in general; thus, younger household heads are expected to benefit more from having land certification. Column 1-4 of Table 3.10, the land certification program increased non-food consumption for older household heads. Column 5-8 of Table 3.10, land certification played an effective role for younger household heads in mitigating the negative effect of weather shock by increasing food and total consumption expenditure. Though young household heads have less opportunity to accumulate wealth and depend on own resources, the low-cost land certification program became more effective for young household heads to smoothen consumption by providing access to credit and receiving gifts

from relatives and friends as reported in Table 1.11.

Apart from that, we also tested if each type of type shock (drought, flood, and landslides) has different impacts and whether land certificate has a mitigating effect on all types of shocks or not. Therefore, this study examined the role of land certification in reducing the impact of drought, flood, and landslides on per capita consumption expenditure separately instead of as a combined measure of weather shock, see in Table 3.A.10. In Table 3.A.10 drought decreased per capita food consumption by 11.5%. But, households in a treated village reduced food consumption expenditure by only 1%. However, there is not precisely estimated zero impact that the land certification has a significant and positive response to flood and landslides. Hence, the response of the land certification that we found in Table 3.6 can be mainly explained by drought and land certification can protect households from the severe effect of drought on consumption.

3.6 Conclusions

This study analyzes two-year LSMS household-level panel data to estimate the effect of Ethiopia's land registration and certification program on smoothing consumption against natural shocks. Following Jack and Suri (2014) and Ahmed and Cowan (2021), we adopted a DID approach, including household fixed effects, to elucidate the response of consumption against shocks across households with and without land certification. Using the same approach, we investigated the mechanisms by which land certification could serve as insurance against shocks. We find that natural shocks reduced household consumption expenditure, which implies that households were not able to protect themselves from natural shocks. This is expected because of limited access to the insurance market. However, land certification could serve as insurance against natural shocks. Households with land certification managed to partially recover from decreased consumption expenditures as a response to natural shocks largely through obtaining credit from their own social networks and credit markets. This may be explained by the fact that land certification improves land tenure security and, in turn, creates trust among people and institutions (Teraji, 2008; Bezabih et al., 2011). Therefore, strengthening land tenure security by land certification can help smoothen consumption by (a) enabling households to access credit from formal and informal markets, and (b) receiving gifts from their relatives and friends. The enhancement of land property rights not only activates the land rental market and agricultural investment but also enhances access to credit markets.

Our study also examined the heterogeneity analysis on the effect of land certification

against weather shock across land size (smaller or larger land owners), and household head's age (younger or older). We found that households with land certification are enabling to increase food consumption in response to weather shocks for households that owned small land sizes through obtaining credit and receiving gifts. The land certification program also increased non-food consumption for older household heads, and food consumption for younger household heads through mainly obtaining credit and receiving gifts.

List of Tables

Table 3. 1: Mean value of main variables across regions

		(1)	(2)	(3)	(4)
	All	TIGRAY	AMHARA	OROMYA	SNNP
Variable	Mean/SE	Mean/SE	Mean/SE	Mean/SE	Mean/SE
=1 Natural Shock	.242	0.272	0.188	0.173	0.227
	.429	[0.016]	[0.010]	[0.010]	[0.010]
=1 drought	.224	0.258	0.163	0.160	0.201
	.417	[0.016]	[0.009]	[0.010]	[0.009]
=1 flood	.022	0.024	0.028	0.011	0.032
	.145	[0.006]	[0.004]	[0.003]	[0.004]
=1 land slide	.004	0.000	0.004	0.003	0.007
	.066	[0.000]	[0.002]	[0.001]	[0.002]
Sum of drought, flood and land slide	.25	0.282	0.194	0.174	0.240
	.451	[0.017]	[0.010]	[0.010]	[0.011]
=1 HH received certification	.612	0.723	0.657	0.576	0.628
	.487	[0.016]	[0.012]	[0.013]	[0.011]
log Food per capita	8.882	8.924	8.740	9.023	8.796
	.682	[0.023]	[0.016]	[0.016]	[0.017]
log Nonfood per capita	7.178	7.297	7.045	7.269	7.063
	1.121	[0.034]	[0.032]	[0.029]	[0.026]
log Educ per capita	2.852	2.932	2.536	3.130	2.983
	2.329	[0.080]	[0.055]	[0.063]	[0.053]
log Cons per capita	9.124	9.173	8.999	9.253	9.037
	.658	[0.021]	[0.016]	[0.016]	[0.017]
=1 Obtained credit	.235	0.307	0.275	0.235	0.217
	.424	[0.017]	[0.011]	[0.011]	[0.010]
=1 received gifts from others	.171	0.216	0.158	0.163	0.152
	.376	[0.015]	[0.009]	[0.010]	[0.008]
=1 received food/cash for work	.037	0.053	0.040	0.028	0.024
	.188	[0.008]	[0.005]	[0.004]	[0.004]
=1 selling asset	.025	0.024	0.009	0.026	0.046
	.156	[0.006]	[0.002]	[0.004]	[0.005]
	7398	776	1606	1488	1878

The figures in brackets represent the standard deviations.

Table 3. 2: Differences in consumption and coping mechanisms by natural shocks (pooled data)

	(1)	(2)	t-test
	Natural Shock	No Natural Shock	Difference
Variable	Mean/SE	Mean/SE	(1)-(2)
log Food exp per capita	8.858[0.016]	8.889[0.009]	-0.031*
log Nonfood exp per capita	6.988[0.027]	7.239[0.015]	-0.251***
log Educ exp per capita	2.735[0.053]	2.890[0.031]	-0.155**
log Cons exp per capita	9.066[0.015]	9.143[0.009]	-0.077***
=1 Obtained credit	0.242[0.010]	0.232[0.006]	0.010
=1 Received gifts from others	0.201[0.009]	0.161[0.005]	0.039***
=1 Received food/cash for work	0.079[0.006]	0.023[0.002]	0.057***
=1 Sold asset	0.023[0.004]	0.026[0.002]	-0.003
Observation	1794	5604	

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 3: Differences in consumption and coping mechanisms by shock years

	Natural shocks in both 2011 and 2015			Natural shocks only in 2011		
	(1)	(2)	t-test	(4)	(5)	t-test
	2015	2011	Difference	2015	2011	Difference
Variable	Mean/SE	Mean/SE	(1)-(2)	Mean/SE	Mean/SE	(4)-(5)
log Food per capita	8.931[0.034]	8.765[0.039]	0.166***	8.744[0.036]	8.596[0.040]	0.148***
log Nonfood per capita	7.067[0.055]	6.623[0.060]	0.444***	7.073[0.061]	6.612[0.080]	0.461***
log Educ per capita	2.886[0.122]	2.050[0.116]	0.836***	3.102[0.126]	2.398[0.114]	0.704***
log Cons per capita	9.128[0.032]	8.933[0.039]	0.195***	8.994[0.034]	8.798[0.039]	0.196***
=1 Obtained credit	0.255[0.024]	0.153[0.020]	0.102***	0.248[0.025]	0.278[0.026]	-0.029
=1 Received gifts from	0.270[0.024]	0.192[0.022]	0.078**	0.170[0.022]	0.170[0.022]	0.000
=1 Received food for work	0.033[0.010]	0.079[0.015]	-0.046**	0.059[0.013]	0.052[0.013]	0.006
=1 Sold asset	0.012[0.006]	0.042[0.011]	-0.030**	0.029[0.010]	0.029[0.010]	0.000
Number of observations	333	333		306	306	
	Natural shock only at 2015			No Natural shock at 2011 and 2015		
	(7)	(8)	t-test	(10)	(11)	t-test
	2015	2011	Difference	2015	2011	Difference
Variable	Mean/SE	Mean/SE	(7)-(8)	Mean/SE	Mean/SE	(10)-(11)
log Food per capita	8.964[0.021]	8.904[0.023]	0.060*	8.949[0.014]	8.844[0.015]	0.104***
log Nonfood per capita	7.244[0.035]	7.020[0.031]	0.224***	7.445[0.023]	7.136[0.025]	0.309***
log Educ per capita	3.077[0.081]	2.421[0.075]	0.656***	3.285[0.051]	2.638[0.049]	0.648***
log Cons per capita	9.194[0.020]	9.097[0.022]	0.097***	9.231[0.014]	9.092[0.014]	0.140***
=1 Obtained credit	0.260[0.015]	0.191[0.014]	0.069***	0.220[0.009]	0.257[0.009]	-0.037***
=1 Received gifts from	0.187[0.014]	0.202[0.014]	-0.015	0.137[0.007]	0.170[0.008]	-0.033***
=1 Received food for work	0.108[0.011]	0.036[0.006]	0.073***	0.010[0.002]	0.026[0.003]	-0.015***
=1 Sold asset	0.017[0.005]	0.016[0.004]	0.001	0.022[0.003]	0.032[0.004]	-0.009*
Number of observations	822	822		2238	2238	

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 4: Differences in consumption and coping mechanisms by certification

	Natural shock without Cert	Natural shock with Cert	No Natural shock with Cert	No Natural shock without Cert	Difference	Difference	Difference
Variable	(1)	(2)	(3)	(4)	(1)-(2)	(3)-(2)	(4)-(1)
log Food per capita	8.755 [0.031]	8.903 [0.018]	8.897 [0.012]	8.879 [0.015]	-0.148***	-0.006	0.124***
log Nonfood per capita	6.746 [0.055]	7.093 [0.030]	7.270 [0.019]	7.194 [0.023]	-0.347***	0.177***	0.447***
log Educ per capita	2.250 [0.093]	2.945 [0.063]	3.023 [0.042]	2.703 [0.048]	-0.695***	0.078	0.452***
log Cons per capita	8.954 [0.031]	9.114 [0.017]	9.155 [0.011]	9.127 [0.014]	-0.160***	0.040*	0.173***
=1 Obtained credit	0.196 [0.017]	0.263 [0.012]	0.236 [0.007]	0.225 [0.009]	-0.067***	-0.026*	0.029
=1 Received gifts from others	0.205 [0.017]	0.199 [0.011]	0.145 [0.006]	0.182 [0.008]	0.006	-0.054***	-0.022
=1 Received food/cash for work	0.067 [0.011]	0.085 [0.008]	0.020 [0.002]	0.027 [0.003]	0.010	0.003	-0.039***
=1 Sold asset	0.030 [0.007]	0.020 [0.004]	0.023 [0.003]	0.029 [0.003]			-0.001
Number of observations	542	1252	3267	2325			

The figures in brackets represent the standard deviations. The values displayed for t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 5: Effect of natural shocks on consumption expenditure

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
Weather shocks	-.06**	-.121***	-.172*	-.066**
	(.03)	(.043)	(.096)	(.027)
Confidence interval	[-.1186443 -.0017757]	[-.2059195 -.0357477]	[-.3601984 .0164984]	[-.118439 -.0127417]
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Rwolf2 FWER p-value	***0.2151***	***0.0040***	***0.0040***	***0.5418***
# Obsens.	7398	7398	7398	7398
R-squared	.671	.737	.757	.709

Other controls include the literacy level of household head, household head age, number of household members, and land size. Wald test (p-value): joint test of an interaction variable with shock. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 6: Role of land certification on mitigating against shock

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
Certification x Shock	.262***	.175*	.167	.2***
	(.07)	(.095)	(.171)	(.067)
Certification	.018	.017	-.259***	.011
	(.028)	(.04)	(.095)	(.025)
Shock	-.251***	-.277***	-.314*	-.213***
	(.068)	(.092)	(.162)	(.065)
Certification x Shock + Shock	0.011	-0.122	-0.157	-0.013
Confidence interval	[.1247315 . 3988094]	[-.0105508 .3610216]	[-.1682606 .5014961]	[.0683349 .3314822]
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0007***	***0.0019***	***0.0940***	***0.0044***
Number of observations	7374	7374	7374	7374
R-squared	.66	.731	.752	.701

Other controls include the literacy level of household head, household head age, number of household members, and land size. Wald test (p-value): joint test of an interaction variable with shock. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 7: Coping mechanisms against natural shocks

	1	2	3	4	5
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
Certification x Shock	.142***	.131***	-.012	-.013	.007
	(.043)	(.04)	(.024)	(.016)	(.016)
Certification	.008	-.009	-.006	.003	-.007
	(.019)	(.017)	(.008)	(.007)	(.01)
Shock	-.049	-.141***	.068***	.018	-.021
	(.042)	(.039)	(.022)	(.014)	(.015)
Certification x Shock + Shock	0.093	-0.01	0.056	0.005	-0.14
Confidence interval	[.0569484 .2269071]	[.0515983 .2094173]	[-.0591606 .0347669]	[-.0435655 .0173533]	[-.0242094 .0378533]
Household FE	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0000***	***0.0016***	***0.0000***	***0.4186***	***0.1109***
Number of observations	7374	7374	7308	7374	5910
R-squared	.569	.599	.541	.532	.567

Other controls include the literacy level of household head, household head age, number of household members, and land size. Wald test (p-value): joint test of an interaction variable with shock. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 8: Heterogeneity based on land size

	1	2	3	4	5	6	7	8
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
	Owning larger land size				Owning smaller land size			
Certification x Shock	-.008	.317**	.246	.017	.488***	.091	.131	.358***
	(.11)	(.137)	(.24)	(.104)	(.094)	(.137)	(.252)	(.092)
Certification	.056	.094*	-.239*	.046	.028	-.022	-.227	.019
	(.039)	(.049)	(.136)	(.035)	(.041)	(.067)	(.139)	(.037)
Natural Shock	-.025	-.438***	-.461*	-.06	-.428***	-.165	-.238	-.335***
	(.107)	(.131)	(.236)	(.101)	(.091)	(.131)	(.234)	(.089)
Certification x Shock + Shock	-0.033	-0.121	-0.251	0.11	0.06	-0.074	-0.107	0.023
Confidence interval	[-.2230 .20806]	[.04872 .58487]	[-.224 . 7161]	[-.185 .2206]	[.3045 .6714]	[-.1770 .35886]	[-.3639 .62598]	[.17721 . 53947]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	0.7489	0.0008	0.0896	0.4968	0.0000	0.3035	0.5244	0.0005
Observations	3600	3600	3600	3600	3772	3772	3772	3772
R-squared	.64	.696	.738	.663	.685	.752	.761	.731

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 9: Mechanisms for Heterogeneity based on land size

	1	2	3	4	5	6	7	8	9	10
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
	Owning larger land size					Owning smaller land size				
Certification x Shock	.094	.076	.007	-.047**	.034	.213***	.16***	-.018	.008	-.016
	(.068)	(.057)	(.029)	(.02)	(.027)	(.056)	(.057)	(.036)	(.02)	(.021)
Certification	.027	-.006	.001	-.01	-.025**	-.028	-.017	-.007	.01	.014
	(.03)	(.021)	(.013)	(.011)	(.012)	(.027)	(.027)	(.012)	(.01)	(.016)
Natural Shock	-.033	-.062	.061**	.053***	-.048*	-.081	-.178***	.065**	-.002	-.004
	(.069)	(.057)	(.028)	(.018)	(.028)	(.052)	(.055)	(.033)	(.02)	(.016)
Certification x Shock + Shock	0.061	0.014	0.068	0.006	-0.014	0.132	-0.018	0.047	0.006	-0.020
Confidence interval	[-.039 .2272]	[-.035 .1877]	[-.04918 .06331]	[-.087 -.007]	[-.019 .0865]	[.10233 .32375]	[.0477 .2725]	[-.08859 .05170]	[-.032 .0476]	[-.057 .0264]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	0.1413	0.4043	0.0024	0.0102	0.1405	0.0000	0.0051	0.0082	0.8557	0.3607
Observations	3600	3600	3574	3600	3316	3772	3772	3732	3772	2592
R-squared	.576	.604	.562	.539	.584	.57	.598	.547	.549	.558

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 10: Heterogeneity based on Household Head age

	1	2	3	4	5	6	7	8
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
	Older HH head				Younger HH head			
Certification x Shock	.074	.288**	.276	.052	.478***	.044	.234	.369***
	(.107)	(.141)	(.248)	(.101)	(.083)	(.126)	(.231)	(.084)
Certification	.001	-.019	-.461***	-.013	.036	.06	-.145	.033
	(.04)	(.065)	(.143)	(.037)	(.039)	(.049)	(.126)	(.034)
Natural Shock	-.071	-.413***	-.441*	-.063	-.453***	-.126	-.301	-.382***
	(.101)	(.143)	(.243)	(.096)	(.085)	(.113)	(.212)	(.083)
Certification x Shock + Shock	0.003	-0.125	-0.165	-0.011	0.025	-0.082	-0.067	-0.013
Confidence interval	[-.1361 .28357]	[.011203 .565527]	[-.2109 .76205]	[-.1459 .24986]	[.31421 .64082]	[-.2034 .29059]	[-.2187 .68704]	[.20353 .53491]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	0.7770	0.0076	0.1491	0.7815	0.0000	0.2075	0.3610	0.0000
Observations	3552	3552	3552	3552	3820	3820	3820	3820
R-squared	.649	.701	.733	.672	.675	.76	.774	.727

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3. 11: Mechanisms for Heterogeneity age of Household head

	1	2	3	4	5	6	7	8	9	10
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
	Older HH head					Younger HH head				
Certification x Shock	.099*	.089	-.031	.009	.018	.191***	.17***	.019	-.038	-.001
	(.057)	(.057)	(.032)	(.018)	(.023)	(.066)	(.057)	(.037)	(.025)	(.022)
Certification	.003	.006	-.012	.002	-.017	.016	-.018	0	.005	.001
	(.027)	(.025)	(.012)	(.01)	(.014)	(.028)	(.022)	(.012)	(.011)	(.013)
Natural Shock	-.03	-.098*	.067**	.002	-.029	-.071	-.182***	.065*	.035	-.01
	(.054)	(.055)	(.03)	(.017)	(.021)	(.065)	(.056)	(.034)	(.023)	(.02)
Certification x Shock + Shock	0.096	-0.009	0.036	0.011	-0.011	0.12	-0.012	0.056	-0.003	-0.011
Confidence interval	[-.012 .2099]	[-.022 .2003]	[-.093 .0328]	[-.026 .0451]	[-.026 .0626]	[.0612 .3215]	[.0574 .2819]	[-.053 .0914]	[-.087 .0117]	[-.044 .0426]
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	0.0647	0.2004	0.0181	0.4948	0.2787	0.0003	0.0049	0.0002	0.2961	0.6141
Observations	3552	3552	3524	3552	2956	3820	3820	3782	3820	2950
R-squared	.573	.614	.541	.536	.571	.568	.582	.551	.532	.57

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

List of Appendix: Tables 3. A

Table 3.A. 1: Consumption and coping mechanisms by year

	(1)	(2)	t-test
	2015	2011	Difference
Variable	Mean/SE	Mean/SE	(1)-(2)
=1 Natural Shock	0.312[0.008]	0.173[0.006]	0.139***
log Food per capita	8.934[0.011]	8.830[0.012]	0.104***
log Nonfood per capita	7.336[0.018]	7.021[0.019]	0.315***
log Educ per capita	3.188[0.039]	2.517[0.037]	0.671***
log Cons per capita	9.194[0.010]	9.054[0.011]	0.140***
=1 Obtained credit	0.235[0.007]	0.235[0.007]	-0.000
=1 Received gifts from others	0.163[0.006]	0.179[0.006]	-0.016*
=1 Received food/cash for work	0.038[0.003]	0.035[0.003]	0.003
=1 Sold asset	0.021[0.002]	0.029[0.003]	-0.008**
=1 Certification (village level)	0.885[0.005]	0.338[0.008]	0.546***
Observation	3699	3699	

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 2: Outcome variables and household characteristics by land certification

	(1)	(2)	t-test
	Treated Village	Control Village	Difference
Variable	Mean/SE	Mean/SE	(1)-(2)
=1 Natural Shock	0.277[0.007]	0.189[0.007]	0.088***
log Food per capita	8.899[0.010]	8.855[0.013]	0.043***
log Nonfood per capita	7.221[0.016]	7.109[0.022]	0.112***
log Educ per capita	3.002[0.035]	2.617[0.043]	0.385***
log Cons per capita	9.143[0.009]	9.094[0.013]	0.049***
=1 Obtained credit	0.244[0.006]	0.219[0.008]	0.024**
=1 Received gifts from others	0.160[0.005]	0.187[0.007]	-0.027***
=1 Received food/cash for work	0.038[0.003]	0.035[0.003]	0.003
=1 Sold asset	0.022[0.002]	0.029[0.003]	-0.007*
age of household head	46.752[0.232]	43.565[0.299]	3.187***
=1 if the Household Head can read and write	0.397[0.007]	0.422[0.009]	-0.024**
Household Size	4.996[0.035]	4.935[0.045]	0.061
Land size in hectare	2.080[0.273]	2.306[0.832]	-0.226
Observation	4519	2867	

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 3: Differences in consumption and coping mechanisms by natural shock in (2011)

	(1)	(2)	t-test
	Natural Shock	No Natural Shock	Difference
Variable	Mean/SE	Mean/SE	(1)-(2)
log Food exp per capita	8.791[0.019]	8.856[0.015]	-0.065***
log Nonfood exp per capita	6.870[0.031]	7.119[0.023]	-0.249***
log Educ exp per capita	2.441[0.057]	2.566[0.048]	-0.125*
log Cons exp per capita	8.996[0.018]	9.092[0.014]	-0.096***
=1 Obtained credit	0.241[0.011]	0.231[0.009]	0.011
=1 Received gifts from others	0.212[0.011]	0.157[0.008]	0.055***
=1 Received food/cash for work	0.063[0.006]	0.016[0.003]	0.047***
=1 Sold asset	0.032[0.005]	0.027[0.003]	0.005
Observation	1466	2233	

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 4: Differences in consumption and coping mechanisms by natural shock (2015)

	(1)	(2)	t-test
	Natural Shock	No Natural Shock	Difference
Variable	Mean/SE	Mean/SE	(1)-(2)
log Food exp per capita	8.938[0.015]	8.929[0.016]	0.009
log Nonfood exp per capita	7.257[0.024]	7.415[0.026]	-0.158***
log Educ exp per capita	3.147[0.054]	3.229[0.056]	-0.082
log Cons exp per capita	9.179[0.014]	9.210[0.015]	-0.031
=1 Obtained credit	0.265[0.010]	0.204[0.009]	0.061***
=1 Received gifts from others	0.200[0.009]	0.125[0.008]	0.075***
=1 Received food/cash for work	0.061[0.006]	0.015[0.003]	0.047***
=1 Sold asset	0.025[0.004]	0.016[0.003]	0.009*
Observation	1857	1842	

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 5: Consumption and coping mechanisms conditional on the occurrence of natural shocks over time (2011)

	(1)	(2)	(3)	(4)	t-test	t-test	t-test	t-test	t-test	t-test
	Natural shocks in both 2011 and 2015	Natural shocks only in 2011	Natural shocks only in 2015	No Natural shocks in 2011 and 2015	Diff	Diff	Diff	Diff	Diff	Diff
Variable	Mean	Mean	Mean	Mean	(1)-(2)	(1)-(3)	(1)-(4)	(2)-(3)	(2)-(4)	(3)-(4)
log Food per capita	8.765 [0.039]	8.596 [0.040]	8.904 [0.023]	8.844 [0.015]	***	***	*	***	***	**
log Nonfood per capita	6.623 [0.060]	6.612 [0.080]	7.020 [0.031]	7.136 [0.025]		***	***	***	***	***
log Educ per capita	2.050 [0.116]	2.398 [0.114]	2.421 [0.075]	2.638 [0.049]	**	***	***		*	**
log Cons per capita	8.933 [0.039]	8.798 [0.039]	9.097 [0.022]	9.092 [0.014]	**	***	***	***	***	
=1 Obtained credit	0.153 [0.020]	0.278 [0.026]	0.191 [0.014]	0.257 [0.009]	***		***	***		***
=1 Received gifts from others	0.192 [0.022]	0.170 [0.022]	0.202 [0.014]	0.170 [0.009]						**
=1 Received food/cash for work	0.079 [0.015]	0.052 [0.013]	0.036 [0.006]	0.026 [0.003]		***	***		***	
=1 Sold asset	0.042 [0.011]	0.029 [0.010]	0.016 [0.004]	0.032 [0.004]		***				**
Observation	333	306	822	2238						

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 6: Consumption and coping mechanisms conditional on the occurrence of natural shocks over time (2015)

	(1)	(2)	(3)	(4)	t-test	t-test	t-test	t-test	t-test	t-test
	Natural shocks in both 2011 and 2015	Natural shocks only in 2011	Natural shocks only in 2015	No Natural shocks in 2011 and 2015	Diff	Diff	Diff	Diff	Diff	Diff
Variable	Mean	Mean	Mean	Mean	(1)-(2)	(1)-(3)	(1)-(4)	(2)-(3)	(2)-(4)	(3)-(4)
log Food per capita	8.931 [0.034]	8.744 [0.036]	8.964 [0.021]	8.949 [0.014]	***			***	***	
log Nonfood per capita	7.067 [0.055]	7.073 [0.061]	7.244 [0.035]	7.445 [0.023]		***	***	**	***	***
log Educ per capita	2.886 [0.122]	3.102 [0.126]	3.077 [0.081]	3.285 [0.051]			***			**
log Cons per capita	9.128 [0.032]	8.994 [0.034]	9.194 [0.020]	9.231 [0.014]	***	*	***	***	***	
=1 Obtained credit	0.255 [0.024]	0.248 [0.025]	0.260 [0.015]	0.220 [0.009]						**
=1 Received gifts from others	0.270 [0.024]	0.170 [0.022]	0.187 [0.014]	0.137 [0.007]	***	***	***			***
=1 Received food/cash for work	0.033 [0.010]	0.059 [0.013]	0.108 [0.011]	0.010 [0.002]		***	***	**	***	***
=1 Sold asset	0.012 [0.006]	0.029 [0.010]	0.017 [0.005]	0.022 [0.003]						
Observation	333	306	822	2238						

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 7: Differences in consumption and coping mechanisms by certification (2011)

	(1)	(2)	(3)	(4)	t-test	t-test	t-test
	Natural shock with No Cert	Natural shock with Cert	No Natural shock with Cert	No Natural shock with No Cert	Difference	Difference	Difference
Variable	Mean/SE	Mean/SE	Mean/SE	Mean/SE	(1)-(2)	(3)-(2)	(4)-(1)
log Food per capita	8.706 [0.038]	8.649 [0.041]	8.803 [0.020]	8.889 [0.016]	0.057	0.154***	0.183***
log Nonfood per capita	6.566 [0.066]	6.703 [0.073]	6.929 [0.032]	7.189 [0.025]	-0.137	0.226***	0.623***
log Educ per capita	2.076 [0.103]	2.449 [0.133]	2.423 [0.068]	2.654 [0.051]	-0.373**	-0.025	0.579***
log Cons per capita	8.884 [0.038]	8.843 [0.037]	9.008 [0.019]	9.135 [0.015]	0.041	0.165***	0.251***
=1 Obtained credit	0.181 [0.019]	0.264 [0.028]	0.272 [0.014]	0.222 [0.009]	-0.083**	0.007	0.040*
=1 Received gifts from others	0.196 [0.020]	0.157 [0.023]	0.141 [0.011]	0.195 [0.009]	0.039	-0.016	-0.002
=1 Received food/cash for work	0.076 [0.013]	0.050 [0.014]	0.023 [0.005]	0.031 [0.004]	0.026	-0.027**	-0.045***
=1 Sold asset	0.038 [0.010]	0.033 [0.012]	0.018 [0.004]	0.032 [0.004]	0.005	-0.015	-0.005
Observation	397	242	1005	2043			

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 8: Differences in consumption and coping mechanisms by certification **(2015)**

	(1)	(2)	(3)	(4)	t-test	t-test	t-test
	Natural shock with No Cert	Natural shock with Cert	No Natural shock with Cert	No Natural shock with No Cert	Difference	Difference	Difference
Variable	Mean/SE	Mean/SE	Mean/SE	Mean/SE	(1)-(2)	(3)-(2)	(4)-(1)
log Food per capita	8.890 [0.054]	8.964 [0.019]	8.939 [0.014]	8.803 [0.038]	-0.074	-0.025	-0.087
log Nonfood per capita	7.241 [0.0587	7.186 [0.032]	7.422 [0.023]	7.227 [0.059]	0.055	0.236***	-0.014
log Educ per capita	2.728 [0.201]	3.064 [0.071]	3.290 [0.051]	3.053 [0.140]	-0.336*	0.225**	0.325
log Cons per capita	9.145 [0.049]	9.179 [0.018]	9.220 [0.014]	9.069 [0.036]	-0.034	0.041*	-0.076
=1 Obtained credit	0.234 [0.035]	0.262 [0.014]	0.221 [0.009]	0.248 [0.026]	-0.028	-0.042***	0.014
=1 Received gifts from others	0.228 [0.035]	0.209 [0.013]	0.147 [0.007]	0.092 [0.017]	0.019	-0.062***	-0.135***
=1 Received food/cash for work	0.041 [0.017]	0.093 [0.009]	0.018 [0.003]	0.000 [0.000]	-0.052**	-0.075***	-0.041***
=1 Sold asset	0.007 [0.007	0.017 [0.007]	0.026 [0.003]	0.004 [0.004]	-0.010	0.009	-0.003
Observation	145	1010	2262	282			

The figures in brackets represent the standard deviations. The values displayed for the t-tests are the differences in the means across the groups. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 9: Correlates between land certification and natural shocks

	Natural Shock	Certification
	(1)	(2)
Certification	.029	
	(.019)	
Natural Shock		.025
		(.016)
Age of household head	.001	-.002**
	(.001)	(.001)
Literacy of household head	-.027	-.028
	(.022)	(.02)
Household size	.006	.009*
	(.005)	(.005)
Land size in ha	-.025	-.091
	(.031)	(.16)
Household FE	Yes	Yes
Year x Woreda	Yes	Yes
Number of Observations	7374	7374
R-squared	.619	.752

Column 1 show the estimation results of equation 4. Standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 10: Role of land certification for each type of natural shocks on consumption

	1	2	3	4	5	6	7	8
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
	Drought				Flood			
Certification x Shock	.105**	.104	.051	.072	*-.22**	.086	-.477	-.186
	(.051)	(.073)	(.138)	(.047)	(.129)	(.242)	(.386)	(.12)
Certification	.033	.03	-.262***	.025	.052*	.042	-.246***	.038
	(.028)	(.04)	(.087)	(.025)	(.027)	(.04)	(.084)	(.025)
Natural Shock	-.115**	-.192***	-.071	-.095**	.126	-.202	.328	.1
	(.047)	(.066)	(.124)	(.044)	(.105)	(.172)	(.257)	(.098)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7374	7374	7374	7374	7374	7374	7374	7374
R-squared	.659	.731	.73	.7	.658	.731	.73	.699
	Landslides							
Certification x Shock	-.141	-.24	.6	-.134				
	(.254)	(.384)	(.75)	(.246)				
Certification	.048*	.043	-.258***	.035				
	(.027)	(.04)	(.083)	(.025)				
Natural Shock	-.077	.284	-.562	-.041				
	(.208)	(.231)	(.641)	(.194)				
Household FE	Yes	Yes	Yes	Yes				
Year x Woreda	Yes	Yes	Yes	Yes				
Other controls	Yes	Yes	Yes	Yes				
Observations	7374	7374	7374	7374				
R-squared	.658	.731	.73	.699				

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 11: Coping mechanisms against combined and each type of natural shocks

	1	2	3	4	5	6	7	8
	=1 obtained credit from others	=1 received gifts from others	=1received food/cash for work	=1selling asset	=1 obtained credit from others	=1 received gifts from others	=1received food/cash for work	=1selling asset
	Drought				Flood			
Certification x Shock	.103***	.065**	-.027	-.011	.113	.015	*-.083**	.01
	(.036)	(.03)	(.019)	(.013)	(.091)	(.076)	(.046)	(.042)
Certification	.003	-.003	-.007	.003	.016	.006	-.008	.001
	(.02)	(.017)	(.008)	(.007)	(.019)	(.016)	(.009)	(.007)
Natural Shock	-.022	-.055**	.074***	.012	.032	-.014	.093**	.003
	(.033)	(.028)	(.017)	(.011)	(.072)	(.056)	(.04)	(.034)
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# of Obns	7374	7374	7308	7374	7374	7374	7308	7374
R-squared	.569	.597	.543	.532	.567	.597	.538	.531
	Landslides							
Certification x Shock	.141	*-.356***	-.054	***.195****				
	(.235)	(.124)	(.053)	(.109)				
Certification	.019	.008	-.009	.001				
	(.019)	(.016)	(.009)	(.007)				
Natural Shock	-.113	.114	.003	-.094				
	(.21)	(.082)	(.01)	(.089)				
Household FE	Yes	Yes	Yes	Yes				
Year x Woreda	Yes	Yes	Yes	Yes				
Other controls	Yes	Yes	Yes	Yes				
# of Obns	7374	7374	7308	7374				
R-squared	.566	.597	.537	.532				

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 12: Role of land certification on consumption expenditure with alternative threshold.[15]

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
Certification x Shock	.319***	.096	.177	.237***
	(.083)	(.109)	(.2)	(.079)
Certification	.003	.005	-.246***	-.003
	(.028)	(.04)	(.095)	(.025)
Natural Shock	-.311***	-.217**	-.33*	-.253***
	(.08)	(.106)	(.19)	(.077)
Cert x Shock + Shock	-0.007	-0.098	-0.102	-0.020
Confidence interval	[.1572 .4808]	[-.117 .308]	[-.214 .567]	[.081 .392718]
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0004***	***0.0051***	***0.1066***	***0.0041***
# Obsn.	7374	7374	7374	7374
R-squared	.66	.731	.752	.701

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 13: Effect of land certification on the mechanisms

	1	2	3	4	5
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
Certification x Shock	.212***	.114***	-.006	.01	.006
	(.047)	(.043)	(.02)	(.016)	(.017)
Certification	.025	-.006	-.006	.007	-.005
	(.02)	(.017)	(.009)	(.008)	(.01)
Natural Shock	-.113**	-.131***	.063***	-.001	-.021
	(.046)	(.043)	(.019)	(.015)	(.016)
Cert x Shock + Shock	0.084	0.5	0.048	0.004	-0.006
Confidence interval	[.1185368 .3047441]	[.0290119 . 1990019]	[-.0454517 .0343422]	[-.0221533 .0413031]	[-.0274516 .0402074]
Household FE	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0000***	***0.0084***	***0.0000***	***0.5018***	***0.1190***
Number of Observations	7374	7374	7308	7374	5910
R-squared	.571	.598	.541	.532	.567

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and

[15] More than 35% of households in the village received land certification for Table 3.A.12 and Table 3.A.13

10% critical level.

Table 3.A. 14: Role of land certification on consumption expenditure with alternative threshold.[16]

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
Certification x Shock	.344***	.228***	.298*	.321***
	(.051)	(.072)	(.167)	(.046)
Certification	.05*	.029	-.132	.057**
	(.029)	(.042)	(.095)	(.026)
Natural Shock	-.257***	-.28***	-.355**	-.254***
	(.047)	(.063)	(.14)	(.043)
Certification x Shock + Shock	0.089	-0.099	-0.026	0.016
Confidence interval	[.2445 .4425]	[.0855 .3697]	[-.0290 .6258]	[.231 .4101]
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0000***	***0.0001***	***0.0401***	***0.0000***
Number of Observations	7374	7374	7374	7374
R-squared	.663	.732	.752	.705

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 15: Effect of land certification on the mechanisms

	1	2	3	4	5
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
Certification x Shock	.04	.081**	.016	-.012	.028**
	(.036)	(.036)	(.023)	(.015)	(.014)
Certification	.004	-.018	.017**	-.005	-.028***
	(.02)	(.017)	(.008)	(.007)	(.01)
Natural Shock	.04	-.086***	.049***	.014	-.032***
	(.031)	(.031)	(.019)	(.014)	(.011)
Certification x Shock + Shock	0.077	0.019	-0.06	0.001	0.003
Confidence interval	[-.030862 .1115122]	[.0097921 .1516772]	[-.0292745 .0605159]	[-.042043 .0177167]	[.0004234 .0546419]
Household FE	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0069***	***0.0233***	***0.0000***	***0.5617***	***0.0091***
Number of Observations	7374	7374	7308	7374	5910
R-squared	.568	.598	.542	.532	.568

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%,

[16] More than 45% of households in the village received land certification for Table 3.A 14 and Table 3.A.15

and 10% critical level.

Table 3.A. 16: Role of land certification on mitigating against shock (HH self-reported shocks)[17]

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
Certification x Shock	.105**	.104	.068	.072
	(.051)	(.073)	(.157)	(.047)
Certification	.033	.03	-.24**	.025
	(.028)	(.04)	(.096)	(.025)
Natural Shock	-.115**	-.192***	-.161	-.095**
	(.047)	(.066)	(.141)	(.044)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0510***	***0.0033***	***0.8335***	***0.0734***
# Obsns	7374	7374	7374	7374
R-squared	.659	.731	.752	.7

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 17: Coping mechanisms against natural shocks (HH self-reported shocks)

	1	2	3	4	5
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
Certification x Shock	.103***	.065**	-.027	-.011	.009
	(.036)	(.03)	(.019)	(.013)	(.014)
Certification	.003	-.003	-.007	.003	-.007
	(.02)	(.017)	(.008)	(.007)	(.01)
Natural Shock	-.022	-.055**	.074***	.012	-.015
	(.033)	(.028)	(.017)	(.011)	(.012)
Household FE	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0001***	***0.0931***	***0.0000***	***0.5355***	***0.3688***
Number of observations	7374	7374	7308	7374	5910
R-squared	.569	.597	.543	.532	.567

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

[17] Shock is measured as a dummy variable indicating if the household is exposed to severe weather shock as shown in Table 3.A.16 and Table 3.A.17.

Table 3.A. 18: Role of land certification on mitigating against shock (**HH level certification**)

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
Certification x Shock	.103	.125	-.33	.109*
	(.063)	(.104)	(.208)	(.058)
Certification	.051	.047	.131	.04
	(.037)	(.052)	(.13)	(.033)
Natural Shock	-.15***	-.227***	-.11	-.146***
	(.048)	(.077)	(.153)	(.045)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0062***	***0.0036***	***0.0143***	***0.0044***
Number of observations	5024	5024	5024	5024
R-squared	.658	.697	.744	.679

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 19: Coping mechanisms against natural shocks (**HH level certification**)

	1	2	3	4	5
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
Certification x Shock	-.024	.021	-.018	-.008	-.008
	(.047)	(.039)	(.028)	(.016)	(.015)
Certification	.04	.017	-.019	.014	-.008
	(.028)	(.022)	(.013)	(.01)	(.012)
Natural Shock	.103***	-.048*	.071***	.005	-.022**
	(.034)	(.029)	(.018)	(.011)	(.011)
Household FE	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0013***	***0.1974***	***0.0000***	***0.8659***	***0.0923***
Number of observations	5024	5024	4966	5024	5024
R-squared	.584	.59	.569	.554	.581

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 20: Role of land certification on mitigating against shock (Enumeration Area shocks)

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
IDDIR x Shock	-.091*	.12	-.098	-.06
	(.051)	(.073)	(.166)	(.047)
IDDIR	.118***	.281***	.113	.132***
	(.029)	(.043)	(.097)	(.026)
Natural Shock	.002	-.205***	-.115	-.026
	(.038)	(.06)	(.125)	(.035)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0834***	***0.0013***	***0.2016***	***0.0569***
Number of Observations	7398	7398	7398	7398
R-squared	.659	.736	.752	.701

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 21: Coping mechanisms against natural shocks (Enumeration Area shocks)

	1	2	3	4	5
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
IDDIR x Shock	.025	.068*	-.034*	.008	0
	(.037)	(.035)	(.019)	(.011)	(.015)
IDDIR	.01	-.005	.044***	.016**	-.006
	(.02)	(.017)	(.009)	(.008)	(.01)
Natural Shock	.055**	-.065**	.073***	.002	-.015*
	(.028)	(.026)	(.017)	(.008)	(.009)
Household FE	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0074***	***0.0455***	***0.0000***	***0.1079***	***0.1079***
Number of observations	7398	7398	7332	7398	5910
R-squared	.567	.595	.544	.532	.567

Other controls include the literacy level of household head, household head age, number of household members, and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 22: Role of land certification on mitigating against shock (Enumeration Area shocks)[18]

	1	2	3	4
	log (per capita food consumption expenditure)	log (per capita non-food consumption expenditure)	log (per capita education expenditure)	log (per capita total consumption expenditure)
Certification x Shock	.256***	.157*	.161	.193***
	(.07)	(.092)	(.171)	(.067)
Certification	.016	.009	-.261***	.008
	(.028)	(.04)	(.095)	(.025)
Natural Shock	-.251***	-.276***	-.313*	-.213***
	(.068)	(.089)	(.162)	(.064)
Household FE	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0008***	***0.0007***	***0.0898***	***0.0040***
# Obsens	7374	7374	7374	7374
R-squared	.661	.736	.753	.702

Other controls include the literacy level of household head, household head age, number of household members, **Social capital** and land size. standard errors are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% critical level.

Table 3.A. 23: Coping mechanisms against natural shocks (Enumeration Area shocks)

	1	2	3	4	5
	=1 obtained credit from others	=1 received gifts from others	=1 received food/cash for work	=1 sold assets	=1 rented out in fixed rental
Certification x Shock	.141***	.13***	-.014	-.014	.007
	(.043)	(.04)	(.024)	(.016)	(.016)
Certification	.008	-.009	-.007	.003	-.007
	(.019)	(.017)	(.008)	(.007)	(.01)
Natural Shock	-.049	-.141***	.068***	.018	-.021
	(.042)	(.039)	(.022)	(.014)	(.015)
Household FE	Yes	Yes	Yes	Yes	Yes
Year x Woreda	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes
Wald test (p-value)	***0.0000***	***0.0016***	***0.0000***	***0.4369***	***0.1160***
Number of observations	7374	7374	7308	7374	5910
R-squared	.569	.599	.544	.532	.567

Other controls include the literacy level of household head, household head age, number of household members, **Social capital** and land size. standard errors are reported in parentheses. ***,

[18] More than 40% of households in the village received land certification for Table 3.A 22 and Table 3.A.23

**, and * indicate significance at the 1%, 5%, and 10% critical level.

Chapter Four

Conclusion

4.1Summary

This dissertation covered two broad research topics on the impact of land certification program on migration and the role of land certification in mitigating the negative impact of weather shocks on consumption expenditure. In this section, we summarize the main findings of chapters 2 and 3 and discuss the policy implication and further extension of this work.

The first study, in chapter 2, examined the impact of providing a rural land certification program in Ethiopia on the activation of labor market participation. In addition to that, further analysis whether the land certification program activated the land market through fixed land rental and sharecropped contracts was undertaken. We used the DID approach and examined the effects of the land certification program on labor market through seasonal and nonseasonal migration using the 2004 and 2014 waves. We used a village-level exogenous measure of land certification based on the proportion of households who had received the land certification program as a treatment group. The result suggests that on average there is not precisely estimated zero impact that the land certification program increased seasonal migration, nonseasonal migration, and rural wage earners. The land certification program has shown no differential impact on seasonal migration and rural wage earners cross the initial expectation of land redistribution before the program. But we found

a negative impact of the program on non-seasonal migration for households who expected of land redistribution before the program. However, the program has shown no statistically significance evidence that activated the labor market participation for households who had not expected land redistribution before the program. Moreover, the land certification program enhanced agricultural intensification by increasing chemical fertilizer use and increased agricultural productivity and agricultural income, that enabled to increase household consumption.

The second paper, reported in chapter 3, examined the effect of land certification on smoothening consumption and its role in mitigating the negative effect of weather shocks on household welfare. The result shows that households were negatively affected by weather shocks. However, households with land certification were able to reduce the negative impact of weather shock on consumption expenditure by enabling them to access credit. We also examined a differential impact of the program across large vs smaller land sizes, and young vs old household heads. Households with land certification program reduced the negative impact of weather shocks on non-food consumption expenditure for households that owned large land sizes. While the program increased food and total consumption expenditure for households that owned small land size. Moreover, households with land certification increased non-food consumption expenditure against weather shocks for older household heads. While the program increased food and total consumption expenditure for younger household heads. This is likely mainly due to increasing access to formal and informal credit.

4.2 Policy implication

In chapter 2 we argue that the Ethiopian land certification program was not able to increase migration. However, households who expected of land redistribution before the program decreased nonseasonal migration. Therefore, this study suggests the importance of initial perception of future land redistribution to activate labor market. Hence, further study is required to deepen the main determinants of factors of reducing the perception of future land redistribution and why the migration rate is not increased for households with land certification. Another result implies that there is no statistically significant evidence that the land certification program increased land market participation. Overall, the land certification enables households to focus more on their land and enhanced agricultural intensification by increasing chemical fertilizer use to increase agricultural productivity. Formalization of land rights through providing land certification can be a policy tool to focus more in their land and enhance agricultural intensification. Hence, policymakers should derive programs and policies that encourage labor market participation as a means of income diversification. To activate labor and land market, complementary efforts that could change farm households' perceptions on land tenure security is needed. Improving the quality of land registration and certification process by engaging the community to actively participate in the rural development plan mainly with practices of land redistribution and land certification process.

In chapter 3 we argue that land certification protected the negative effect of weather shock on consumption expenditure for all sample households in our dataset. However, the program seems effective in securing food consumption for small land size owners, and young household heads by enabling them to access credit. The land certification program became a

pro-poor agricultural program; thus, it changed the livelihood of the small landholder and young household heads who likely lacks assets and wealth to rely on. Hence, providing formal land property rights in the form of land certification becomes an effective way to reduce the negative impact of weather shock on consumption expenditure. Therefore, policymakers need to upgrade in the value of land certification that enables them to formally use to access credit.

4.3 Limitations and future research

The paper in chapter 2 and chapter 3 has a few limitations: first, the land certification treatment definition is used at a village level. However, due to a lack of enough sample of controlled villages I used a proportion of households with land certification as a treatment group. It would be great to have pure control villages to be taken as a counterfactual to improve the work. Second, as a parallel trend assumption, I used 2004 vs 2006 survey data using the 2014 treatment as a fulfillment of the main assumption. Because the program was started a long year back and it is difficult to trace back a dataset that purely supports the assumption of common trending before the program was started. Third, Food consumption is measured by the last week's consumption. The timing of the food consumed can be before shock occurred. Hence, this is a limitation of this paper. Fourth, this study lack objective rainfall data to measure weather shock. The weather shock variable that I employed for this study is if 70% and more of the sample households in the enumeration area were exposed to weather shock.

Overall, we found a promising result that rural households' income and consumption

expenditure can be improved by making a reform in agricultural programs. It is also interesting to see agricultural land reform can also play an insurance role to mitigate the effect of severe weather shocks on the economy.

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