Three Essays on Development and Wellbeing

By

Mya Yae Mon

Dissertation

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

IN DEVELOPMENT POLICY

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Committee in charge:

Professor Shun Wang, Supervisor	
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ABSTRACT

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This dissertation studies the effect of government program and policy on development and wellbeing such as malaria prevention program in Myanmar and joint land certification policy in Ethiopia. In addition, this study discovers the situation of government support of agricultural recovery after the Cyclone Nargis in Myanmar.

Chapter one examines the impacts of Malaria Prevention Program – distribution of insecticide-treated bed nets (ITNs) on human wellbeing such as health, labor force participation, and cognitive ability by using "Integrated Household Living Conditions Assessment (IHLCA) Survey", 2010 Myanmar data. To identify the program impacts, this study mainly uses a Difference-in-Differences approach by exploiting variations in malaria intensity rate and the use of insecticide-treated bed net. Findings show that the distribution of insecticide-treated bed nets program improve human wellbeing such as increase in labor force participation and cognitive ability, and reduce the probability of getting sick.

Chapter two examines the affect of joint land certification policy on husband and wife's subjective wellbeing and household expenditure. To identify the policy impact, the study mainly used a Difference-in-Differences approach by using "Ethiopian Rural Household

Survey (ERHS)" data. We compare the outcome variables between individuals who have and who do not have jointly land certificate in Tigray region and SNNP (Southern Nations, Nationalities, and People's) region by exploiting time variation of policy intervention. Findings indicate that the expanding the rights to land tenure for women not only increases wife's subjective wellbeing but also husband's subjective wellbeing and household consumption expenditure.

Chapter three investigates the situation of rebuilding agriculture activities and agricultural assistance after the Cyclone Nargis between households situated in the severely affected and less affected townships by using "Integrated Household Living Conditions Assessment (IHLCA) Survey" Myanmar, 2004 and 2009 round. The study mainly used a Difference-in-Differences approach by exploiting time variation between households situated in severely affected area and less affected area. The study found that after the Cyclone Nargis, households situated in severely affected area have decreasing number of own agriculture equipment, own farm large animals, and own motor boats, less likely to use land for crop production, and less likely to engage in livestock breeding activities. The study also found that after the Cyclone Nargis, households situated in severely affected area need more financial support, government bank support more financial to this area than private bank, and both public and private sectors still weak in terms of supporting agricultural service.

Keywords: Malaria; Insecticide-treated bed net; Cognitive ability; Joint land certification; Subjective wellbeing; Household expenditure; Natural disaster; Agriculture activities; Agricultural assistance; Myanmar; Ethiopia

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CHAPTER ONE

IMPACT OF MALARIA PREVENTION PROGRAM ON HUMAN WELLBEING: EVIDENCE FROM MYANMAR

1.1 Introduction

For many years, malaria has afflicted humans. Malaria is a disease caused by mosquitoes that affects more than 450 million people worldwide each year (Hay et al., 2009). Global malaria response has been considered one of the great successes for public health in the world (WHO, 2017). Malaria is endemic in more than one hundred countries today, affecting forty percent of the world's population. International organization stepped up their efforts to combat the epidemic in the face of this immense global burden. Therefore, the United Nations has been made combating malaria as one of its Millennium Development Goals (Cutler, Fung, Kremer, & Singhal, 2011). In Myanmar, the humanitarian aspect of malaria is immense because a large proportion of the population is affected by malaria. The disease is prevalent in 284 out of 325 townships, especially in rural areas and some pen urban sites (MoHS, 2004).

Because of its deleterious association with human wellbeing and economic growth, malaria has long been an important topic in economic literature. Malaria exposure can have several effects on human capital formation and employment. Barreca (2010) and Lucas (2010) observed significant negative consequences of exposure to malaria during childhood on educational outcomes by using United States, Sri Lanka and Paraguay data. Exposure of malaria during childhood also deteriorates neurocognitive performance such as attention, remembering, seeing, communication, and school performance more difficult (Kihara, Carter, & Newton, 2006). There are several ways in which malaria is expected to affect cognitive

growth. In addition to nutrient diversion, malaria can also effect adversely on cognitive endowment formation due to deprivation of anemia-related oxygen. Tapajós et al (2019) also found that children who have at least one malaria episode displayed poor cognitive development. Malarial infection in pregnant women may also result in weaker growth of the fetus and adverse development of neurobehavioral (Holding & Snow, 2001). Reducing malaria is contributing to improvements in infant mortality and early childhood health at a microeconomic level (Kuecken, Thuilliez, & Valfort, 2016).

Many argue that improvement in health can also contribute to greater growth and development in the economy. Gallup & Sachs (2001) show that there is 1.3 % less of growth rate per year in countries with extreme malaria and if 10 % decrease in malaria was lead to 0.3 % higher growth rate. Bloom & Canning (1999) clarified that healthy people are more efficient in assimilating knowledge and attaining higher levels of productivity. The best way of malaria burden elimination is to prevent bites of mosquitoes. Using the insecticide-treated bed net (sleeping under it) and spraying the inside walls of a dwelling with an insecticide are the most widely used approaches to prevent mosquito bites (WHO, 2017). Insecticide-treated bed net is a bed net treated with insecticide which is much more protective than regular bed net (untreated net). It has been shown that, in Sub-Saharan Africa, insecticide-treated bed net use has reduced malaria mortality rates by 55 percent in children under the age of 5 (WHO, 2017), staying overnight in farmhouses was not linked to the risk of malaria infection when insecticide-treated bed nets are widely used in farmhouses (Nonaka et al., 2010), and the long-term insecticide-treated bed net use substantially decreases the transmission of malaria and the mortality associated with it (Press, 2004). Therefore those two main vector-control strategies such as using the insecticide-treated bed net (sleeping under it) and spraying the inside walls of a dwelling with an insecticide are considered to contribute substantially to reducing the burden of malaria (WHO, 2017).

On the other hand, there is one study found that increased malaria in children in spite of using insecticide-treated bed nets and timely treatment for malaria. Jagannathan et al (2012) examined the impact of using insecticide-treated bed nets and timely treatment for malaria in 100 children (age of six weeks to 10 months) in the high rate area of malaria transmission intensity in Tororo, Uganda. They found that despite provision of insecticide-treated bed nets and timely treatment with anti-malarial therapy, malaria incidence is very high and seems to have risen and they suggested that further malaria control interventions are likely required in high-transmission environments.

Therefore we would like to examine the effect of malaria prevention program in Myanmar. In this paper, we examine the impacts of a Malaria Prevention Program – distribution of Insecticide-Treated Bed Nets (ITNs) on human wellbeing such as health, labor force participation, and cognitive ability. We use "Integrated Household Living Conditions Assessment (IHLCA) Survey", 2010 Myanmar. We also use malaria risk area classification data from the Ministry of Health and Sports and exploit variations in malaria intensity and insecticide-treated bed net use by using Difference-in-Differences approach. We compare the outcome variables - health, labor force participation, and cognitive ability between individual who sleep under the insecticide-treated bed net and who do not sleep under it by exploiting the variations in malaria intensity rate. The Difference-in-Differences estimate shows improve in labor force participation and cognitive ability, and reduce in the probability of getting sick for the people living in the malarious area and using insecticide-treated bed net.

Our findings are closely related to recent research papers examining the effect of malaria eradication campaigns. Venkataramani (2012) explores the impact of malaria exposure in childhood on cognitive ability by using national efforts of malaria eradication program in Mexico. The study found that exposure of malaria eradication program during the birth year was correlated with increase in test scores of matrices. Their findings suggest that improved

child health can explain secular increases the test score of cognitive ability, which can be related to early life health and adult earnings. Bleakley (2010) also studied about the malaria eradication programs in the United States, Brazil, Colombia, and Mexico to determine how much malaria exposure in childhood depresses labor productivity. Bleakley found that malaria exposure in childhood decreases labor productivity and results in lower income of adult.

The paper continues as follows: Section "1.2" provides background of malaria, malaria risk micro stratification, and malaria prevention program. Data and summary statistics are described in Section "1.3". The methodological approach is presented in Section "1.4". Our main findings are summarized in Section "1.5". The robustness test is given in Section "1.6", falsification test in Section "1.7" and Section "1.8" concludes.

1.2 Background of the study

Myanmar is the largest country and officially accounts for a large majority of outbreaks of malaria and death in Southeast Asia's mainland. The country is divided administratively into seven states, seven regions, one union territory, five self-governing zones, and one self-governing division. Myanmar has three seasons of a tropical climate such as the rainy season which is between the middle of May and the middle of October, the winter season which is from middle of October to middle of February, and the summer season which is between the middle of February and the middle of May.

Malaria is remaining a significant cause of diseases and deaths in Myanmar. In Myanmar, distribution of malaria is very heterogeneous: forests are main environmental driving factors for disease outbreaks and global and internal migrations are risk factors as well. Malaria is endangering life disease transmitted by female anopheles mosquitoes (Yelwa & Diyoke,

2014). There are six vectors (primary vectors such as Anopheles minimus & Anopheles dirus, local vectors such as Anopheles annularis & Anopheles sundaicus, and secondary vectors such as Anopheles culicifacies & Anopheles philippinensis) of malaria have been found in Myanmar (MoHS, 2015). Among them, more than one or two vectors might be found within the ecological area of township. For example, malaria transmission in the Tanintharyi region is caused by combined infectious bites of Anopheles dirus, Anopheles minimus, and Anopheles sundaicus. Depending on climate conditions, the proportion of infectious bites among these malaria vectors may vary from township to township.

Figure 1-1: Administrative States/Regions of Myanmar

Source: Myanmar Information Management Unit

1.2.1 Malaria Risk Micro Stratification

The malaria disease burden is distributed unevenly both geographically and socio-demographically. Even within a high risk township, the risk of malaria significantly varies depending on various environmental and social factors. For example, in some townships, a large number of malaria cases occur only in forest fringes or limited areas of vector breeding sites while the transmission may be minimal in urban areas of some townships. In some settings, serious mortality can be observed only among migrant workers but not among the general population.

To know the malaria disease burden exactly, Ministry of Health and Sports was conducted micro stratification test in 180 townships. Each township is classified as either malarious, or non-malarious. Malarious area is characterized by facts such as the number of indigenous cases of malaria, the presence of major vectors, the topography and attitude which is favorable for malaria vectors, and the number of outbreaks. Then the malarious area in a township is divided into two areas such as high risk area and low risk area. High risk area is defined based on the facts: located in the forest, presence of main vectors e.g. Anopheles minimus and/or Anopheles dirus, and remote village e.g. at least three hours of travel time to the nearest health facilities.

1.2.2 Malaria Prevention Program

Myanmar has made substantial progress in recent years in reducing morbidity and mortality of malaria. However, the disease is remaining a priority issue for the country's public health. Reported deaths from malaria peaked in 1991 (> 5,000) and then steadily declined; 3,744 deaths in 1995, 1,261 in 2007 and 788 in 2010 (MoHS, 2019). The deaths reported relate to malaria patients seeking public health care, estimated at 25-40 percent of the total (MoHS,

2019). On the other hand, we know that the real death toll from malaria is much higher than the overall recorded deaths in the organized system of Myanmar's health information. Although the underreporting of malaria mortality in Myanmar, those registered constitute thirty three percent of all of the deaths reported related with malaria in the region of Southeast-Asia in the year 2010. In 2010, among the six countries of the Greater Mekong Sub-region (GMS), Myanmar recorded the highest death rate for malaria (seventy five percent of total deaths from malaria) (MoHS, 2019). Malaria also has devastating economic and social effects as it perpetuated poverty.

The Ministry of Health and Sports (MoHS) in Myanmar is the main ministry responsible for raising people's health status and accomplishing this by offering comprehensive health services. For malaria prevention and eradication, integrated vector control measures are needed in Myanmar based on the available entomological information. Because of the emergence of artemisinin-resistant malaria in Myanmar, it was proposed that the transmission of malaria be interrupted by using the insecticide-treated bed nets. Using the insecticide-treated bed nets is a main strategy for preventing malaria and complementing other appropriate approaches for vector control. In many areas of Myanmar, the mosquito net use culture is exist, but this is vary a lot with less ownership of mosquito net and low rate of using mosquito net among some of the most malaria-exposed population. Families can buy nets at the price of 3 to 5 USD for single net and 5 to 6 USD for family net. But this price is probably a barrier to the poorest families' net ownership. The government has therefore initiated a National Malaria Control Program (NMCP) to increase the effective use of Insecticide-Treated Bed Nets (ITNs) to prevent and control malaria in all targeted areas. By consulting with the township and village health committees, the identification and assessment of targeted distribution groups of insecticide-treated bed nets was done through micro stratification of endemic areas of malaria. Since 2003, the distribution of free insecticide-

treated bed nets has started in different townships in malarious areas every year. Insecticide-treated bed nets distribution policy is one insecticide-treated bed net for two people. The programme was initiated by the Disease Control Unit, under the Department of Public Health of the Ministry of Health and Sports. The goal is to ensure that insecticide-treated bed nets can cover 80 percent of populations in high-risk areas by 2015.

On the other hand, while the ownership of bed net is high, there are some concerns about whether or not these bed nets are being used properly and consistently for achieving effective prevention of malaria. Malaria surveillance workers have found that when people go for work to the forest, existing mosquito nets are not carried with them. Because workers are travelling and leaving their family behind and therefore they would like to leave the mosquito nets for their family members. There is an issue of the amount of supplies to be carried for work. Sometimes the whole families temporarily migrate from lowlands that have been flooded during the rainy season to the mountain site or forest area where they are at high risk of malaria and they bring the mosquito net with them to be treated. Therefore, the objective of this study is to examine the impact of Insecticide-Treated Bed Nets (ITNs) distribution programme on the human wellbeing in the difference between the individuals who is using insecticide-treated bed net and who is not using insecticide-treated bed net in Myanmar.

1.3 Data and Summary Statistics

The data used in this study is individual level and comes from "Integrated Household Living Conditions Assessment (IHLCA) Survey", 2010 Myanmar. The IHLCA project provides the statistical data for determining living conditions in the country. The survey included a nationwide representative sample of 18,660 households. The survey collects details information on the areas of social concern such as household characteristics, housing,

education, health, consumption expenditures, household assets, labor and employment, business, and finance. Regarding the question of problem solving skill, the IHLCA administered to all respondents who are aged 15 years and above and who had never attended school or if highest standard passed is KG or 1st standard to control the potential endogeneity in cognitive ability due to the different levels of education. The test is used as an insightful predictor of the ability of a person. Malaria risk area is classified according to micro stratification test at the township level and data used in this research are from Ministry of Health and Sports (MoHS).

The summary statistics of the study is presented in Table (1-1). The observation used in this study is individual and there are 55,394 observations. The main dependent variables are based on human wellbeing such as dummy for getting sick in past 30 days, number of working days per week per person, and dummy for cognitive ability.

Table 1-1: Summary Statistics

Variable	Mean	Std.Dev	Min	Max	*N*
Dummy for Sick (Yes = 1)	0.076	0.265	0	1	55,394
Number of working days in a week	6.285	1.203	1	7	27,158
Dummy for Problem solving skill (All correct = 1)	0.089	0.285	0	1	4,132
Dummy for Malarious Area (Malarious intensity >= 50% = 1)	0.637	0.481	0	1	55,394
Malarious area	0.607	0.372	0	1	55,394
High risk area	0.306	0.225	0	1	55,394
Sleep under ITN	0.147	0.354	0	1	55,394
Sleep under regular bed net	0.880	0.324	0	1	55,394
Male	0.477	0.499	0	1	55,394
Years of schooling	5.007	2.713	0	13	55,394
Age of respondent	30.432	19.899	0	95	55,394
Rural area (Yes = 1)	0.752	0.432	0	1	55,394
Number of household members	6.208	2.475	1	18	55,394

1.4 Empirical Strategy

To estimate the impact of a Malaria Prevention Program – distribution of Insecticide-Treated Bed Nets (ITNs) on human wellbeing, we mainly use a Difference-in-Differences approach. We compare the outcome variables such as health, labor force participation, and cognitive ability between individual who sleep under the insecticide-treated bed net and who do not sleep under the insecticide-treated bed net by exploiting the variations in malaria intensity rate. The malaria intensity at township level is calculated by using the following equation (1.1):

$$Malaria\ Intensity_a = \frac{Number\ of\ HHs\ in\ Malarious\ Area}{Total\ HHs\ in\ Township} \quad (1.1)$$

Where, a township is classified two main categories such as malarious area and non-malarious area. Malarious area is characterized by facts such as the number of indigenous cases of malaria, the presence of major vectors, the topography and attitude which is favorable for malaria vectors, and the number of outbreaks.

To estimate the effects of Malaria Prevention Program – distribution of Insecticide-Treated Bed Nets (ITNs) on human wellbeing, we use the following equation (1.2):

$$y_{ij} = \beta_0 + \beta_1 Mala_{Town} + \beta_2\ Sleep_{ITN} + \beta_3 Mala_{Town} *\ Sleep_{ITN} + X'_{ij}\beta_4 + \delta_j + \varepsilon_{ij} \quad (1.2)$$

Where, "*i*" and "*j*" denote individual and region respectively. "y_{ij}" represents outcome variables such as dummy for getting sick in past 30 days, number of working days per week per person, and dummy for cognitive ability. "$Mala_{Town}$" is a dummy variable, which equals

one if a township has more than 50% of households live in malarious area, and zero takes otherwise. "$Sleep_{ITN}$" is a dummy variable, which equals one if an individual sleep under the insecticide-treated bed net, and zero defines otherwise. "X'_{ij}" represents individual characteristics including gender, years of schooling, age of respondent, live in rural or urban, and number of household members. Our coefficient of interest is β_3 and represents the different change in outcome variations in malaria intensity rate and the use of insecticide-treated bed net. In all regressions, we control for regional fixed effects, "δ_j". "ε_{ij}" is the error term.

The coefficient of "$Mala_{Town}$", β_1, is the expected difference in "y" between the malarious intensity rate before the intervention. The coefficient of "$Sleep_{ITN}$", β_2, is the expected mean change in outcome between individuals who sleep under the insecticide-treated bed net and who do not sleep under the insecticide-treated bed net. The coefficient of the interaction term "$Mala_{Town}$ x $Sleep_{ITN}$", β_3, describe the estimates from a Difference-in-Differences approach.

1.5 Main Results

Equation (1.2) examines the average effect of the Malaria Prevention Program – distribution of Insecticide-Treated Bed Nets (ITNs) on human wellbeing. Table (1-2) displays the results from estimating equation (1.2) that presents statistics of using the insecticide-treated bed net for the person who is living in the malarious area. Controlling for individual's characteristics such as gender, years of schooling, age of respondent, area, and number of household members, the study found that the distribution of insecticide-treated bed nets program improves human wellbeing.

The results shows positive association of using insecticide-treated bed net and labor force participation and cognitive ability, and negative association of using insecticide-treated bed net and the probability of getting sick. Columns (1) to (3) show the results of outcome variables by using dummy malarious area and Columns (4) to (5) show the results of outcome variables by using intensity of malarious area. Holding other covariates constant, the estimate column (1) shows the probability of getting sick reduced by 2.3 percent but not statistically significance, and in column (4) shows the probability of getting sick reduced statistically significance by 6.9 percentage point. Estimates in Column (2) shows that the individual who lives in the malarious area and sleep under the insecticide-treated bed net have 0.3 more working days compare to their counterparts, and in column (5) indicates that sleeping under insecticide-treated bed net in one percent higher malaria intensity is associated with 0.00325 $[(\beta/100)\ \%\Delta X]$ more working days relative to the individual who do not sleep under insecticide-treated bed net. This means that on average 5% $[(\beta/mean) * 100$ = (0.325/6.285) * 100] increase in labor supply. In column (3) and (6), the program is positively impact on the individuals' cognitive ability who are aged 15 years and above and who had never attended school or if highest standard passed is KG or 1st standard by 8.9 percent and 9.7 percentage point respectively. All results are statistically significance except Column (1).

Therefore, the study indicates that the program is positively effect on human wellbeing and this paper is contribution to the previous researches done by Venkataramani (2012) and Bleakley (2010). Venkataramani (2012) explores the impact of malaria exposure in childhood on cognitive ability by using national efforts of malaria eradication program in Mexico. The study found that exposure of malaria eradication program during the birth year was correlated with increase in test scores of matrices. Their findings suggest that improved child health can explain secular increases the test score of cognitive ability, which can be related to early life health and adult earnings. Bleakley (2010) also studied about the malaria eradication

programs in the United States, Brazil, Colombia, and Mexico to determine how much malaria exposure in childhood depresses labor productivity. Bleakley found that malaria exposure in childhood decreases labor productivity and results in lower income of adult.

Table 1-2: Effects on Human Wellbeing

	(1)	(2)	(3)	(4)	(5)	(6)
	Dummy			Intensity		
	Sick	Working Day	Problem Solving Skill	Sick	Working Day	Problem Solving Skill
Malarious area	-0.021	0.189**	-0.035	-0.013	0.049	-0.114
	(0.013)	(0.075)	(0.035)	(0.016)	(0.101)	(0.107)
Sleep under ITN	0.028**	-0.291***	-0.090***	0.063***	-0.262**	-0.084**
	(0.014)	(0.103)	(0.018)	(0.015)	(0.116)	(0.038)
Malarious area*Sleep under ITN	**-0.023**	**0.309*** **	**0.089** **	**-0.069*** **	**0.325** **	**0.097** **
	(0.017)	**(0.119)**	**(0.037)**	**(0.022)**	**(0.159)**	**(0.045)**
Male	-0.014***	-0.003	0.058***	-0.014***	-0.004	0.059***
	(0.001)	(0.008)	(0.012)	(0.001)	(0.008)	(0.011)
Years of schooling	-0.002***	0.004	-0.002	-0.002***	0.004	-0.003
	(0.000)	(0.003)	(0.002)	(0.000)	(0.003)	(0.002)
Age of respondent	0.001***	-0.002***	0.000	0.001***	-0.002***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rural area	-0.002	-0.212***	0.003	-0.002	-0.211***	0.005
	(0.003)	(0.023)	(0.013)	(0.003)	(0.023)	(0.012)
Number of household members	-0.005***	0.006	-0.002	-0.005***	0.007*	-0.002
	(0.000)	(0.004)	(0.003)	(0.000)	(0.004)	(0.003)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
N	44,924	21,968	1,124	44,924	21,968	1,124

Notes: Coefficients are reported with cluster-bootstrapped standard errors in parentheses. The unit of observations is a person. In Columns (1)-(3), "Malarious area" is an indicator, which equals one for the township in which more than 50% of households are in malarious area, zero takes otherwise. In Columns (4)-(6), "Malarious area" is an intensity rate calculated by using equation (1.1). The dependent variables in Column (1) & (4) are dummy variables which equals one for the person who got sick in past 30 days, and zero indicates otherwise, in Column (2) & (5) are a person's working days in a week, in Column (3) & (6) are a dummy variables which equals one for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could solve the basic mathematical problem, and zero indicate for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could not solve the basic mathematical problem. * p<0.10, ** p<0.05, *** p<0.01

1.6 Robustness Check

1.6.1 Robustness Check with Subsamples of Malarious Area

To check the robustness, we use information from the subsamples of malarious area only. To calculate the malaria intensity in this setting, we use the following equation (1.3):

$$Malaria\ Intensity_b = \frac{Number\ of\ HHs\ in\ High\ Risk\ Area}{Total\ HHs\ in\ Malarious\ Area\ in\ a\ Township} \quad (1.3)$$

Where, the malarious area in a township is also partitioned into two areas such as high risk area and low risk area. High risk area is defined based on the facts: located in the forest, presence of main vectors e.g. Anopheles minimus and/or Anopheles dirus, and remote village e.g. at least three hours of travel time to the nearest health facilities.

To conduct the robustness check, we use the following equation (1.4):

$$y_{ij} = \beta_0 + \beta_1 Mala_{Highrisk} + \beta_2\, Sleep_{ITN} + \beta_3 Mala_{Highrisk} * Sleep_{ITN} + X'_{ij}\beta_4 + \delta_j + \varepsilon_{ij} \quad (1.4)$$

Where, "*i*" and "*j*" denote individual and region respectively. "y_{ij}" represents outcome variables such as dummy for getting sick in past 30 days, number of working days per week per person, and dummy for cognitive ability. "$Mala_{Highrisk}$" is the intensity of high risk in malarious area. "$Sleep_{ITN}$" is a dummy variable, which equals one if an individual sleep under the insecticide-treated bed net, and zero defines otherwise. "X'_{ij}" represents individual characteristics such as gender, years of schooling, age of respondent, live in rural or urban, and number of household members. Our coefficient of interest is β_3 and represents the

different change in outcome variations in intensity of high risk in malarious area and the use of insecticide-treated bed net. In all regressions, we control for regional fixed effects, "δ_j". "ε_{ij}" is the error term.

The coefficient of "$Mala_{Highrisk}$", β_1, is the expected difference in "y" between the malaria intensity rate before the intervention. The coefficient of "$Sleep_{ITN}$", β_2, is the expected mean change in outcome between individuals who sleep under the insecticide-treated bed net and who do not sleep under the insecticide-treated bed net. The coefficient of the interaction term "$Mala_{Highrisk}$ x $Sleep_{ITN}$", β_3, describe the estimates from a Difference-in-Differences approach.

The estimates from equation (1.4) are reported in Table (1-3). Estimates in Column (1) shows that the probability of getting sick for individual who slept under insecticide-treated bed net in high risk area reduced by 3.8 percentage point relative to their counterparts, in Column (2) shows that sleeping under insecticide-treated bed net in one percent higher malaria intensity is associated with 0.00379 [$(\beta/100)$ %ΔX] more working days or on average 6% [$(\beta/mean) * 100$ = (0.379/6.285) * 100] increase in labor supply relative to the individual who do not sleep under insecticide-treated bed net and column (3) reveals that the higher cognitive ability who are aged 15 years and above and who had never attended school or if highest standard passed is KG or 1st standard by 28.8 percentage point. The findings are consistent with our main results and the results of robustness check support the robustness of the baseline estimation results.

Table 1-3: Robustness Check with Subsamples of Malarious Area

	(1) Sick	(2) Working Day	(3) Problem Solving Skill
High risk area	-0.022	-0.077	0.390**
	(0.019)	(0.281)	(0.156)
Sleep under ITN	0.018***	-0.120**	-0.167**
	(0.004)	(0.055)	(0.074)
High Risk Area*Sleep under ITN	**-0.038*** **	**0.379***	**0.288****
	(0.007)	**(0.196)**	**(0.123)**
Male	-0.014***	-0.003	0.105***
	(0.001)	(0.010)	(0.008)
Years of schooling	-0.002***	0.005	-0.002
	(0.000)	(0.004)	(0.003)
Age of respondent	0.001***	-0.003***	-0.000*
	(0.000)	(0.000)	(0.000)
Rural area	-0.001	-0.223***	-0.052***
	(0.003)	(0.025)	(0.013)
Number of household members	-0.005***	-0.077	0.000
	(0.000)	(0.281)	(0.001)
Region FE	Yes	Yes	Yes
N	42,230	20,545	1,159

Notes: Coefficients are reported with cluster-bootstrapped standard errors in parentheses. The unit of observations is a person. "High risk area" is an intensity rate calculated by using equation (1.3). The dependent variables in Column (1) is dummy variables which equals one for the person who got sick in past 30 days, and zero indicates otherwise, in Column (2) is a person's working days in a week, in Column (3) is a dummy variable which equals one for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could solve the basic mathematical problem, and zero indicate for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could not solve the basic mathematical problem. * p<0.10, ** p<0.05, *** p<0.01

1.6.2 Robustness Check with Probit and Logit Model

We conduct an extra robustness check for probability of getting sick and cognitive ability by using the Probit and Logit model. The estimates are reported in Table (1-4) and indicate that the program impact remains unchanged. The point estimates remain negative on probability of getting sick and positive on cognitive ability. The results are also statistically significance.

Table 1-4: Robustness Check with Probit & Logit Model (Marginal Effects)

	(1)	(2)	(3)	(4)
	Probit		Logit	
	Sick	Problem Solving Skill	Sick	Problem Solving Skill
Malarious area	-0.023***	-0.024	-0.023***	-0.019
	(0.006)	(0.024)	(0.005)	(0.020)
Sleep under ITN	0.026**	-0.364***	0.024**	-0.533***
	(0.010)	(0.052)	(0.009)	(0.091)
Malarious area*Sleep under ITN	**-0.019***	**0.359*****	**-0.019***	**0.527*****
	(0.011)	**(0.057)**	**(0.010)**	**(0.094)**
Male	-0.012***	0.041***	-0.012***	0.033***
	(0.002)	(0.014)	(0.002)	(0.011)
Years of schooling	-0.002***	-0.002	-0.002***	-0.001
	(0.000)	(0.002)	(0.000)	(0.002)
Age of respondent	0.001***	0.000	0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Rural area	-0.001	0.002	-0.002	0.005
	(0.003)	(0.017)	(0.003)	(0.015)
Number of household members	-0.005***	-0.002	-0.004***	-0.002
	(0.000)	(0.002)	(0.000)	(0.002)
Region FE	Yes	Yes	Yes	Yes
N	44,924	1,030	44,924	1,030

Notes: Coefficients are reported with robust standard errors in parentheses. The unit of observations is a person. Columns (1)-(2) describe the Probit estimates and columns (3)-(4) describe the Logit estimates. For all columns, "Malarious area" is an indicator, which equals one for the township in which more than 50% of households are in malarious area, and zero takes otherwise. "Malarious area" is an intensity rate calculated by using equation (1.1). The dependent variables in Column (1) & (3) are dummy variables which equals one for the person who got sick in past 30 days, and zero indicates otherwise, in Column (2) & (4) are a dummy variables which equals one for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could solve the basic mathematical problem, and zero indicate for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could not solve the basic mathematical problem. * p<0.10, ** p<0.05, *** p<0.01

1.7 Falsification Test

To check the falsification test, we used equation (1.2). But instant of using "$Sleep_{ITN}$" dummy variable (which equals one if an individual sleep under the insecticide-treated bed net and zero defines otherwise), we used "Dummy for using regular bed net" which equals one if an individual sleep under the regular bed net and zero defines not sleep under both insecticide-treated or regular bed net. Regular bed net is not treated with insecticide so that the effect on malarial prevention is less protective than insecticide-treated bed net. Table (1-5) shows the result from the falsification test. It is clear that if the individual living in the malarious area and just sleep under the regular bet net, the results of human wellbeing should be insignificant. The results in Table (1-5) show insignificant for all the outcome variables. These results support the validity of our main results in Table (1-2).

Table 1-5: Falsification Test

	(1) Sick	*(2)* Working Day	*(3)* Problem Solving Skill
Malarious area	-0.035*	0.707***	0.032
	(0.021)	(0.258)	(0.061)
Sleep under regular bed net	0.014**	0.619***	-0.003
	(0.007)	(0.237)	(0.027)
Malarious area*Sleep under regular bed net	**0.008**	**-0.384**	**0.033**
	(0.011)	**(0.233)**	**(0.042)**
Individual controls	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
N	38,228	1,255	3,548

Notes: Coefficients are reported with cluster-bootstrapped standard errors in parentheses. The unit of observations is a person. "Malarious area" is an indicator which equals one for the township in which more than 50% of households are in malarious area, and zero takes otherwise. "Malarious area" is an intensity rate calculated by using equation (1.1). The dependent variable in Column (1) is dummy variable which equals one for the person who got sick in past 30 days, and zero indicates otherwise, in Column (2) is a person's working days in a week, in Column (3) is a dummy variable which equals one for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could solve the basic mathematical problem, and zero indicate for a person who is aged 15 years and above and has never attended school or if highest standard passed is KG or 1st standard, could not solve the basic mathematical problem. "Individual controls" include gender, years of schooling, age of respondent, live in rural or urban, and number of household members. In all regressions, we control for regional fixed effects (There are fifteen administrative regions). * p<0.10, ** p<0.05, *** p<0.01

1.8 Discussion and Conclusion

Most of the studies in the existing literature focus on evidence from Africa and some other developed countries and explore the impact of national malaria control program on human wellbeing. There is no such kind of study that investigates the impact of national malaria control program on human wellbeing in Myanmar. This study fills this gap and examines the effects of a Malaria Prevention Program – distribution of Insecticide-Treated Bed Nets (ITNs) on human wellbeing in Myanmar. Based on the entomological information available in Myanmar, a key strategy for malaria prevention is the wide-scale use of insecticide-treated bed net. The government has therefore initiated a National Malaria Control Program (NMCP) to increase the effective use of Insecticide-Treated Bed Nets (ITNs) to prevent and control malaria in all targeted areas. This setting allows us to implement a Difference-in-Differences setting to study the impacts of the malaria prevention program.

According to the study results, the program provides better health condition on individuals, so that the person can more participate in the labor force. And on the other hand, by controlling the education, the program is positively impact on human cognitive ability. The results provide evidence of using insecticide-treated bed nets is effective against malaria. Based on our findings, using insecticide-treated bed net reduced the probability of getting sick by 6.9 percentage point, improved cognitive ability by 9.7 percentage point, and on average 5% increase in labor force participation compared with not using the insecticide-treated bed net.

Using the insecticide-treated bed net can reduce transmission of malaria, but its effectiveness would depend on transmission intensity: the more effective in the higher intensity (MoHS, 2015). Our findings contribute to that point and we found that in the high risk malarious area, the impact of using insecticide-treated bed net is more effective on human wellbeing than the

low risk malarious area. One of the study in Southeast Asia and the Pacific examined the impact of insecticide-treated bed nets programs and shown that a priori there are no malaria forms or vectors for which insecticide-treated bed nets would not contribute to malaria (MoHS, 2015). Where insecticide-treated bed nets seem to fail, this is due to factors of human behavior related to coverage, proper and consistent use of insecticide-treated bed nets. Such challenges are not insurmountable; they could be resolved by appropriate policy and successful execution of sound strategies.

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CHAPTER TWO

HOW DOES WOMEN'S AUTONOMY AFFECT ON HUSBAND AND WIFE'S SUBJECTIVE WELLBEING?

2.1 Introduction

To different people land has different meanings. Few people look at it as an area of a soil or a structure not covered by water; few people look at it as the area where grain is produced to feed themselves, their families and their livestock. For few people, the land to which they belong or reside is like their worthiness, which is why most people look at their country as their land and give it more respect than anything else. Land is a significant asset for agricultural societies in which land holdings decide growth, economic wellbeing and social status (Agarwal, 1994). Widely describe land rights could be considered as a collection of legal land claims (Meinzen-Dick, Brown, Feldstein, & Quisumbing, 1997). Land is more than just a normal thing and it is the economic foundation of the agricultural system (Allendorf, 2007). Consequently, land rights can be an effective tool for promoting the protection of the poor (Sen, 2001). Land rights distribution is a very critical political and economic issue, and has played a key role to the processes of transition in Europe and Asia (Van Landeghem, Swinnen, & Vranken, 2008). Van Landeghem et al (2008) examine household welfare effect of land distribution using Moldova's rural household survey data. The study found that the household land ownership has a positive impact on subjective wellbeing.

Theoretically, improvements in the protection of household land tenure are stated by four mechanisms to make households wealthier. First, increasing the protection of land tenure would increase the opportunities for investment in agricultural and soil inputs that increase land holding productivity (Besley, 1995). Secondly, better land tenure protection is needed to

reduce household time and money to defend their claims for land (Field, 2007). Thirdly, improved formal protection for tenure of land is supposed to improve access to finance, since lands could be able to use as collateral (Feder & Feeny, 1991). Fourthly, the system of registration of land can decrease the cost of selling the right of land to purchasers because it provides details about land registry information publicly (Deininger, Ali, & Alemu, 2011). If households are prosperous, they can receive their requirements, invest in human capital, such as a variety of capacities and qualities that enable members of household to give jobs (Schultz, 1961).

Beside the prosperous impact of household land tenure protection, improvements in protecting household members' land tenure will effect on how they use their very limited resources for investing in human capital and other competing needs. Previous literature studied the relation of protection of women's land ownership and the distribution of family resources. In India and Peru, women are more possible to take part in decision of family if they own land (Garikipati, 2009 and Wiig, 2013). In Nepal, in families in which women have land property, they are more possible to have final speech in family decision compared to families in which women do not have land property (Allendorf, 2007). In Nepal, the children that their mothers own land are low risk to be underweight than those their mothers do not own land (Allendorf, 2007). Other study also found that, in Ghana, the share of women owned family farms is related to the proportion of the household budget spending on food consumption (Doss, 2006). In Vietnam, according to a study, children from households owning land certificates are less likely to get ill, to be more possible be cover by medical insurance, as well as to be more able to register at school (Menon, Van Der Meulen Rodgers, & Nguyen, 2014). Furthermore, households with women owned family farmland use their family income more on food consumption than households with men owned or jointly owned family farmland (Menon et al., 2014).

Allendorf (2007) stated that securing the rights to women on land will improve the wellbeing of women, their families, and the environment. Women land rights are the way of fostering women's empowerment, prosperity and welfare growth (Allendorf, 2007). In developing countries, since women have a less chance of owing land than men, land rights reform program is especially strong for women (Muchomba, 2017). Cross-sectional evidence based study showed that the likelihood of marital violent acts among women holding land or homes property was substantially lower in terms of their own wellbeing (Allendorf, 2007) and positively related to health and nutrition consumption in the household (Menon et al., 2014), suggesting that health and wellbeing of a women and her family might rely on the security of her individual land tenure (Muchomba, 2017). Therefore, women's land rights are seen as a way of achieving human rights, improving economic and stable lives, empowering women and promoting welfare and security (Allendorf, 2007). Mishra & Sam (2016) also studied the effect of possession of land by using Nepal Demographic and Health Surveys and they found that the ownership of land has a strong effect on the empowerment of women. The study found that enhancing the equity of land policies has the potential effect to improve women's empowerment and welfare in areas where farming is women's primary economic source.

Muchomba (2017) also analyzed the effect of programs for joint land certification in Ethiopia on household consumption such as healthcare expenditure, food consumption, expenditure on education, and expenditure on clothing by using household panel data. The study found that jointly land certification was linked with increasing in household consumption and decreasing in spending on education compare with household which have land certificate with only household head name. Jointly land certification was also linked with increasing in women's and girls' clothing consumption but decreasing in men's clothing expenditure. Holden & Bezu (2014) also examine whether joint land certification has contributed to fair land rights for women and increase their position in decision-making at home. They found

that getting the certificate of land has increased the awareness of wives regarding their land rights and thereby positive impact on bargaining power within household and within community involvement.

In Ethiopia, as regards access rural land and control over it, women are societally the most disadvantaged group. The main challenging on effectively implementation of rural land right for women is largely attributing to negative views and discriminatory practices which deny women to own land and control. In addition, women have no right to receive their families' land, and land control during marriage falls mainly in the hands of husbands. Furthermore, women cannot manage the land's fruits because she could not take part in the decision making of household. The bad part is that women have to leave her husband's home without asking her share of the marriage property and must look for another marriage. Hence, the government of Ethiopia has enacted legislation on the administration of rural land that recognizes the right of a woman to rural land. There is interesting fact that how reforms can be formulated in various policy areas for clear promoting equality between men and women as well as women's empowerment (Kumar & Quisumbing, 2015). In this study, we examine the affect of women's autonomy on husband and wife's subjective wellbeing and household consumption expenditure based on the type of land certifications (jointly or household head alone) in Tigray and SNNP region. The study mainly uses a Difference-in-Differences approach by using "Ethiopian Rural Household Survey (ERHS)" data. We compare the outcome variable of subjective wellbeing such as the measure of possible life "Ladder", "Household Circumstances", "Doing Well", and household consumption expenditure between individuals who have jointly land certificate and who do not have jointly land certificate in Tigray and SNNP regions by exploiting before and after the joint land certification policy. The Difference-in-Differences estimate shows improve in subjective

wellbeing for both men and women and also increase in household consumption expenditure after the joint land certification policy intervention.

Our findings are closely related to recent papers examining the effect on household wellbeing of land distribution such as Van Landeghem et al (2008), Mishra & Sam (2016), and Muchomba (2017). Van Landeghem et al (2008) study the effect on household wellbeing of land distribution in Moldova by using subjective wellbeing data. They explore general empirical model and found that household land holdings have a positive effect on subjective wellbeing. Mishra & Sam (2016) also studied the impact of land ownership by using Nepal Demographic and Health Surveys and they found that enhancing the equity of land policies has the potential effect to improve women's empowerment and welfare in areas where farming is women's primary economic source. Regarding the household consumption expenditure, Muchomba (2017) also found that jointly land certification in Ethiopia was linked with increasing in household consumption expenditure compare with household which have land certificate with only household head's name.

The remaining part of the paper has the following structure. Section "2.2" contains some information about Ethiopia's land reform process. Section "2.3" contains an overview of the data used in this study. Section "2.4" outlines the empirical strategy. Section "2.5" addresses the regression results. Section "2.6" presents the robustness check, and section "2.7" concludes.

2.2 Background of the study

Ethiopia is a federation divided into regional states and chartered cities based on ethno-linguistics. With more than 85 ethnic groups, Ethiopia is the second-largest country in Africa (Kumar & Quisumbing, 2015). At present there are nine regional states and two chartered cities.

Before 1975 the land tenure system in Ethiopia rarely recognized women's independent ownership of land, except by marriage and legacy. While women were able to inherit land from their parents or deceased from their husband, they were unable to own land on their own right (Bezabih & Holden, 2010). In 1975, after the military communist regime was established, all of Ethiopia's land was nationalized and granted the right of use to farmers, organized through peasant associations at the community level (Muchomba, 2017). The households were unable to sell and lease the land they were allocating under this regime. In 1991, the military junta was abolished and land policy reforms were implemented by the new government. Land renting was permitted but it was still not allowed to sell. In 1995, the new regime divided the country into nine regions and two cities. After that different land certification programs were carried out at different times between 1998 and 2005 in four regions of the country (Muchomba, 2017).

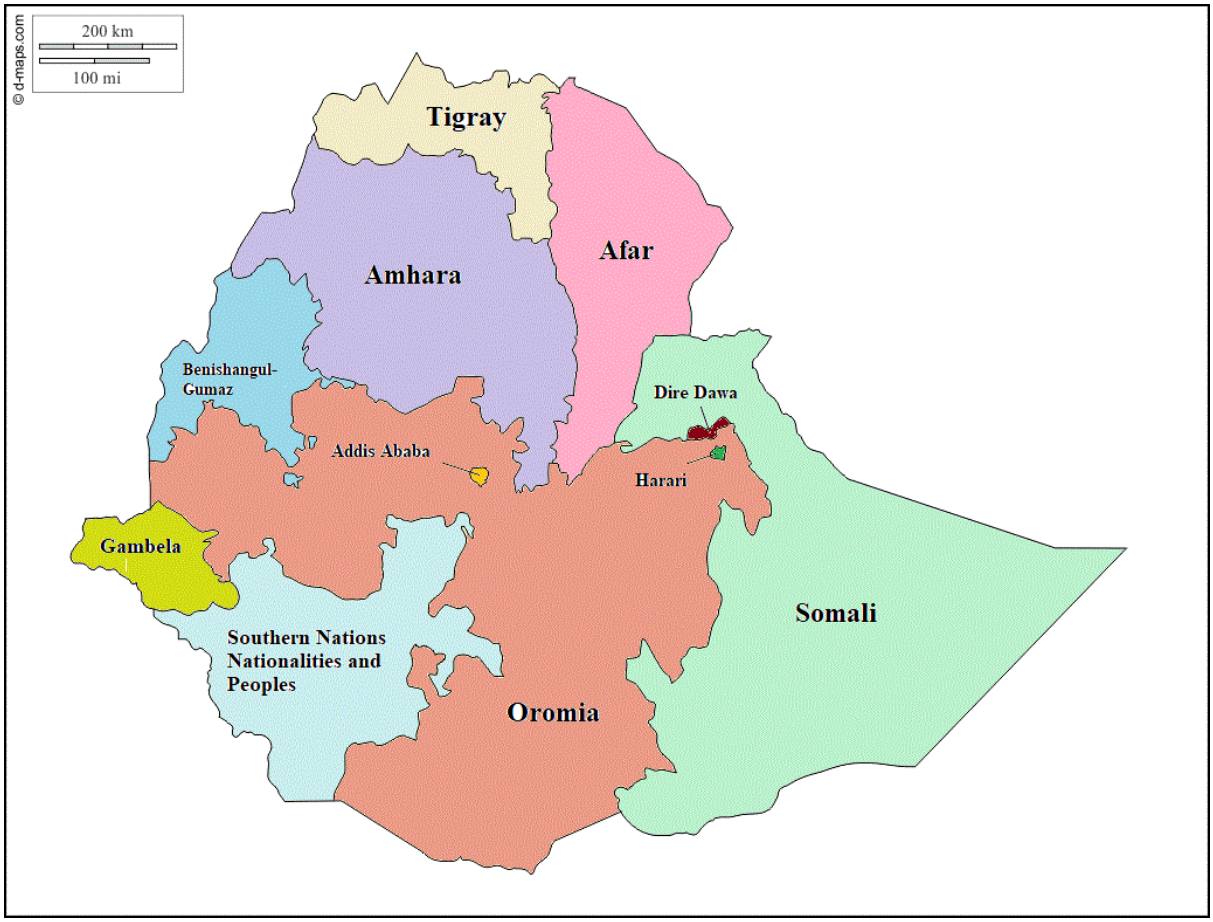

Figure 2-1: Regions and Chartered Cities of Ethiopia

Source: "Regions of Ethiopia," n.d

2.2.1 Land Certification

In 1998-1999, Tigray region conducted a land registration and certification, covering 80 percent of rural households. The entire process included the identification of plot owners (i.e., household allocated plots during the previous government and land-holders), checking and delimitation boundaries of plot with agreement from landowners and neighboring plot owners, and entering information of plot in a book for land registration. Households were received land certificates with the name of household head and the legal right to use, rent, and leave the land to their household members was given. The land certification has been

implemented as a fair to gender program, but the truth is that de facto land protection for men and women still differs. For example, in Tigray, divorced and widowed women are disadvantage because of sons are more likely to inherit land than daughters after death of household head. Unmarred women are therefore less possible to have inherited land than unmarried men (Fafchamps & Quisumbing, 2002). A divorced woman or a widow who is accused of partiality to a man may be low standing in courts without her name on the land record (Muchomba, 2017).

Three additional regions benefited from Tigray's experience. In 2003, the Amhara region started certificates of land, followed in the years 2003 and 2005 by Oromia region and the Southern Nations, Nationalities, and People's (SNNP) region, respectively. As with Tigray region, the land certificate did not reallocation but the household head and spouse were given certificates jointly. The inclusion of the name of wife on the land certificate may improve the security of her land ownership. Land certification program of Ethiopia was lauded for its rapidity and cost-effectiveness. This land certification policy was decentralized and implemented at the village level, allowing quick development for most rural households covered within two to three years period since implementation started (Deininger, Ali, Holden, & Zevenbergen, 2008).

Table (2-1) shows the implementation of land certification program in four main regions of Ethiopia by different year and different certification type. Hence, the objective of this study is to identify the affect of women's autonomy on husband and wife's subjective wellbeing and household consumption expenditure based on the type of land certifications (jointly or household head alone) in Tigray and SNNP region.

Table 2-1: Time Frame of Ethiopia Land Certification Program

	Tigray Region	Amhara Region	Oromia Region	SNNP Region
Program started year	1998	2003	2003	2005
Type of certificate	Household Head Only	Jointly	Jointly	Jointly

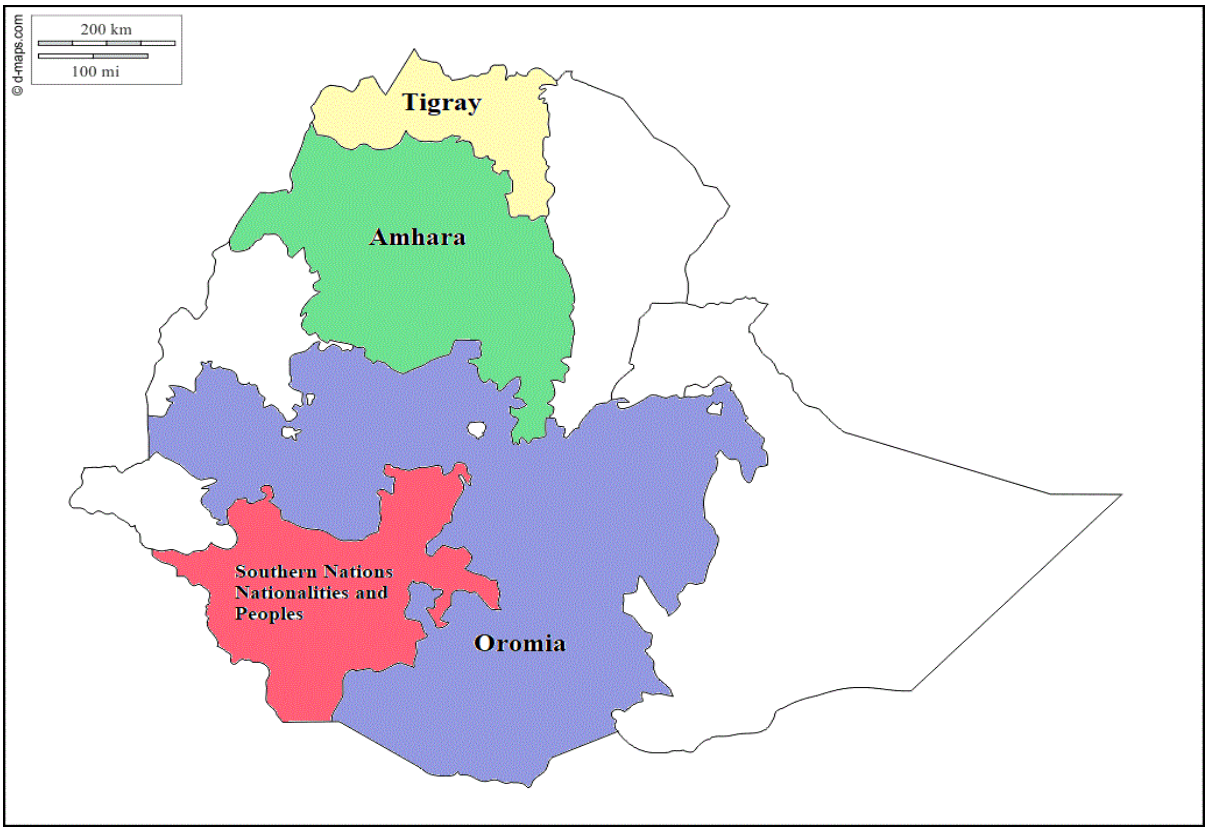

Figure 2-2: Four Main Regions where Land Certification Program Implemented

Source: "Regions of Ethiopia," n.d

2.3 Data and Summary Statistics

In this study, we used Ethiopian Rural Household Survey (ERHS) data which covers many rural Ethiopian villages. The collection of data began in 1989. Other additional rounds were conducted in 1994, 1995, 1997, 1999, 2004 and 2009 with low attrition rate. ERHS covered a great deal of information of all members of household at every wave such as household demographic, household assets, food and non-food expenditures, credit and poverty perceptions, agriculture, and women's activities.

The summary statistics of the study are provided in Table (2-2). In this study, the author used the sample of 2004 and 2009 waves of ERHS to estimate the affect of women's autonomy on husband and wife's subjective wellbeing based on the type of land certifications (jointly or household head alone) in Tigray and SNNP region. The main dependent variables are based on the subjective wellbeing of husbands and wives. Regarding the wellbeing data, the study used three main wellbeing variables such as "Ladder", "Household Circumstances", and "Doing Well". "Ladder" is defined with 0-10 scale and respondents were asked – "Suppose we assume that the top of a ladder is your best life and the bottom is your worst life. Where on the ladder do you think you are currently standing? (Circle selected number)". To answer this question, there are level 0 to 10 to circle and 10 is the best life and 0 is the worst life. "Household Circumstances" is defined with 1-7 scale and respondents were asked - "Just think about the situation in your own household, can you describe your family as: 1 (destitute) to 7 (very rich)". "Doing Well" is defined with 1-4 scale and respondents were asked - "would you like to describe your household in general as: 1 (unable to meet household requirements, reliant on community or government assistance) to 4 (able to meet household requirements through own efforts and make additional saving and investment)".

Table 2-2: Summary Statistics

Variable	Mean	Std.Dev	Min	Max	*N*
Panel A: Individual characteristics (Men)					
Ladder	4.671	1.769	0	10	1,563
Household Circumstances	3.863	1.155	1	7	1,562
Doing Well	2.475	0.760	1	4	1,513
Years of schooling	5.394	6.575	0	19	1,560
Respondent's age	50.327	14.432	14	100	1,577
Panel B: Individual characteristics (Women)					
Ladder	4.704	1.725	0	10	1,427
Household Circumstances	3.800	1.133	1	7	1,427
Doing Well	2.491	0.742	1	4	1,367
Years of schooling	3.341	5.948	0	19	1,457
Respondent's age	40.649	11.105	10	95	1,472
Panel C: Household characteristics					
Number of household members	4.679	2.307	1	15	2,399
Log of total value of household assets	5.627	1.499	0	12.209	2,398
Log of food consumption expenditure	3.804	1.067	0	8.320	2,359
Log of nonfood consumption expenditure	5.889	1.402	0	11.472	2,397
Log of total value of livestock	6.275	2.540	0	11.069	2,399
Improved toilet	0.055	0.228	0	1	2,399
Improved drinking water	0.244	0.429	0	1	2,399

Notes: "Ladder" is defined with 0-10 scale and respondents were asked – "Suppose we assume that the top of a ladder is your best life and the bottom is your worst life. Where on the ladder do you think you are currently standing?". "Household Circumstances" is defined with 1-7 scale and respondents were asked - "Just think about the situation in your own household, can you describe your family as: 1 (destitute) to 7 (very rich)". "Doing Well" is defined with 1-4 scale and respondents were asked - "would you like to describe your household in general as: 1 (unable to meet household requirements, reliant on community or government assistance) to 4 (able to meet household requirements through own efforts and make additional saving and investment)".

2.4 Empirical Strategy

As we mentioned above, the Ethiopian government has enacted legislation on rural land administration that recognizes the right of a woman to rural land. In 1998-1999, Tigray region conducted a land registration and certification, covering 80 percent of rural households. Households were received land certificates with the name of household head and the legal right to use, rent, and leave the land to their household members was given. The land certification has been implemented as a fair to gender program, but the truth is that de facto land protection for men and women still differs. Three additional regions benefited from Tigray's experience. In 2003, the Amhara region started certificates of land, followed in the years 2003 and 2005 by Oromia region and the Southern Nations, Nationalities, and People's (SNNP) region, respectively. In these three regions, household head and spouse were given certificates jointly. Therefore, to estimate the affect of women's autonomy on husband and wife's subjective wellbeing based on the type of land certifications (jointly or household head alone) in Tigray and SNNP region, the study mainly used a Difference-in-Differences approach. The study compared the outcome variables of subjective wellbeing such as "Ladder" (the measure of possible life), "Household Circumstances", and "Doing Well" between individuals who have and who do not have jointly land certificate by exploiting before and after the joint land certification policy by using year 2004 as pre policy intervention period and year 2009 as post policy intervention period. This study will employ the following equations:

Measuring Subjective Wellbeing:

$$Y_{ijt} = \beta_0 + \beta_1 Post + \beta_2 Treat + \beta_3 Post * Treat + X'_{ijt}\beta_4 + \theta_j + \in_{ijt} \quad (2.1)$$

Where, "*i*", "*j*", and "*t*" denote individual, region, and year respectively. "Y_{ijt}" represents the dependent variables of wife's subjective wellbeing and husband's subjective wellbeing indicators such as "Ladder", "Household Circumstances", and "Doing Well". "$Post$" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "$Treat$" is a binary explanatory variable (equal to "1" if the individual is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the individual is from Tigray region where land certificates are issued with only household head's (husband's) name). "X'_{ijt}" represents the individual characteristics such as educational level of respondent, age of the respondent, types of occupation, and household characteristics such as number of household members, log of total value of household assets. Our coefficient of interest is "β_3" and represents the different change in outcome variations in before and after the joint land certification policy and the type of land certification. In all regression, we control for regional fixed effect, "θ_j ". " $\in_{ijt}$" is the error term.

The coefficient of "$Post$", β_1, is the predicted mean difference in outcome between the control group before and after the start of policy intervention period. The coefficient of "$Treat$", β_2, is the expected difference in "*Y*" between the treatment group and the control group prior to the policy intervention. The coefficient of the "*Post* x *Treat*", β_3, describes the estimates from a Difference-in-Differences approach.

To know is there any differential effect between Husband and Wife's Subjective Wellbeing, we use the following equation:

$$Y_{ijt} = \beta_0 + \beta_1\, Post + \beta_2\, Treat + \beta_3\, Post * Treat + \beta_4\, Husband + \beta_5\, Post * Husband + \beta_6\, Treat * Husband + \beta_7\, Post * Treat * Husband + X'_{ijt}\,\beta_8 + \theta_j + \in_{ijt} \qquad (2.2)$$

Where, "*i*", "*j*", and "*t*" denote individual, region, and year respectively. "Y_{ijt}" represents wife's subjective wellbeing indicators such as "Ladder", "Household Circumstances", and "Doing Well". "$Post$" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "$Treat$" is a binary explanatory variable (equal to "1" if the individual is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the individual is from Tigray region where land certificates are issued with only household head's (husband's) name). "$Husband$" is a binary explanatory variable (equal to "1" if an individual is men and equal to "0" if an individual is women). "X'_{ijt}" represents the individual characteristics such as educational level of respondent, age of the respondent, types of occupation, and household characteristics such as number of household members, log of total value of household assets. Our coefficient of interest is "β_7" and represents different between husband and wife's subjective wellbeing. In all regression, we control for regional fixed effect, "θ_j ". " $\in_{ijt}$" is the error term.

The coefficient of "$Post$", β_1, is the predicted mean difference in outcome between the control group before and after the start of policy intervention period. The coefficient of "$Treat$", β_2, is the expected difference in "*Y*" between the treatment group and the control group prior to the policy intervention. The coefficient of "*Post* x *Treat*", β_3, describes the estimates from first Difference-in-Differences approach. The coefficient of "*Husband*", β_4, is

the expected difference in "*Y*" between husband and wife before the policy intervention. The coefficient of "*Post* x *Husband*", β_5, describes the estimates from second Difference-in-Differences approach. The coefficient "*Treat* x *Husband*", β_6, describes the estimates from third Difference-in-Differences approach. The coefficient of "*Post* x *Treat* x *Husband*", β_7, describes the estimates from triple Difference-in-Differences approach.

Household Consumption Expenditure:

$$Y_{ijt} = \beta_0 + \beta_1 Post + \beta_2 Treat + \beta_3 Post * Treat + X'_{ijt}\beta_4 + \theta_j + \in_{ijt} \quad (2.3)$$

Where, "*i*", "*j*", and "*t*" denote household, region, and year respectively. "Y_{ijt}" represents outcome variables such as "log of food consumption expenditure", and "log of nonfood consumption expenditure". "$Post$" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "$Treat$" is a binary explanatory variable (equal to "1" if the household is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the household is from Tigray region where land certificates are issued with only household head's (husband's) name). "X'_{ijt}" represents the household characteristics such as household head's education, household head's age, number of members of the household, log of total value of household assets, and household head's occupation. Our coefficient of interest is "β_3" and represents the different change in outcome variations in before and after the joint land certification policy and the type of land certification. In all regression, we control for regional fixed effect, "θ_j ". " $\in_{ijt}$" is the error term.

The coefficient of "$Post$", β_1, is the predicted mean difference in outcome between the control group before and after the start of policy intervention period. The coefficient of "$Treat$", β_2, is the expected difference in "Y" between the treatment group and the control group prior to the policy intervention. The coefficient of "*Post* x *Treat*", β_3, describes the estimates from a Difference-in-Differences approach.

2.5 Main Results

In this section, we described the results of our estimations. We investigate the affect of increasing women's autonomy driven by land certification policy on husband and wife's subjective wellbeing and household consumption expenditures by exploiting the policy variation in Tigray and SNNP region. Results show that higher women autonomy (who have joint land certificate) would increase subjective wellbeing and household expenditures. The detail explanations of the results are as follows:

2.5.1 Effects on Wife's Subjective Wellbeing

Equation (2.1) examines the affect of higher women's autonomy on wife's subjective wellbeing. Table (2-3) displays the results from estimating equation (2.1). The dependent variable in Columns (1) and (2) is "Ladder" (0-10 scales), in Columns (3) and (4) is "Household Circumstances" (0-7 scale), and in Columns (5) and (6) is "Doing Well" (0-4 scale). Columns (1), (3) and (5) show the OLS estimation results and Columns (2), (4) and (6) show the Ordered Probit estimation results. In all columns, we set 2004 as pre policy intervention period, 2009 as post policy intervention period, treatment region as SNNP, and control region as Tigray. We also control for individual characteristics such as educational level of

respondent, age of the respondent, types of occupation, and household characteristics such as number of household members, log of total value of household assets.

Holding other covariates constant, estimates in Columns (1), (3), and (5) show that women who lives in SNNP region (where household head and spouse were given land certificates jointly) increase the wellbeing level after the policy intervention period. Columns (1), (3), and (5) show that a one standard deviation increase in difference between before and after the joint land certification policy and the type of land certification increase women's "Ladder" measure by 0.501 [= (2.030 * 0.426) / 1.725] standard deviation, "Household Circumstances" measure by 0.129 [= (0.344 * 0.426) / 1.133] standard deviation, and "Doing well" measure by 0.616 [= (1.074 * 0.426) / 0.742] standard deviation respectively. All of the results are statistically significance at 1% significance level. The Ordered Probit estimation results reported in Columns (2), (4), and (6) indicate that the results remain unchanged and also statistically significance.

Table 2-3: Effects on Wife's Subjective Wellbeing

	Ladder		*Household Circumstances*		*Doing Well*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	OLS	*Ordered Probit*	*OLS*	*Ordered Probit*	*OlS*	*Ordered Probit*
Post	-2.063***	-1.395***	-0.320***	-0.435**	-1.121***	-2.008***
	(0.165)	(0.203)	(0.037)	(0.206)	(0.013)	(0.234)
Treat	-1.181***	-0.749***	-0.531***	-0.578***	-0.263***	-0.456**
	(0.105)	(0.171)	(0.131)	(0.176)	(0.077)	(0.188)
Post * Treat	**2.030*** **	**1.380*** **	**0.344*** **	**0.441***	**1.074*** **	**1.930*** **
	(0.214)	**(0.222)**	**(0.131)**	**(0.226)**	**(0.056)**	**(0.255)**
Individual controls						
Years of schooling	-0.004	-0.003	0.018***	0.016	0.006***	0.011
	(0.010)	(0.009)	(0.003)	(0.010)	(0.002)	(0.010)
Respondent's age	-0.005	-0.002	-0.004	-0.003	0.001	0.002
	(0.003)	(0.004)	(0.003)	(0.004)	(0.002)	(0.005)
Dummies for types of occupation	Yes	Yes	Yes	Yes	Yes	Yes
Household controls						
Number of household members	0.083***	0.059***	0.049***	0.054***	0.024***	0.043*
	(0.016)	(0.020)	(0.008)	(0.021)	(0.007)	(0.023)
Log of total value of household assets	0.351***	0.245***	0.266***	0.278***	0.129***	0.222***
	(0.036)	(0.034)	(0.024)	(0.036)	(0.015)	(0.039)
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes
N	626	626	626	626	594	594

Note: The coefficients are reported with cluster-bootstrapped standard errors in parentheses. The dependent variable in columns (1) and (2) is "Ladder" (0-10 scales), in columns (3) and (4) is "Household Circumstances" (0-7 scale), and in columns (5) and (6) is "Doing Well" (0-4 scale). "Post" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "Treat" is a binary explanatory variable (equal to "1" if the individual is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the individual is from Tigray region where land certificates are issued with only household head's (husband's) name). The unit of observations is a person. In all regressions, we control for regional fixed effects (There are seven administrative districts: Woreda). * p<0.10, ** p<0.05, *** p<0.01

2.5.2 Effects on Husband's Subjective Wellbeing

Equation (2.1) examines the affect of higher women's autonomy on husband's subjective wellbeing. Table (2-4) displays the results from estimating equation (2.1). The dependent variable in Columns (1) and (2) is "Ladder" (0-10 scales), in Columns (3) and (4) is "Household Circumstances" (0-7 scale), and in Columns (5) and (6) is "Doing Well" (0-4 scale). Columns (1), (3) and (5) show the OLS estimation results and Columns (2), (4) and (6) show the Ordered Probit estimation results. In all columns, we set 2004 as pre policy intervention period, 2009 as post policy intervention period, treatment region as SNNP, and control region as Tigray. We also control for individual characteristics such as educational level of respondent, age of the respondent, types of occupation, and household characteristics such as number of household members, log of total value of household assets.

Holding other covariates constant, estimates in Columns (1), (3), and (5) show that men who lives in SNNP region (where household head and spouse were given land certificates jointly) increase the wellbeing level after the policy intervention period. Columns (1), (3), and (5) show that a one standard deviation increase in difference between before and after the joint land certification policy and the type of land certification increase men's "Ladder" measure by 0.452 [= (1.877 * 0.426) / 1.769] standard deviation, "Household Circumstances" measure by 0.076 [= (0.208 * 0.426) / 1.155] standard deviation, and "Doing well" measure by 0.442 [= (0.789 * 0.426) / 0.760] standard deviation respectively. All of the results are statistically significance. The Ordered Probit estimation results reported in Columns (2), (4), and (6) indicate that the results remain unchanged and also statistically significance.

Table 2-4: Effects on Husband's Subjective Wellbeing

	Ladder		*Household Circumstances*		*Doing Well*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	OLS	*Ordered Probit*	*OLS*	*Ordered Probit*	*OlS*	*Ordered Probit*
Post	-1.906***	-1.316***	-0.199***	-0.369*	-0.761***	-1.255***
	(0.273)	(0.189)	(0.032)	(0.211)	(0.226)	(0.208)
Treat	-1.151***	-0.771***	-0.446***	-0.619***	-0.163**	-0.267
	(0.133)	(0.159)	(0.030)	(0.180)	(0.073)	(0.172)
Post * Treat	**1.877*** **	**1.291*** **	**0.208** **	**0.382***	**0.789*** **	**1.303*** **
	(0.304)	**(0.209)**	**(0.085)**	**(0.231)**	**(0.230)**	**(0.230)**
Individual controls						
Years of schooling	0.014**	0.010	0.017***	0.013	0.008***	0.014
	(0.006)	(0.008)	(0.004)	(0.009)	(0.002)	(0.009)
Respondent's age	-0.007**	-0.005*	-0.004***	-1.363	-0.005***	-0.008***
	(0.003)	(0.003)	(0.001)	(1.264)	(0.000)	(0.003)
Dummies for types of occupation	Yes	Yes	Yes	Yes	Yes	Yes
Household controls						
Number of household members	0.056***	0.041**	0.041***	0.047**	0.025***	0.042**
	(0.015)	(0.019)	(0.010)	(0.022)	(0.006)	(0.021)
Log of total value of household assets	0.404***	0.286***	0.281***	0.312***	0.135***	0.219***
	(0.042)	(0.034)	(0.027)	(0.037)	(0.021)	(0.038)
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes
N	683	683	681	681	657	657

Note: The coefficients are reported with cluster-bootstrapped standard errors in parentheses. The dependent variable in columns (1) and (2) is "Ladder" (0-10 scales), in columns (3) and (4) is "Household Circumstances" (0-7 scale), and in columns (5) and (6) is "Doing Well" (0-4 scale). "Post" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "Treat" is a binary explanatory variable (equal to "1" if the individual is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the individual is from Tigray region where land certificates are issued with only household head's (husband's) name). The unit of observations is a person. In all regressions, we control for regional fixed effects (There are seven administrative districts: Woreda). * p<0.10, ** p<0.05, *** p<0.01

2.5.3 Differential Effects between Husband and Wife's Subjective Wellbeing

As we see in Table (2-3) and Table (2-4), the study indicates that joint land certification policy is positively effect on both husband and wife's subjective wellbeing. Therefore, we would like to check whether there is the difference between the level of impact on husband and wife's subjective wellbeing. We used equation (2.2) to know is there any differential effect between husband and wife's subjective wellbeing.

Table (2-5) displays the results from estimating equation (2.2). The dependent variable in Columns (1) and (2) is "Ladder" (0-10 scales), in Columns (3) and (4) is "Household Circumstances" (0-7 scale), and in Columns (5) and (6) is "Doing Well" (0-4 scale). Columns (1), (3) and (5) show the OLS estimation results and Columns (2), (4) and (6) show the Ordered Probit estimation results. In all columns, we set 2004 as pre policy intervention period, 2009 as post policy intervention period, treatment region as SNNP, control region as Tigray, and "Husband" is a binary explanatory variable (equal to "1" if an individual is men and equal to "0" if an individual is women). We also control for individual characteristics such as educational level of respondent, age of the respondent, types of occupation, and household characteristics such as number of household members, log of total value of household assets. Holding other covariates constant, the results show that there is no differential effect between husband and wife's subjective wellbeing.

Table 2-5: Differential Effects on Wellbeing between Husband and Wife

	Ladder		*Household Circumstances*		*Doing Well*	
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	OLS	***Ordered Probit***	***OLS***	***Ordered Probit***	***OlS***	***Ordered Probit***
Post	-2.017***	-1.362***	-0.334***	-0.443**	-0.958***	-1.543***
	(0.210)	(0.199)	(0.028)	(0.202)	(0.089)	(0.256)
Treat	-1.252***	-0.813***	-0.561***	-0.603***	-0.386***	-0.612***
	(0.121)	(0.166)	(0.147)	(0.170)	(0.086)	(0.214)
Post * Treat	1.985***	1.346***	0.366	0.459**	1.064***	1.712***
	(0.243)	(0.218)	(0.245)	(0.222)	(0.130)	(0.292)
Husband	0.401	0.309	-0.079	-0.062	0.084	0.145
	(0.268)	(0.217)	(0.080)	(0.213)	(0.128)	(0.292)
Post * Husband	0.104	0.058	0.090**	0.087	0.112	0.179
	(0.488)	(0.269)	(0.044)	(0.276)	(0.210)	(0.388)
Treat * Husband	0.071	0.035	0.070	0.041	0.194	0.295
	(0.236)	(0.226)	(0.093)	(0.230)	(0.144)	(0.328)
Post*Treat*Husband	**-0.074**	**-0.048**	**-0.103**	**-0.092**	**-0.366**	**-0.583**
	(0.507)	**(0.298)**	**(0.107)**	**(0.304)**	**(0.231)**	**(0.438)**
Individual controls						
Years of schooling	0.006	0.004	0.016***	0.015**	0.007	0.011
	(0.008)	(0.006)	(0.004)	(0.006)	(0.006)	(0.010)
Respondent's age	-0.007*	-0.004*	-0.005*	-0.004*	-0.006***	-0.009**
	(0.004)	(0.002)	(0.003)	(0.002)	(0.002)	(0.004)
Dummies for types of occupation	Yes	Yes	Yes	Yes	Yes	Yes
Household controls						
Number of household members	0.070***	0.050***	0.044***	0.044***	0.029	0.046**
	(0.017)	(0.014)	(0.011)	(0.014)	(0.018)	(0.022)
Log of total value of household assets	0.381***	0.267***	0.276***	0.279***	0.134***	0.211***
	(0.058)	(0.024)	(0.054)	(0.024)	(0.043)	(0.038)
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1,309	1,309	1,307	1,307	1,251	1,251

Note: The coefficients are reported with cluster-bootstrapped standard errors in parentheses. The dependent variable in columns (1) and (2) is "Ladder" (0-10 scales), in columns (3) and (4) is "Household Circumstances" (0-7 scale), and in columns (5) and (6) is "Doing Well" (0-4 scale). "Post" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "Treat" is a binary explanatory variable (equal to "1" if the individual is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the individual is from Tigray region where land certificates are issued with only household head's (husband's) name). "Husband" is a binary explanatory variable (equal to "1" if an individual is men and equal to "0" is an individual is women). The unit of observations is a person. In all regressions, we control for regional fixed effects (There are seven administrative districts: Woreda). * p<0.10, ** p<0.05, *** p<0.01

2.5.4 Effects on Household Consumption Expenditure

According to the previous results, we know that joint land certification policy is positively effect on both husband and wife's subjective wellbeing and there is no difference between the level of impact on husband and wife's subjective wellbeing. So, we also would like to know the impact of joint land certification policy on household consumption expenditure. We tried to examine this fact by using equation (2.3).

Equation (2.3) examines the affect of women's autonomy on household consumption expenditure. Table (2-6) displays the results from estimating equation (2.3). Controlling for household head's education, household head's age, number of members of the household, log of total value of household assets, and household head's occupation, the study found that higher women autonomy increase household expenditure. Column (1) shows the result of log of food consumption expenditure and Column (2) shows the result of log of nonfood consumption expenditure. In both columns, we set 2004 as pre policy intervention period, 2009 as post policy intervention period, treatment region as SNNP, and control region as Tigray.

Holding other covariates constant, Column (1) indicates that increasing the household food consumption expenditure after the policy intervention in SNNP region (where household head and spouse were given land certificates jointly). A one unit increase in difference between before and after the joint land certification policy and the type of land certification increase household food consumption expenditure by 74.6 percent. Estimate in Column (2) indicates that increasing the household nonfood consumption expenditure after the policy intervention in SNNP region (where household head and spouse were given land certificates jointly). A one unit increase in difference between before and after the joint land certification policy and the type of land certification increase household nonfood consumption

expenditure by 37.9 percent. The results of both Columns are statistically significant at 1% significance level.

Table 2-6: Effects on Household Consumption Expenditure

	(1)	(2)
	Food	**Non-food**
Post	0.044	0.094
	(0.149)	(0.072)
Treat	-0.516***	0.302
	(0.106)	(0.362)
Post * Treat	**0.746*** **	**0.379*** **
	(0.174)	**(0.142)**
Household head's education	0.006	0.014*
	(0.006)	(0.008)
Household head's age	-0.003	0.003
	(0.002)	(0.002)
Number of household members	0.102***	0.132***
	(0.015)	(0.009)
Log of total value of household assets	0.105***	0.246***
	(0.016)	(0.035)
Household head's occupation	Yes	Yes
Regional FE	Yes	Yes
N	997	1,032

Note: The coefficients are reported with cluster-bootstrapped standard errors in parentheses. The dependent variable in column (1) is "Log of food consumption expenditure" and column (2) is "Log of nonfood consumption expenditure". "Post" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "Treat" is a binary explanatory variable (equal to "1" if the household is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the household is from Tigray region where land certificates are issued with only household head's (husband's) name). The unit of observations is households. In all regressions, we control for regional fixed effects (There are seven administrative districts: Woreda). * p<0.10, ** p<0.05, *** p<0.01

2.6 Robustness Check

To check the robustness, we used equation (2.1) by adding additional control variables of household characteristics such as “Log of total value of livestock”, “Improved toilet”, and “Improved drinking water”. Table (2-7) displays the results of robustness check. Columns (1), (2), and (3) show robustness check results of wife’s subjective wellbeing and Columns (4), (5), and (6) show robustness check results of husband’s subjective wellbeing. The dependent variable in Columns (1) and (4) is “Ladder” (0-10 scales), in Columns (2) and (5) is “Household Circumstances” (0-7 scale), and in Columns (3) and (6) is “Doing Well” (0-4 scale). In all columns, we set 2004 as pre policy intervention period, 2009 as post policy intervention period, treatment region as SNNP, and control region as Tigray. We also control for individual characteristics such as educational level of respondent, age of the respondent, types of occupation, household characteristics such as number of members of the household, log of total value of household assets, and household additional controls such as log of total value of livestock, improved toilet, and improved drinking water.

Holding other covariates constant, estimates in Columns (1), (2), and (3) show that women who lives in SNNP region (where household head and spouse were given land certificates jointly) increase the wellbeing level after the policy intervention period. Columns (1), (2), and (3) show that a one standard deviation increase in difference between before and after the joint land certification policy and the type of land certification increase women’s “Ladder” measure by 0.502 [= (2.035 * 0.426) / 1.725] standard deviation, “Household Circumstances” measure by 0.127 [= (0.338 * 0.426) / 1.133] standard deviation, and “Doing well” measure by 0.614 [= (1.070 * 0.426) / 0.742] standard deviation respectively.

Table 2-7: Robustness Check

	Wife's Subjective Wellbeing			*Husband's Subjective Wellbeing*		
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Ladder	***Household Circumstances***	***Doing Well***	***Ladder***	***Household Circumstances***	***Doing Well***
Post	-2.080***	-0.306***	-1.124***	-1.929***	-0.174***	-0.758***
	(0.159)	(0.040)	(0.012)	(0.288)	(0.025)	(0.232)
Treat	-1.235***	-0.458***	-0.274***	-1.161***	-0.392***	-0.168***
	(0.110)	(0.137)	(0.069)	(0.152)	(0.032)	(0.063)
Post * Treat	**2.035*** **	**0.338** **	**1.070*** **	**1.891*** **	**0.188** **	**0.788*** **
	(0.203)	**(0.135)**	**(0.055)**	**(0.333)**	**(0.083)**	**(0.236)**
Individual controls						
Years of schooling	-0.001	0.015***	0.007***	0.014**	0.017***	0.008***
	(0.010)	(0.003)	(0.002)	(0.006)	(0.004)	(0.002)
Respondent's age	-0.003	-0.006**	0.001	-0.007**	-0.005***	-0.005***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.001)	(0.001)
Dummies for types of occupation	Yes	Yes	Yes	Yes	Yes	Yes
Household controls						
Number of household members	0.089***	0.045***	0.027***	0.058***	0.038***	0.025***
	(0.014)	(0.008)	(0.006)	(0.013)	(0.009)	(0.006)
Log of total value of household assets	0.345***	0.257***	0.131***	0.394***	0.276***	0.138***
	(0.037)	(0.023)	(0.014)	(0.040)	(0.026)	(0.021)
Additional controls						
Log of total value livestock	0.020	0.005	-0.012	0.012	-0.014**	-0.001
	(0.018)	(0.005)	(0.007)	(0.008)	(0.007)	(0.006)
Improved toilet	0.161	-0.432***	0.069	-0.180**	-0.236***	0.085***
	(0.108)	(0.065)	(0.050)	(0.072)	(0.056)	(0.032)
Improved drinking water	0.232	-0.178***	0.085	0.169	-0.115	-0.044
	(0.151)	(0.063)	(0.060)	(0.147)	(0.102)	(0.081)
Regional FE	Yes	Yes	Yes	Yes	Yes	Yes
N	626	626	594	683	681	657

Note: The coefficients are reported with cluster-bootstrapped standard errors in parentheses. The dependent variable in columns (1) and (4) is "Ladder" (0-10 scales), in columns (2) and (5) is "Household Circumstances" (0-7 scale), and in columns (3) and (6) is "Doing Well" (0-4 scale). "Post" is a binary explanatory variable (equal to "1" if the year of survey is 2009 and equal to "0" if the year of survey is 2004). "Treat" is a binary explanatory variable (equal to "1" if the individual is from SNNP region where household head and spouse were given land certificates jointly and equal to "0" if the individual is from Tigray region where land certificates are issued with only household head's (husband's) name). The unit of observations is a person. In all regressions, we control for regional fixed effects (There are seven administrative districts: Woreda). * p<0.10, ** p<0.05, *** p<0.01

Estimates in Columns (4), (5), and (6) show that men who lives in SNNP region (where household head and spouse were given land certificates jointly) increase the wellbeing level after the policy intervention period. Columns (4), (5), and (6) show that a one standard deviation increase in difference between before and after the joint land certification policy and the type of land certification increase men's "Ladder" measure by 0.455 [= (1.891 * 0.426) / 1.769] standard deviation, "Household Circumstances" measure by 0.069 [= (0.188 * 0.426) / 1.155] standard deviation, and "Doing well" measure by 0.441 [= (0.788 * 0.426) / 0.760] standard deviation respectively. All of the results from Column (1) to (6) are statistically significance and consistence with our baseline estimation results. Therefore this robustness check results support the robustness of the baseline estimation results.

2.7 Discussion and Conclusion

This study examines the affect of women's autonomy on husband and wife's subjective wellbeing based on the type of land certifications (jointly or household head alone) in Tigray and SNNP region of Ethiopia.

In Ethiopia, land certification legislation gives households the legal right to use the ultimate term, rent, and inheritance land to household members. In 1998-1999, Tigray region conducted a land registration and certification, covering 80 percent of rural households. Households were received land certificates with the name of household head and the legal right to use, rent, and leave the land to their household members was given. The land certification has been implemented as a fair to gender program, but the truth is that de facto land protection for men and women still differs. Three additional regions benefited from Tigray's experience. In 2003, the Amhara region started certificates of land, followed in the years 2003 and 2005 by Oromia region and the Southern Nations, Nationalities, and People's

(SNNP) region, respectively. In these three regions, household head and spouse were given certificates jointly. This setting allows us to implement a Difference-in-Differences setting to study the effect of joint land certification policy.

Our findings indicate that extending the security of land tenure to women increase not only wife's subjective wellbeing but also husband's subjective wellbeing and household consumption expenditure. These findings support the findings of Van Landeghem et al (2008) and Muchomba (2017). Van Landeghem et al (2008) study the effect on household wellbeing of land distribution in Moldova by using subjective wellbeing data and they found that household land holdings have a positive effect on subjective wellbeing. Regarding the household consumption expenditure, Muchomba (2017) also analyzed the effect of programs for joint land certification in Ethiopia on household consumption and they found that jointly land certification in Ethiopia was linked with increasing in household consumption expenditure compare with household which have land certificate with only household head's name. In addition, our findings also fill the gap of Muchomba by indicating that extending the security of land tenure to women also increase subjective wellbeing of both men and women which are not investigated in Muchomba's paper.

We also found that there is no difference between the level of impact of joint land certification policy on husband and wife's subjective wellbeing. This fact also support the findings of Holden, Stein, and Tefera (2008) and they mentioned in their study that when they asked the men in Ethiopia about their perception of tenure insecurity after the joint land certification policy and they found that most of the men felt that their feelings of tenure security had increased with the joint land certificate, and none of them responded that after the reform, they felt less secure tenure. Therefore, their wives are not considered to be the primary or significant cause of tenure insecurity. In other words, they do not see land certification within households as a zero-sum game.

Due to the data limitation, we could not do the falsification test in this study. However, we did robustness check by adding additional control variables of household characteristics and robustness check results are statistically significance and consistence with our baseline estimation results. Therefore, based on our findings, we can conclude that joint land certificates seem a valuable policy tool for fostering more equitable land rights which promote both husband and wife's subjective wellbeing and increase household consumptions expenditure.

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CHAPTER THREE

GOVERNMENT SUPPORT OF AGRICULTURAL RECOVERY AFTER A NATURAL DISASTER: A CASE STUDY ON CYCLONE NARGIS IN MYANMAR

3.1 Introduction

Myanmar has an area of 676,600 square kilometers and it is the largest nation in South East Asia, and it heavily depends on the economic benefits of the basin of the river Ayeyarwady and the Ayeyarwady delta. The Ayeyarwady region consists of 26 townships, which has an estimated area of 35,031.88 km^2 (Khaing, May, & Myint, 2019). The findings of 2014 census show that around 15 million of Myanmar's current population (51.4 million) resides in the Ayeyarwady region. It also accounts for the highest percentage (88%) of people are living in countryside (rural areas) relative to urban areas (12%). Ayeyarwady region is one of the world's most rice productive regions with large area of farming land. In that region, the majority of households engage in farming, fishing, forestry, cattle and poultry. The region has a tropical monsoon climate. Agriculture is the most important economic sector, providing employment for about 70% of the workforce and contributing about 53% of the country's GDP (Khaing et al., 2019). Fisheries is the second most important after rice.

However, Myanmar is one of 15 nations which together represent 80 percent of the global population exposed to river flood (Besset, Anthony, Dussouillez, & Goichot, 2017). This type of natural hazard is especially pertinent to the region of Ayeyarwady delta. Agriculture land assets and infrastructure can be destroyed by natural hazards such as storms and earthquakes thereby disrupting production cycles, flows of trade and means of livelihood (Rohwerder,

2017). There is a greater impact of natural hazards on different areas of the agriculture sector. The most vulnerable sector to disaster impact is farming sector followed by livestock, fisheries, and forestry (Rohwerder, 2017). Natural disasters are destroying crops lands, crops production circles, infrastructure, storage facilities, livestock shelters, seed stores, as well as agricultural tools, equipment, and machinery (Rohwerder, 2017). For example, the physical effects of the earthquake and tsunami in 2004 at the municipal district of Aceh, Indonesia have resulted in disintegration of the rice fields, deterioration of boundaries of fish pond, water resources and seed stocks needed for aquaculture and rice production (Tinning, 2008) and (Fekete et al., 2017). Heath, Kenyon, & Zepeda Sein (1999) and Danilo C. Israel; Roehlano M. Briones (2012) discuss that numerous geophysical disasters can aggravate epizootics, resulting in the deaths of many animals and the reduction of production efficiency so that the economic and environmental effects of these natural disasters are negative for affected regions and people living there.

In addition, because of the direct exposed to natural hazards and their adverse, agriculture sectors are extremely endangered. Mainville (2003) also pointed out that natural disaster damage occurs significantly to developing countries, especially to rural communities of vulnerable people within those countries. From an economic point of view, disasters affect more on poor people worldwide (SAMHSA, 2017), because they tend to have their resources concentrated at their homes and farm animals, which are damaged, injured, or destroyed by disasters. By comparison, non-poor people are more likely to invest in different ways, including financial institutions, which better protects their capital against natural disasters. After the natural disaster, the rapid reconstruction of agricultural sectors is necessary to alleviate the suffering of human and to enable the economy and society recovery.

The aim of most people in the sense of disaster recovery is to restore the usual patterns of household, business and public life before the disaster hit. In the sense of disaster restoration

there are three fairly different categories of social units such as households, business, and government organizations. Households and businesses rely primarily on recovery for themselves, but government organizations must meet the needs of the whole society for recovery (Lindell, 2013). In post-natural disaster policies, agricultural rebuilding is often seen as the government's priority. Since the very beginning of post-disaster recovery, agriculture should be considered to ensure the seasons of plantation do not missed. Provision of seed, tools and fertilizers are important for recovering the agriculture sector and providing farmers with financial to invest in restarting their business activities is also important (Rohwerder, 2017).

Therefore, the aim of this study is to investigate the situation of rebuilding agriculture activities and agricultural assistance after the Cyclone Nargis between households situated in the severely affected and less affected townships of Cyclone Nargis affected area. To conduct the study, we mainly use a Difference-in-Differences approach by using "Integrated Household Living Conditions Assessment (IHLCA) Survey" Myanmar, 2004 and 2009 round. We compare the outcome variables between households situated in severely affected area and less affected area by exploiting time variation.

The Difference-in-Differences estimate show that after the Cyclone Nargis, households situated in severely affected area have decreasing number of own agriculture equipment, own farm large animals, and own motor boats, less likely to use land for crop production, and less likely to engage in livestock breeding activities. These results are consistent with previous studies. Doan (2008), UN (2010), and Turnell (2010) stated that Cyclone Nargis devastated crop land, agricultural equipment, motor boat ownership, and killed countless number of animals. Cyclone Nargis also destroyed the homes completely. Due to these major losses, their ability to grow crops, household gardening and livestock production activities were clearly and continuously disadvantaged. The deaths and loss of too many animals have had a

detrimental impact on the livelihoods of community within cyclone affected area. There are specific concerns about the loss of draught animals (buffaloes and cattle), as these animals play a key role in cropping. Draught animals can also draw carts or drive small grinder mills, in addition to their role in the preparation and ploughing fields. Tinning (2008) also stated that tsunamis, cyclones, and floods are the most severe cause of death of people, damage homes, crops, and livestock. Apart from this losses and damages, Tinning (2008) also mentioned that the direct effects of natural disasters such as infrastructure destruction have been experienced not only by the farmers returning to agriculture; they have also had a major indirect impact including high pest animals' populations, limited availability of agricultural inputs and agricultural extension services.

Our study also found that after the Cyclone Nargis, households situated in severely affected area need more financial support, government bank support more financial to this area than private bank, and both public and private sectors still weak in terms of supporting agricultural service. These results are also contributed to previous studies. Doan (2008) pointed out that in recovering their livelihood, the effort by cyclone affected households were limited by the lack of capital because of the effects of death tools on rural Myanmar's credit-reliant system. Majority of the loans provided in rural areas are through business partners in vertical arrangements within the sector, e.g., from traders and suppliers. The loss of business partners and husbands as the households' main contact with external business partners and relationship has major impact on the livelihood recovery of the households in cyclone affected area. With regard to the credit system of the affected areas of Cyclone Nargis, South, Kempel, Perhult, & Carstensen (2011) mentioned that disaster has also disrupted the current credit system and adequate support or improved food security is insufficient. In Myanmar, there is no proper banking system, no comprehensive rural credit mechanism supported by the government, or a sufficient small enterprise or micro-business credit lending system. But

borrowing money from private lenders is a well-known coping strategy although it is not quite sustainable. Credits were more easily available in the past, but after cyclone, lenders especially rice millers, business people or richer families have been much more reluctant to provide the capital especially to the people who have not assets (who are the most needy and vulnerable) because they themselves have lost considerable assets because of the cyclone.

UN (2010) also mentioned that livelihoods recovery for households in cyclone affected townships remains weak. The majority of communities in Ayeyarwady delta region had not access in sustainable resources management training or awareness raising programs (UNEP, 2009). The extension services from government in forestry, agriculture, and aquaculture remained inadequate because of a severe shortage of human resources and financial capital. The scarcity of organizations in the civil society has also contributed to very few non-governmental organizations (NGOs) being able to fill the needs of capacity building (UNEP, 2009). Our findings are also consistent with Turner, Baker, Oo, & Aye (2008), they mentioned that many local organizations which are qualified for cyclone response realizing that it is not sufficient to provide relief assistance alone, and are exploring ways to step beyond relief and participate in long term recovery activities.

The remaining part of the paper is organized as follows: Section “3.2” offers some background information of Cyclone Nargis. Section “3.3” contains an overview of the data used in this study. Section “3.4” presents empirical strategy, while section “3.5” deals with the regression results. Section “3.6” presents robustness check, and section “3.7” concludes.

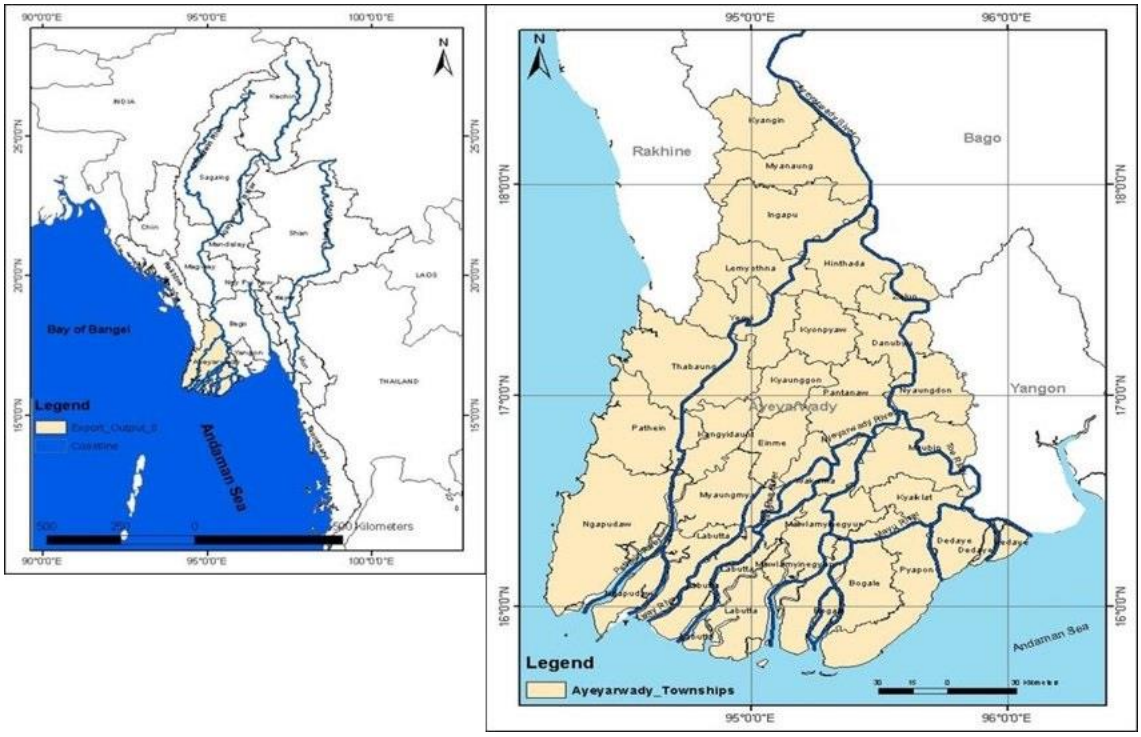

Figure 3-1: Location of Ayeyarwady Region

Source: Myanmar Information Management Unit

3.2 Background of the study

On the late afternoon of 2nd May 2008, Cyclone Nargis struck the part of lower Myanmar especially to Ayeyarwady division. Cyclone Nargis is the latest, most severe meteorological event, and the worst disaster in Myanmar's history that has affected Myanmar's delta. Myanmar had never experienced a disaster of that scale in recorded history. The storm brought winds up 200 km per hour and a tidal wave rise up to 3.6 m (12 ft) that caused different damage types. Cyclone Nargis affected more than 7 million people, and among them there were more than 2.4 million affected severely. There have been reports of 140,000 people deaths and fatalities and around 800,000 people homelessness. A large numbers of infrastructure were destroyed including homes, jetty, roads and piers.

Farming activities dominate in the area affected by the cyclone with over 62% of the population depending on their livelihoods on fishing, farming, the forestry, livestock and poultry. Boats are significance asset of the Ayeyarwady region because boats are used for transportation where water is more dominated than roads. Households that owned boat prior to the storm offered transportation for people and goods, and assisted the fishing industry. Cyclone Nargis destroyed countless number of animals and boats. Significant quantities of food, planting seeds for the next monsoon season, livelihood-related facilities, including agricultural equipment and farming equipment, stock of merchants and household goods, have all been lost or ruined. The storm is degrading soil fertility and leaving the fields with brackish water. There have been many unusual and difficult transitions in the cyclone affected region. Households in this cyclone affected area have been less likely to have adequate food, are more likely to live in lower-quality housing and their children are less likely to be in school as a result of the cyclone, and their capabilities to grow crops and other household-business activities are decreased (UN, 2010). Early recovery support is urgently needed to assist agriculture dependent families, who risk falling into permanent destitution and food insecurity if food production is not restored in time (FAO, 2009).

Figure 3-2: Cyclone Nargis Affected Area

Source: Post Nargis Periodic Review

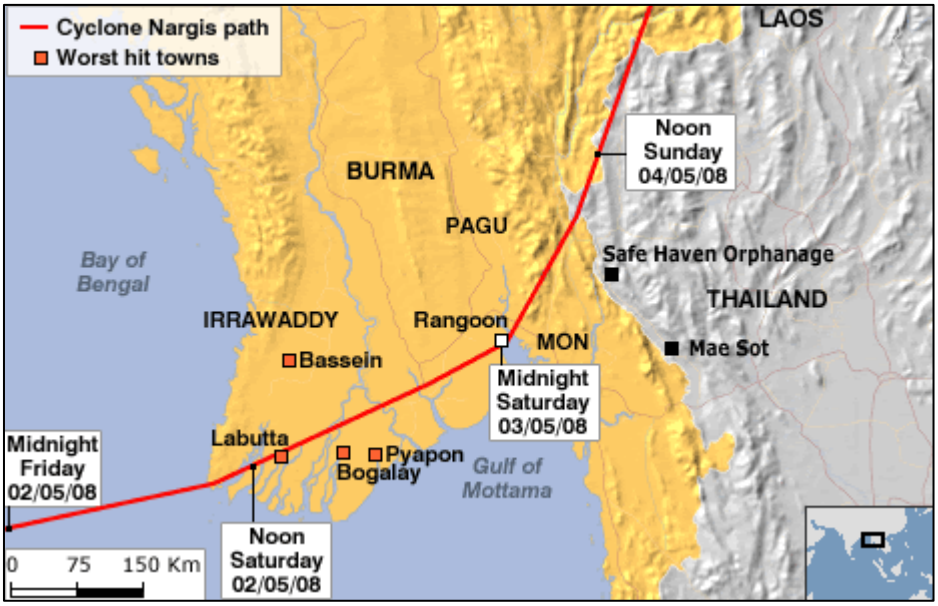

Figure 3-3: Cyclone Nargis Path

Source: Post Nargis Periodic Review

3.2.1 Severely Affected and Less Affected Townships

There are ten Cyclone Nargis affected townships in Ayeyarwady division such as Bogalae, Kyaiklat, Labutta, Maubin, Mawlamyinegyun, Myaungmya, Ngapudaw, Pyapon, Dadeya, and Wakema (UN, 2010). Among them four townships such as Bogalae, Labutta, Pyapone, and Dadeya are severely affected townships and other six townships such as Kyaiklat, Maubin, Mawlamyinegyun, Myaungmya, Ngapudaw, and Wakema are less affected townships. We classified severely affected and less affected townships based on Figure 3-4: "Storm Surge Hazard Potential Map" (Tun, 2009). There are four levels of risk area in "Storm Surge Hazard Potential Map", which include low risk area which is possible flood less than 4 ft, moderate risk area which is possible flood 4 ft to 6 ft, high risk area which is possible flood 6 ft and above, and very high risk area which is possible flood 12 ft and above. By using this storm surge classifications, we construct affected townships situated in high risk to very high risk area as severely affected townships (storm surge possible flood 6 ft and above) and affected townships situated in low risk to moderate risk area as less affected townships (storm surge possible flood under 6 ft).

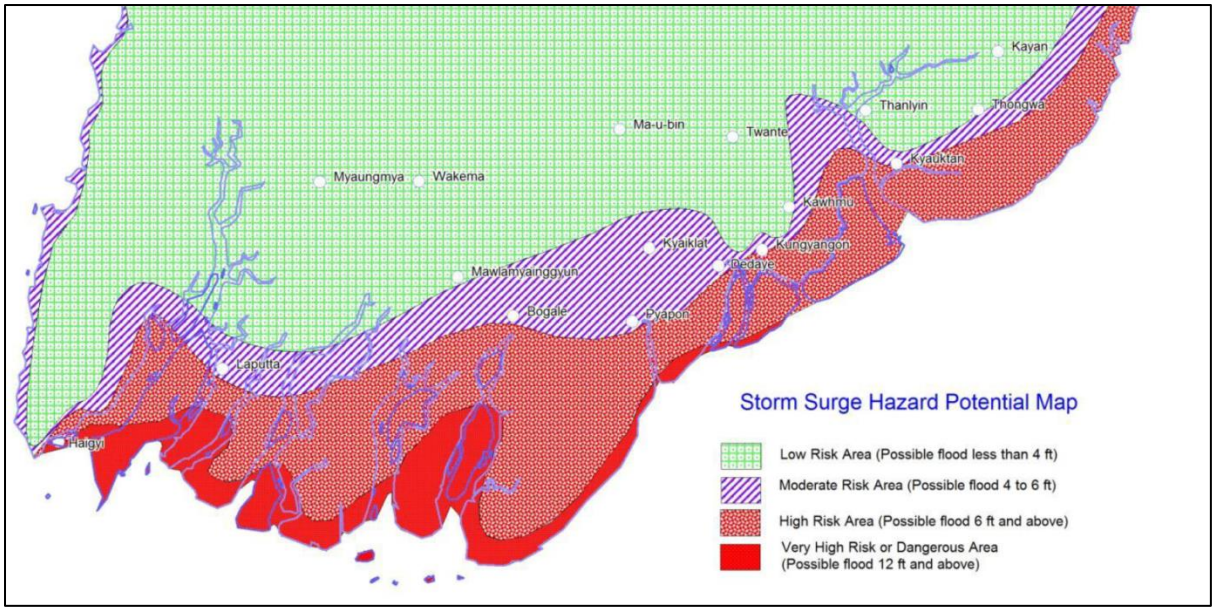

Figure 3-4: Storm Surge Hazard Potential Map

Source: Myanmar Environment Institute

3.3 Data and Summary Statistics

The study uses "Integrated Household Living Conditions Assessment (IHLCA) Survey" Myanmar, 2004 and 2009 round. The IHLCA project provides the statistical data for determining living conditions in the country. The survey included a nationwide representative sample of 37,232 households. The survey collects details information on the areas of social concern such as household characteristics, housing, education, health, consumption expenditures, household assets, labor and employment, business, and finance. Survey questions included our outcome of interests such as number of agricultural equipment, farm large animals, and motor boat own by household; whether household use their own land for crop production or not, whether household engage livestock breeding activities or not, whether household try to get agricultural loan, received loan, received agricultural services or not etc.,.

Table (3-1) summarizes details of the main variables used in this analysis. The observation used in this study is household level. The main dependent variables are based on household assets, business activities, agricultural loan, and agricultural services.

Table 3-1: Summary Statistics

Variable	Mean	Std.Dev.	Min	Max	*N*
Number of Agricultural Equipment	1.132	2.395	0	91	37,232
Number of Farm Large Animals	1.617	26.195	0	5,000	37,232
Number of Motor Boats	0.010	0.116	0	7	37,232
Land use for crop production (yes=1)	0.682	0.466	0	1	37,232
Engaged in livestock breeding activities (yes=1)	0.807	0.394	0	1	37,232
Try to get agricultural loan (yes=1)	0.093	0.291	0	1	37,232
Get loan from public bank (yes=1)	0.055	0.229	0	1	37,232
Get loan from private bank (yes=1)	0.001	0.030	0	1	37,232
Receive agricultural service from government (yes=1)	0.780	0.268	0	1	37,232
Receive agricultural service from private (yes=1)	0.030	0.170	0	1	37,232
Year (2009=1)	0.499	0.500	0	1	37,232
Household head’s gender (Male=1)	0.805	0.396	0	1	37,232
Age of household head	52.050	13.911	16	99	37,232
Household head’s education	5.771	3.828	0	13	37,232
Number of household members	5.203	2.284	1	24	37,232
Rural area (yes = 1)	0.703	0.457	0	1	37,232

3.4 Empirical Strategy

To investigate the situation of rebuilding agriculture activities and agricultural assistance after the Cyclone Nargis between households situated in severely Cyclone Nargis affected area (storm surge possible flood 6 ft and above) and households situated in less Cyclone Nargis affected area (storm surge possible flood under 6 ft), we mainly use a Difference-in-Differences approach. We compare the outcome variables between households which are situated in severely affected area (storm surge possible flood 6 ft and above) and households which are situated in less affected area (storm surge possible flood under 6 ft) by exploiting time variation (2004 as before Cyclone Nargis affected period and 2009 as after Cyclone Nargis affected period) by using the following equation:

$$Y_{ijt} = \beta_0 + \beta_1 Treat + \beta_2 Post + \beta_3 Treat * Post + X'_{ijt}\beta_4 + \in_{ijt} \quad (3.1)$$

Where "*i*" indicates household, "*j*" indicates township, and "*t*" indexes time periods, which are 2004 and 2009. "*Y*" denotes the outcomes of interest such as household assets, household business activities, and agricultural loan and services. "*Treat*" is a dummy variable which equals 1 for severely cyclone affected townships (storm surge possible flood 6 ft and above) and 0 for less cyclone affected townships (storm surge possible flood under 6 ft). "*Post*" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. 'X'_{ijt}' represents a set of household characteristics. Our coefficient of interest is "β_3". "$\mathcal{E}_{ijt}$" is the error term.

The coefficient of "*Treat*", β_1, is the expected difference in "*Y*" between the treatment group and control group prior to the intervention. The coefficient of "*Post*", β_2, is the predicted mean difference in outcome between the control group before and after the start of

intervention period. The coefficient of the interaction term "*Treat* x *Post*", β_3, describe the estimates from a Difference-in-Differences approach.

3.5 Main Results

Equation (3.1) investigate the situation of rebuilding agriculture activities and agricultural assistance after the Cyclone Nargis between households situated in severely affected area (storm surge possible flood 6 ft and above) and less affected area (storm surge possible flood under 6 ft). The main estimation results from equation (3.1) are reported in Table (3-2). Columns (1)-(5) provide estimates of number of agricultural equipment, number of farm large animals, number of motor boats, land use for crop production, and engaged in livestock breeding activities respectively. All specifications include household characteristics such as household head's gender, age, and education, number of household members, and place of resident.

Controlling for household characteristics, the study found that after the Cyclone Nargis, households situated in severely affected area have decreasing number of own agriculture equipment, own farm large animals, own motor boats, less likely to use land for crop production, and less likely to engage in livestock breeding activities. Holding other covariates constant, the estimates in Column (1), Column (2), and Column (3) show that the household situated in severely affected area after the Cyclone Nargis have 0.241 less number of agricultural equipment, 0.534 less number of farm large animals, and 0.049 less number of motor boats compare to their counterparts. As we all know, without agriculture equipment and farm large animals, it is very difficult to restart the agriculture and livestock breeding activities. The estimates in Column (4) and (5) also show that for the household situated in severely affected area, the probability of land use for crop production on their own land

reduced by 1.9 percent and the probability of engage in livestock breeding activities reduced by 19.8 percent compare to their counterparts. The results of Column (2), (3) and (5) are statistically significance.

These results are consistent with previous studies such as Doan (2008); Tinning (2008); UN (2010); and Turnell (2010). In the studies of Doan (2008); UN (2010); and Turnell (2010), the authors stated that Cyclone Nargis devastated crop land, agricultural equipment, motor boat ownership, and killed countless number of animals. Because of these major losses, the ability to grow crops, household gardening and livestock production activities of household situated in this cyclone affected area were disadvantaged. Tinning (2008) also mentioned that the direct effects of natural disasters such as infrastructure destruction have been experienced not only by the farmers returning to agriculture; they have also had a major indirect impact including high pest animals' populations, limited availability of agricultural inputs and agricultural extension services.

Table 3-2: Household Assets and Business Activities

	(1) Number of agricultural equipment	(2) Number of farm large animals	(3) Number of motor boats	(4) Land use for crop production	(5) Engaged in livestock breeding activities
Treat	0.373**	0.528**	0.032*	-0.011	0.163***
	(0.158)	(0.239)	(0.019)	(0.030)	(0.027)
Post	-0.076	-0.664***	0.004	0.596***	0.367***
	(0.094)	(0.112)	(0.013)	(0.021)	(0.020)
Treat x Post	**-0.241**	**-0.534****	**-0.049****	**-0.019**	**-0.198*****
	(0.187)	**(0.241)**	**(0.021)**	**(0.032)**	**(0.029)**
Male household head	0.114	-0.060	0.026*	-0.011	-0.024
	(0.190)	(0.272)	(0.016)	(0.022)	(0.020)
Age of household head	0.018***	0.010***	0.000	-0.000	-0.002***
	(0.003)	(0.004)	(0.000)	(0.001)	(0.001)
Household head education	0.030**	0.021	0.004**	-0.003	-0.001
	(0.015)	(0.021)	(0.002)	(0.003)	(0.002)
Number of household	0.125***	0.187***	0.013**	-0.000	-0.019***
members	(0.034)	(0.054)	(0.005)	(0.004)	(0.004)
Rural area	0.782***	0.892***	0.050***	-0.001	-0.209***
	(0.115)	(0.146)	(0.011)	(0.019)	(0.015)
N	2,128	2,128	2,128	2,128	2,128

Notes: Coefficients are reported with bootstrap standard errors in parentheses. The dependent variables in Columns (1) to (5) are "Number of agricultural equipment", "Number of farm large animals", "Number of motor boats", "Land use for crop production", and "Engaged in livestock breeding activities" respectively. "Treat" is a dummy variable which equals 1 for severely cyclone affected townships (storm surge possible flood 6 ft and above) and 0 for less cyclone affected townships (storm surge possible flood under 6 ft). "Post" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. The unit of observations is households. * p<0.10, ** p<0.05, *** p<0.01

To enable to restart their agriculture and business activities, households in natural disaster affected area need assistance or government support in terms of financial and other service such as providing seed, tools and fertilizers as well as agricultural extension service. Table (3-3) displays the main results from estimating equation (3.1) that presents agricultural loan and service. Columns (1)-(5) provide estimates of try to get agricultural loan, get loan from public bank, get loan from private bank, receive agricultural service from government, and receive agricultural service from private respectively. All specifications include household characteristics such as household head's gender, age, and education, number of household members, and place of resident.

Controlling for household characteristics, the study found that after the Cyclone Nargis, households situated in severely affected area need more financial support, government bank support more financial to this area than private bank, and both public and private sectors still weak in terms of supporting agricultural service. Holding other covariates constant, the estimate in Column (1) shows that the probability of household situated in severely affected area try to get agricultural loan by 2.5 percent more than before the Cyclone Nargis compare to their counterparts. In terms of public sector supporting activities, Column (2) and (4) show that, the probability of get loan from public bank is 5.5 percent more and probability of receive agricultural service from government is 0.8 percent less than before for household situated in severely affected area. In terms of private sector supporting activities, Column (3) shows the probability of get loan from private bank is 0.4 percent less and Column (5) shows the probability of receive agricultural service from private sector is 6.4 percent less compare to their counterparts. The results of Column (2) and (5) are statistically significance. So, we can conclude that both public and private sectors are still weak in terms of agricultural service activities and private sector supporting is still weak in financial assistance to agricultural sector.

These results are also contributed to previous studies. Doan (2008) pointed out that in recovering their livelihood, the effort by cyclone affected households were limited by the lack of capital because of the effects of death tools on rural Myanmar's credit-reliant system. With regard to the credit system of the affected areas of cyclone Nargis, South et al (2011) mentioned that in Myanmar, there is no proper banking system, no comprehensive rural credit mechanism supported by the government, or a sufficient small enterprise or micro-business credit lending system. But borrowing money from private lenders is a well-known coping strategy although it is not quite sustainable. Credits were more easily available in the past, but after cyclone, lenders especially rice millers, business people or richer families have been much more reluctant to provide the capital especially to the people who have not assets (who are the most needy and vulnerable) because they themselves have lost considerable assets because of the cyclone. Regarding the agricultural service activities, UN (2010) also pointed out that livelihoods recovery for households in cyclone affected townships remains weak as the extension services from government in forestry, agriculture, and aquaculture remained inadequate because of a severe shortage of human resources and financial capital. The scarcity of organizations in the civil society has also contributed to very few non-governmental organizations (NGOs) being able to fill the needs of capacity building (UNEP, 2009). Our findings are also consistent with Turner et al (2008), they mentioned that many local organizations which are qualified for cyclone response realizing that it is not sufficient to provide relief assistance alone, and are exploring ways to step beyond relief and participate in long term recovery activities.

Table 3-3: Agricultural Loan and Service

	(1) Try to get agricultural loan	(2) Get loan from public bank	(3) Get loan from private bank	(4) Receive agricultural service from government	(5) Receive agricultural service from private
Treat	-0.044***	-0.030***	0.002	-0.006	0.000
	(0.016)	(0.010)	(0.002)	(0.016)	(0.001)
Post	0.120***	0.089***	0.001	0.050***	0.072***
	(0.020)	(0.016)	(0.002)	(0.017)	(0.010)
Treat x Post	**0.025**	**0.055****	**-0.004**	**-0.008**	**-0.064*****
	(0.029)	**(0.023)**	**(0.003)**	**(0.025)**	**(0.012)**
Male household head	0.051***	0.052***	0.000	0.023	0.002
	(0.019)	(0.014)	(0.000)	(0.018)	(0.012)
Age of household head	0.002***	0.002***	-0.000	0.001**	0.001**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Household head education	0.002	0.002	-0.000	0.000	-0.001*
	(0.002)	(0.002)	(0.000)	(0.002)	(0.001)
Number of household	0.006*	0.005*	0.001	0.009***	-0.001
members	(0.003)	(0.003)	(0.000)	(0.003)	(0.001)
Rural area	0.173***	0.111***	0.001	0.117***	0.033***
	(0.012)	(0.010)	(0.001)	(0.011)	(0.005)
N	2,128	2,128	2,128	2,128	2,128

Notes: Coefficients are reported with bootstrap standard errors in parentheses. The dependent variables in Columns (1) to (5) are "Try to get agricultural loan", "Get loan from public bank", "Get loan from private bank", "Receive agricultural service from government", and "Receive agricultural service from private" respectively. "Treat" is a dummy variable which equals 1 for severely cyclone affected townships (storm surge possible flood 6 ft and above) and 0 for less cyclone affected townships (storm surge possible flood under 6 ft). "Post" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. The unit of observations is households. * p<0.10, ** p<0.05, *** p<0.01

3.6 Robustness Check

3.6.1 Robustness Check with Severely Affected and Not Affected Townships

In this section, we compare between severely affected and not affected townships to test the robustness of our main findings. We use equation (3.1) to investigate the situation of rebuilding agriculture activities and agricultural assistance after the Cyclone Nargis between households situated in the severely affected area (storm surge possible flood 6 ft and above) and not affected area. Table (3-4) displays the robustness check results from estimating equation (3.1) that presents household assets and business activities. Columns (1)-(5) provide estimates of number of agricultural equipment, number of farm large animals, number of motor boats, land use for crop production, and engaged in livestock breeding activities respectively. All specifications include household characteristics such as household head's gender, age, and education, number of household members, and place of resident.

Controlling for household characteristics, the results show that after the Cyclone Nargis, households situated in severely affected area have decreasing number of own agriculture equipment, own farm large animals, own motor boats, less likely to use land for crop production, and less likely to engage in livestock breeding activities. Holding other covariates constant, the estimates in Column (1), Column (2), and Column (3) show that the household situated in severely affected area after the Cyclone Nargis have 0.401 less number of agricultural equipment, 0.427 less number of farm large animals, and 0.052 less number of motor boats compare to their counterparts. The estimates in Column (4) and (5) also show that for the household situated in severely affected area, the probability of land use for crop production on their own land reduced by 3.1 percent and the probability of engage in livestock breeding activities reduced by 13.2 percent compare to their counterparts. All of the results are statistically significance except Column (4).

Table 3-4: Household Assets and Business Activities

	(1) Number of agricultural equipment	(2) Number of farm large animals	(3) Number of motor boats	(4) Land use for crop production	(5) Engaged in livestock breeding activities
Treat	-0.119	0.080	0.058***	0.002	0.086***
	(0.160)	(0.232)	(0.016)	(0.027)	(0.024)
Post	0.138	-0.782***	-0.002	0.622***	0.302***
	(0.104)	(0.103)	(0.006)	(0.015)	(0.014)
Treat x Post	**-0.401****	**-0.427***	**-0.052*****	**-0.031**	**-0.132*****
	(0.198)	**(0.250)**	**(0.019)**	**(0.029)**	**(0.026)**
Male household head	0.351**	0.101	0.010	0.021	-0.042***
	(0.142)	(0.205)	(0.010)	(0.018)	(0.015)
Age of household head	0.022***	0.003	-0.000	0.000	-0.002***
	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)
Household head education	0.042***	0.019	0.002*	0.001	-0.002
	(0.014)	(0.018)	(0.001)	(0.002)	(0.002)
Number of household	0.162***	0.211***	0.010**	0.003	-0.016***
members	(0.030)	(0.045)	(0.004)	(0.003)	(0.003)
Rural area	1.159***	1.006***	0.020***	-0.005	-0.150***
	(0.099)	(0.116)	(0.008)	(0.015)	(0.012)
N	3,186	3,186	3,186	3,186	3,186

Notes: Coefficients are reported with bootstrap standard errors in parentheses. The dependent variables in Columns (1) to (5) are "Number of agricultural equipment", "Number of farm large animals", "Number of motor boats", "Land use for crop production", and "Engaged in livestock breeding activities" respectively. "Treat" is a dummy variable which equals 1 for severely cyclone affected townships (storm surge possible flood 6 ft and above) and 0 for not cyclone affected townships. "Post" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. The unit of observations is households. * p<0.10, ** p<0.05, *** p<0.01

Table (3-5) displays the robustness check results from estimating equation (3.1) that presents agricultural loan and service. Columns (1)-(5) provide estimates of try to get agricultural loan, get loan from public bank, get loan from private bank, receive agricultural service from government, and receive agricultural service from private respectively. All specifications include household characteristics such as household head's gender, age, and education, number of household members, and place of resident.

Controlling for household characteristics, the results show that after the Cyclone Nargis, households situated in severely affected area need more financial support, government bank support more financial to this area than private bank, and both public and private sectors still weak in terms of supporting agricultural service. Holding other covariates constant, the estimate in Column (1) shows that the probability of household situated in severely affected area try to get agricultural loan by 4.2 percent more than before the Cyclone Nargis compare to their counterparts. In terms of public sector supporting activities, Column (2) and (4) show that government bank support 2.4 percent more financial and the probability of receive agricultural service from government is 3 percent less than before for household situated in severely affected area. In terms of private sector supporting activities, Column (3) shows the probability of get loan from private bank is 0.3 percent less and Column (5) shows the probability of receive agricultural service from private sector is 1.6 percent less than before compare to their counterparts. The results of Column (1) and (5) are statistically significance. Overall, we can conclude that in terms of financial and service activities for agricultural sector, both public and private sectors are still weak. The findings are consistent with our main results and this robustness check support the robustness of the baseline estimation results.

Table 3-5: Agricultural Loan and Service

	(1) Try to get agricultural loan	(2) Get loan from public bank	(3) Get loan from private bank	(4) Receive agricultural service from government	(5) Receive agricultural service from private
Treat	-0.048***	-0.020**	0.002	0.015	-0.015***
	(0.014)	(0.008)	(0.002)	(0.014)	(0.004)
Post	0.106***	0.116***	-0.000	0.080***	0.029***
	(0.014)	(0.012)	(0.000)	(0.012)	(0.007)
Treat x Post	**0.042***	**0.024**	**-0.003**	**-0.030**	**-0.016***
	(0.025)	**(0.021)**	**(0.002)**	**(0.023)**	**(0.009)**
Male household head	0.054***	0.042***	-0.000	0.012	0.012*
	(0.015)	(0.012)	(0.000)	(0.013)	(0.007)
Age of household head	0.002***	0.002***	-0.000	0.001***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Household head education	0.003*	0.000	-0.000	0.003**	-0.000
	(0.002)	(0.001)	(0.000)	(0.001)	(0.001)
Number of household	0.008***	0.007***	0.000	0.009***	0.000
members	(0.003)	(0.002)	(0.000)	(0.003)	(0.001)
Rural area	0.156***	0.103***	0.000	0.078***	0.023***
	(0.010)	(0.009)	(0.000)	(0.010)	(0.005)
N	3,186	3,186	3,186	3,186	3,186

Notes: Coefficients are reported with bootstrap standard errors in parentheses. The dependent variables in Columns (1) to (5) are "Try to get agricultural loan", "Get loan from public bank", "Get loan from private bank", "Receive agricultural service from government", and "Receive agricultural service from private" respectively. "Treat" is a dummy variable which equals 1 for severely cyclone affected townships (storm surge possible flood 6 ft and above) and 0 for not cyclone affected townships. "Post" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. The unit of observations is households. * p<0.10, ** p<0.05, *** p<0.01

3.6.2 Robustness Check with Probit Model

To conduct another robustness check, we use Probit estimation model. We conduct robustness checks for "Land use for crop production", "Engaged in livestock breeding activities", "Try to get agricultural loan", "Get loan from public bank", and "Receive agricultural service from government" by using the Probit model. The results of marginal effects of Probit model are shown in Table (3-6). All of the results are statistically significance except Column (5). The findings are also consistent with our main results and the results of robustness check support the robustness of the baseline estimation results.

Table 3-6: Robustness Check with Probit Model (Marginal Effects)

	(1) Land use for crop production	(2) Engaged in livestock breeding activities	(3) Try to get agricultural loan	(4) Get loan from public bank	(5) Receive agricultural service from government
Treat	-0.007	0.083***	-0.055***	-0.045***	-0.003
	(0.021)	(0.015)	(0.021)	(0.016)	(0.017)
Post	0.692***	0.319***	0.099***	0.065***	0.043***
	(0.031)	(0.022)	(0.016)	(0.012)	(0.015)
Treat x Post	**-0.148*** **	**-0.165*** **	**0.047***	**0.059*** **	**-0.005**
	(0.052)	**(0.301)**	**(0.026)**	**(0.019)**	**(0.023)**
Male household head	-0.021	-0.026	0.043**	0.039***	0.019
	(0.027)	(0.018)	(0.018)	(0.013)	(0.017)
Age of household head	-0.000	-0.002***	0.002***	0.001***	0.001**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Household head education	-0.004	0.001	0.003	0.003**	0.000
	(0.003)	(0.002)	(0.002)	(0.001)	(0.002)
Number of household	-0.000	-0.015***	0.006**	0.004**	0.007***
members	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
Rural area	-0.003	-0.212***	0.225***	0.125***	1.155***
	(0.022)	(0.019)	(0.019)	(0.014)	(0.017)
N	2,128	2,128	2,128	2,128	2,128

Notes: Coefficients are reported with bootstrap standard errors in parentheses. The dependent variables in Columns (1) to (5) are "Land use for crop production", "Engaged in livestock breeding activities", "Try to get agricultural loan", "Get loan from public bank", and "Receive agricultural service from government" respectively. "Treat" is a dummy variable which equals 1 for severely cyclone affected townships (storm surge possible flood 6 ft and above) and 0 for less cyclone affected townships (storm surge possible flood under 6 ft). "Post" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. The unit of observations is households. * p<0.10, ** p<0.05, *** p<0.01

3.6.3 Robustness Check with Log of Total Flooded Area

We also conduct extra robustness check with log of total flooded area. Figure (3-5) shows satellite-detected flooded waters over the affected Ayeyarwady division as of 5th May 2008. Red areas represent standing flood waters. Flooded area estimates by township have been calculated in km^2. In this setting, we used equation (3.1). But instant of using "Treat" dummy variable which equals 1 for severely cyclone affected townships (storm surge possible flood 6 ft and above) and 0 for less cyclone affected townships (storm surge possible flood under 6 ft), we used "Log of flooded area" variable which is a continuous variable of total flooded area (km^2) per township.

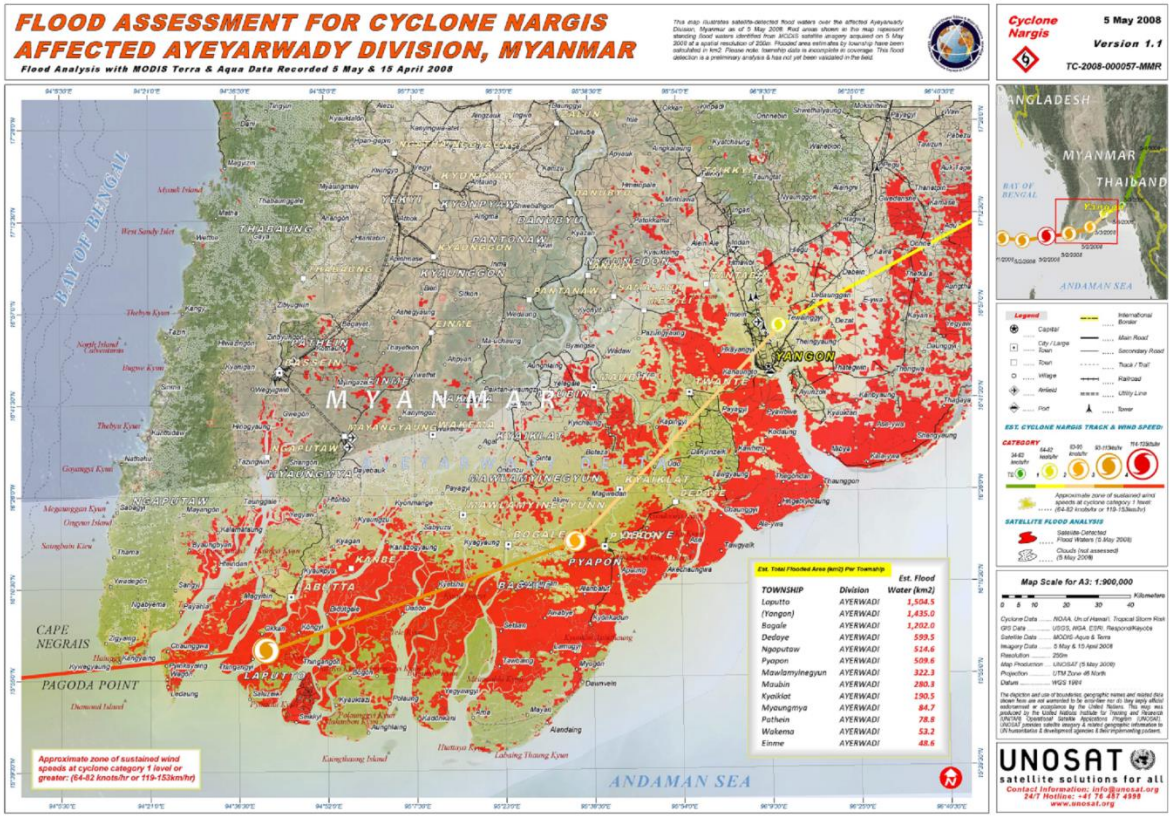

Figure 3-5: Flood Assessment for Cyclone Nargis Affected Ayeyarwady Division

Source: United Nations Operational Satellite Applications Programme (UNOSAT)

The robustness check estimation results for household assets and business activities are reported in Table (3-7). Columns (1)-(5) provide estimates of number of agricultural equipment, number of farm large animals, number of motor boats, land use for crop production, and engaged in livestock breeding activities respectively. All specifications include household characteristics such as household head's gender, age, and education, number of household members, and place of resident. Controlling for household characteristics, the results show that as the total flooded area increase after the Cyclone Nargis, households have decreasing number of own agriculture equipment, own farm large animals, own motor boats, less likely to use land for crop production, and less likely to engage in livestock breeding activities. The findings are consistent with our main results and the results of robustness check support the robustness of the baseline estimation results.

Table 3-7: Household Assets and Business Activities

	(1) Number of agricultural equipment	(2) Number of farm large animals	(3) Number of motor boats	(4) Land use for crop production	(5) Engaged in livestock breeding activities
Log of flooded area	0.285***	0.363**	0.020*	-0.006	0.099***
	(0.098)	(0.153)	(0.011)	(0.018)	(0.016)
Post	0.598	1.426	0.174**	0.659***	1.002***
	(0.678)	(0.932)	(0.083)	(0.119)	(0.112)
Log of flooded area x Post	**-0.125**	**-0.370****	**-0.030****	**-0.011**	**-0.115*****
	(0.113)	**(0.155)**	**(0.013)**	**(0.019)**	**(0.018)**
Male household head	0.112	-0.062	0.026*	-0.011	-0.025
	(0.188)	(0.282)	(0.015)	(0.022)	(0.019)
Age of household head	0.018***	0.009***	0.000	-0.000	-0.002***
	(0.003)	(0.004)	(0.000)	(0.001)	(0.001)
Household head education	0.028*	0.019	0.004***	-0.003	-0.001
	(0.015)	(0.022)	(0.002)	(0.003)	(0.002)
Number of household	0.125***	0.186***	0.013**	-0.000	-0.019***
members	(0.034)	(0.055)	(0.006)	(0.004)	(0.004)
Rural area	0.777***	0.889***	0.050***	-0.000	-0.209***
	(0.114)	(0.149)	(0.011)	(0.019)	(0.015)
N	2,128	2,128	2,128	2,128	2,128

Notes: Coefficients are reported with bootstrap standard errors in parentheses. The dependent variables in Columns (1) to (5) are "Number of agricultural equipment", "Number of farm large animals", "Number of motor boats", "Land use for crop production", and "Engaged in livestock breeding activities" respectively. "Log of flooded area" is a continuous variable of total flooded area (km^2) per township. "Post" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. The unit of observations is households. * p<0.10, ** p<0.05, *** p<0.01

The robustness check estimation results for agricultural loan and service are reported in Table (3-8). Columns (1)-(5) provide estimates of try to get agricultural loan, get loan from public bank, get loan from private bank, receive agricultural service from government, and receive agricultural service from private respectively. All specifications include household characteristics such as household head's gender, age, and education, number of household members, and place of resident. Controlling for household characteristics, the results show that as the total flooded area increase after the Cyclone Nargis, households need more financial support, government bank support more financial to this area than private bank, and both public and private sectors still weak in terms of supporting agricultural service. The findings are consistent with our main results and the results of robustness check support the robustness of the baseline estimation results.

Table 3-8: Agricultural Loan and Service

	(1) Try to get agricultural loan	(2) Get loan from public bank	(3) Get loan from private bank	(4) Receive agricultural service from government	(5) Receive agricultural service from private
Log of flooded area	-0.019**	-0.013**	0.002	-0.015	0.000
	(0.009)	(0.005)	(0.002)	(0.010)	(0.001)
Post	0.026	-0.111	0.013	0.053	0.306***
	(0.102)	(0.081)	(0.009)	(0.101)	(0.052)
Log of flooded area x Post	**0.017**	**0.035*** **	**-0.002**	**-0.001**	**-0.042*** **
	(0.016)	**(0.013)**	**(0.002)**	**(0.016)**	**(0.008)**
Male household head	0.052***	0.052***	0.000	0.023	0.003
	(0.019)	(0.014)	(0.000)	(0.017)	(0.011)
Age of household head	0.002***	0.002***	-0.000	0.001**	0.001**
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Household head education	0.002	0.002	-0.000	0.001	-0.001
	(0.002)	(0.002)	(0.000)	(0.002)	(0.001)
Number of household	0.006**	0.005*	0.001	0.009***	-0.001
members	(0.003)	(0.003)	(0.000)	(0.003)	(0.001)
Rural area	0.173***	0.111***	0.001	0.118***	0.033***
	(0.012)	(0.010)	(0.001)	(0.011)	(0.005)
N	2,128	2,128	2,128	2,128	2,128

Notes: Coefficients are reported with bootstrap standard errors in parentheses. The dependent variables in Columns (1) to (5) are "Try to get agricultural loan", "Get loan from public bank", "Get loan from private bank", "Receive agricultural service from government", and "Receive agricultural service from private" respectively. "Log of flooded area" is a continuous variable of total flooded area (km^2) per township. "Post" is a dummy variable which equals 1 if the survey year is 2009 and 0 if the survey year is 2004. The unit of observations is households. * p<0.10, ** p<0.05, *** p<0.01

3.7 Discussion and Conclusion

The study investigate the situation of rebuilding agriculture activities and agricultural assistance after the Cyclone Nargis between households situated in severely affected and less affected townships of Cyclone Nargis affected area. The uniqueness of this study is investigating on both physical and financial situation of households located in Cyclone Nargis affected area as well as the situation of government and private sector supporting activities for rebuilding agricultural business of these households after the Cyclone Nargis in one study.

The study found that after the Cyclone Nargis, households situated in severely affected area have decreasing number of own agriculture equipment, own farm large animals, and own motor boats, less likely to use land for crop production, and less likely to engage in livestock breeding activities. These findings support FAO (2009) report and in this report the author stated that the Cyclone Nargis affected area is Myanmar's rice bowl and the agriculture sector endured the most extensive damage.

To enable to restart their agriculture and business activities, households in natural disaster affected area need assistance or government support in terms of financial and other service such as providing seed, tools and fertilizers as well as agricultural extension service. Our study also found that after the Cyclone Nargis, households situated in severely affected area need more financial support, government bank support more financial to this area than private bank, and both public and private sectors still weak in terms of supporting agricultural service. All of these findings are consistent with Doan (2008) study. Doan (2008) pointed out that in recovering their livelihood, the effort by cyclone affected households were limited by the lack of capital because of the effects of death tools on rural Myanmar's credit-reliant system. Majority of the loans provided in rural areas are through business partners in vertical

arrangements within the sector, e.g., from traders and suppliers. The loss of business partners and husbands as the households' main contact with external business partners and relationship has major impact on the livelihood recovery.

We also checked the robustness of our baseline estimation results by using three types of robustness check although we could not do the falsification test because of the data limitation. All robustness check results are consistence with our baseline estimation results.

As we all know, most of the government, international agencies and local NGOs' efforts have been focused on food security, mainly on food distribution, and providing immediate access to critical agricultural inputs for the monsoon planting season; not much has been done in livelihoods recovery yet. It is very clear that there is need to recover livelihoods, particularly grants/credit to resume business and local economic infrastructure conducive to the local livelihood development. So, the government should initiate a variety of support schemes, including insurance cover, direct loss compensation, loans and cost share to rehabilitate damaged land following natural disasters, to tackle agricultural losses. Apart from these assistance programmess, local agricultural service organizations should conduct the supporting activities to the affected communities by collaboration with national and international agricultural agencies.

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