

**ANALYSIS OF FACTORS INFLUENCING WOMEN'S DECISION TO  
ADAPT TO CLIMATE CHANGE: THE CASE OF RURAL WOMEN IN  
HARAMAYA DISTRICT, EASTERN ETHIOPIA**

**M. Sc. THESIS**

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**Analysis of Factors Influencing Women's Decision to Adapt to Climate Change: The Case of Rural Women in Haramaya District, Eastern Ethiopia**

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MASTER OF SCIENCE IN AGROMETEOROLOGY AND  
NATURAL RISK MANAGEMENT**

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**April 2015  
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## **DEDICATION**

I dedicated this thesis work to my father Abdelhameid Abdelhai Osman.

## STATEMENT OF AUTHOR

By my signature below, I declare and affirm that this thesis is my own work. I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this Thesis. Any scholarly matter that is included in the Thesis has been given recognition through citation.

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## **BIOGRAPHICAL SKETCH**

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## **LIST OF ABBREVIATION**

|                 |                                                              |
|-----------------|--------------------------------------------------------------|
| CARE            | Cooperative for Assistance and Relief Everywhere             |
| CO <sub>2</sub> | Carbon Dioxide                                               |
| CSA             | Central Statistics Agency                                    |
| Das             | Development Agents                                           |
| EPA             | United States Environmental Protection Agency                |
| ESPJ            | Environmental Science and Policy Journal                     |
| FAO             | Food and Agricultural Organization                           |
| FGD             | Focus Group Discussion                                       |
| IPCC            | Intergovernmental Panel on Climate Change                    |
| MDG             | Millennium Development Goals                                 |
| NAP-GE          | National Action Plan for Gender Equality                     |
| OECD            | Organization for Economic Cooperation and Development        |
| PCGCC           | Pew Center on Global Climate Change                          |
| SPSS            | Statistical Package for Social Science                       |
| UNDP            | United Nations Development Program                           |
| UNFCCC          | United Nations Framework Convention on Climate Change        |
| UNISDR          | United Nations International Strategy for Disaster Reduction |
| USGCRP          | United States Global Change Research Program                 |
| VIF             | Variance Inflation Factor                                    |
| WDR             | Wide Dynamic Range                                           |
| WFP             | World Farmers' Organization                                  |
| WFP             | World Food Program                                           |
| WMO             | World Meteorological Organization                            |

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# **ANALYSIS OF FACTORS INFLUENCING WOMAN’S DECISION TO ADAPT TO CLIMATE CHANGE: THE CASE OF RURAL WOMEN IN HARAMAYA DISTRICT, EASTERN ETHIOPIA**

## **ABSTRACT**

*Climate change poses a great threat to human security through erratic rainfall patterns and decreasing crop yields, contributing to increased hunger. Adaptation is considered an appropriate response to climate change, especially for women farmers. Therefore, this study investigates whether women farmers in Haramaya recognize climate change and consequently adapt to it in their agricultural activities. The study also examines the factors influencing woman’s decision to adapt to climate change and identifying the types of climate change adaptation options practiced by women in Haramaya district, eastern Ethiopia. A multi-stage sampling procedure was employed to obtain a total of 150 rural women households in Haramaya district, while descriptive statistics and multinomial logit model (MNL) were used to analyze the data obtained from the households. The results showed that the most widely used adaptation method by women farmers were soil and water conservation measures (37.3percent). The multinomial logit analysis revealed that the factors influencing women’s decision to adapt to climate change include age of women, education, family size, farming experience, access to credit, access to information on climate change, total annual income, perception of women households on climate change and women empowerment. Therefore, the government needs to help farmers overcome constraints they face in taking up adaptation to climate change. Furthermore, the government can play a significant role by promoting policies aimed to enhance adaptation at household level through empowering women and the support of extension services, meteorological service by reporting and alerting households about weather changes in an understandable way so that they can be able to plan for their future farming.*

# **1. INTRODUCTION**

## **1.1. Background**

Climate change poses great challenges for the rural poor in developing countries who tend to rely on natural resources for their livelihoods and have limited capacity to adapt to climate change (UNFCCC, 2007). Long term changes in temperature and precipitation and increases in climate variability and extreme weather related events are already evident in many parts of the world. It has become increasingly clear that even serious efforts to mitigate climate change will be inadequate to prevent devastating climate change impacts that threaten to reverse many of the economic gains made in the developing world in recent decades (USGCRP, 2009).

Agriculture is the mainstay of the Ethiopian economy. Nonetheless, its contribution to ensure household food security is dramatically declining due to the fact that a large majority of the farmers operate at the smallholder level, and that a disproportionately large fraction of the agricultural output is in the hands of these smallholder farmers. These farmers are the most vulnerable groups to the effects of climate change among whom women are the most vulnerable despite of their substantial contribution to ensuring household food security and in the efforts geared towards mitigating the impacts of climate change adaptation (Petrie, 2010).

The vast majority of Ethiopians live in rural areas the majority of whom are women, who depend upon natural resources for their livelihoods, and they are engaged in rain-fed subsistence agriculture. Therefore, household food security largely influenced by some factors including “rainfall patterns, land degradation, climate change, population density, low levels of rural investment and the global market” (WFP, 2011). Women in rural areas in Ethiopia have the major responsibility for household water supply and energy for cooking and heating, as well as for food security, and are negatively affected by drought, uncertain rainfall deforestation because of their roles (Enete and Amusa, 2010).

Women are not only victims of climate change; they can be also effective agents in relation to adaptation, mitigation and disaster reduction strategies. Their responsibilities in households and communities as guardians of natural resources have prepared them well for livelihood strategies adapted to changing environmental realities. Given their roles in society, Women have important knowledge, skills and experiences for shaping the adaptation process and the search for better and safer communities (Emmeline, 2011).

Though the literature on climate change adaptation is quite extensive, much of it focuses on policy responses to climate change (either nationally or internationally) or community level often leaving out autonomous adaptation at the individual or household level and participation of women in adaptation efforts (Smit et al, 2009; Rasmus et al., 2009; Bryant et al., 2000 and Smit and Skinner, 2002). In the literature on gender and disasters, it is stated that women are more vulnerable in disasters because of their limited access to resources, that they have unique capacities as community leaders or managers of natural resources and that they are underutilized in strategies for managing emergencies (Agrawal and Perrin, 2008). Nonetheless, in the literature on climate change, it is beginning to be suggested that women generally understand better the causes and local consequences of changes in the climatic conditions and have the knowledge and skills for orienting the adaptation process because of their closeness to the local environment and high dependence on natural capital, their local knowledge systems are important for climate adaptation (UNISDR, 2008; Noor and Keerty, 2011).

## **1.2. Statement of the Problem**

Women in Ethiopia account for 50% of the population (CSA, 2007). Women are the main work force in most rural Ethiopia where economy depends on agriculture, and they are engaged in various economic activities including land cultivation and harvesting, food processing, marketing, gardening, construction of housing, and animal husbandry (Messay, 2012).

Climate change is not a gender neutral phenomenon, however, the poor people are the most affected by climate change, and that women being the disproportionate majority of the world's poor and because their role is primarily in household food security, therefore, they are the most vulnerable. In many parts of the world, women constitute the population most vulnerable to climate change, due to certain inequitable conditions and situations that place them at risk. Empirical evidence shows that women suffer a greater impact in a disaster or emergency; and economic losses have a disproportionate effect on economically vulnerable women (Enarson, 2000; Lambrou and Piana, 2005 and Rohr, 2007).

Haramya district is one of the most vulnerable areas to the impacts of climate change in eastern Hararghe, which is evidently seen by the drying of Lake Haramaya. The lake was a major source of water for the whole of Eastern Hararghe region as well as fluctuation of onset date and decreasing crop production (Socio economic profile of easrt Harerghe, 2006). The fact cannot be disputed that many factors or event exits influencing women's adaptation of climate change. However there is insufficiency of empirical analysis carried out to clarify the specific factors that influence women's decision to adapt to climate change, especially aiming rural women in Haramaya district. Therefore, this study is attempting to address this gap by trying to identify the factors influencing woman's decision to adapt to climate change in Haramaya district, Ethiopia.

### **1.3. Objectives of the Study**

#### **1.3.1. General objective**

The general objective of this study is to assess women's perception, identify the type of adaptation options and determine the factors that influence their decisions to adapt to climate change in Haramaya district.

#### **1.3.2. Specific objectives**

- To assess women's perception on climate change.
- To determine the factors influencing women's decisions in climate change adaptation.
- To identify the type of climate change adaptation options practiced by women in Haramaya district.

### **1.4. Research Questions**

- How do women perceive climate change?
- What are the factors influencing women's decision in climate change adaptation?
- What are the types of climate change adaptation options practiced by women household in Haramaya?

### **1.5. Significance of the Study**

Climate change affects agriculture, agriculture is the core for a country's economy therefore, the significance of this study lays ground to provide information for further improvement of adaptation to climate change and it contributes much to the agricultural development in the study area. The findings of this study may also be important for all development partners interested in issues of climate change and women such as researchers, extension workers, policy makers, education institutions, NGOs, and planners of adaptation strategies to climate change by creating awareness and make understanding about issues of women and adapting to climate change and the constraints women face in adaptation to climate change.

The research finding might be used to raise awareness among different stakeholders and also serve as background information for others who seek to do further related research and would serve in formulating the factors that influence women's decision to adapt to climate change in the region as well as other places. In addition to this, the result may also be used for drawing logical and conceptual relationships among variables. The in-depth review of literatures in this topic, apart from enhancing and enriching the knowledge base of the researcher, is believed to be a basic document in the field that could further enable different stakeholders at different level to look into dimensions of unused existing knowledge.

### **1.6. Scope and Limitation of the Study**

The objectives of this study are to analyze the factors that influence women's decisions to adapt to climate change, to assess women's perception on climate change and identify different climate change adaptation options practiced by women. However, this study is limited to Haramaya district in its three sample Kebeles. This may limit the representativeness of the study while intending to use it at zonal and other higher administrative level. Conceptually, the study focuses on factors affecting women to adapt to climate change, the study will not cover the entire rural women population in the study area due to time and budget constraints.

## **2. LITERATURE REVIEW**

### **2.1. Definition and Concepts of Climate Change**

Climate refers to the characteristic conditions of the earth's lower surface atmosphere at specific location. Weather refers to the day-to-day fluctuations in these conditions at the same location. The variables that are commonly used by meteorologists to measure daily weather phenomena are air temperature, precipitation (e.g., rain, sleet, snow and hail), atmospheric pressure and humidity, wind, and sunshine and cloud cover. When these weather phenomena are measured systematically at a specific location over several years, a record of observations is accumulated from which averages, ranges, maximums and minimums for each variable can be computed, along with the frequency and duration of more extreme events (FAO, 2008).

The World Meteorological Organization (WMO, 2008) defines climate change as 'a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (FAO, 2008). The most general definition of climate change is a change in the statistical properties of the climate system when considered over long periods of time, regardless of cause.

According to IPCC (2007), climate change is expressed as deviations from a regional climatology determined by analysis of long-term measurements, usually over a period of at least 30 years, or the normally experienced climate conditions and a different, but recurrent, set of climate conditions over a given region of the world. The Intergovernmental Panel on Climate Change (IPCC) predicts that during the next decades, billions of people, particularly those in developing countries, will face changes in rainfall patterns that will contribute to severe water shortages or flooding, and rising temperatures that will cause shifts in crop growing seasons. This will increase food shortages and distribution of disease vectors, putting populations at greater health and life

risks. The predicted temperature rise of 1 to 2.5 °C by 2030 will have serious effects, including reduced crop yield in tropical areas.

Earth's climate is changing in ways; Natural causes alone cannot explain all of these changes. Human activities are contributing to climate change, primarily by releasing billions of tons of carbon dioxide (CO<sub>2</sub>) and other heat-trapping gases, known as greenhouse gases, into the atmosphere every year. Climate changes will continue into the future. The more greenhouse gases we emit, the larger future climate changes will be. Changes in the climate system affect our health, environment, and economy. We can prepare for some of the impacts of climate change to reduce their effects on our well being (EPA, 2011).

## **2.2. Farmers' Perception and Adaptation to Climate Change**

Adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptations and implement them. Generally, studies on farmers' perception of an adaptation to climate change have elicited significant research interest in Africa. In one such study, Maddison (2006) notes that perception of climate change appears to hinge on farmer experience and the availability of free extension advice specifically related to climate change. In another study, Gbetibouo (2009) argues that farmers with access to extension services are likely to perceive changes in the climate because extension services provide information about climate and weather. Consequently, awareness and perceptions of a problem shapes action or inaction on the problem of climate change.

Adaptation at farm-level involves two stages: perceiving the change in climate, and deciding whether to adapt or not, or which adaptation strategy to choose (Maddison, 2007). There are still important questions on perception that need to be addressed, such as: Are farmers able to perceive the change in climate in the long run, which changes are they able to perceive, what economic, social and institutional factors influence their level and speed of perception (Deressa *et al.*, 2009). Farmers who have perceived the change in climate may not adapt or the nature of their adaptation response may vary as a result of a

complex interplay between social, economic and institutional factors (Maharjan *et al.*, 2011).

Adaptation to climate change includes all adjustments in behaviour or economic structure that reduce the vulnerability of society to changes in the climate system and Adaptability refers to the degree to which adjustments are possible in practices, processes or structures of systems to projected or actual changes of climate. Adaptation can be spontaneous or planned, and can be carried out in response or in anticipation of change in conditions (Smih *et al.*, 2009).

Adaptation options to climate change can be grouped into autonomous or private and planned or public sector adaptation strategies. Private adaptation strategies involve action taken by non-state agencies such as farmers, communities or organizations and or firms in response to climate change. According to Bruin (2011) adaptation strategies include switching crops, shifting crop calendar, engaging new management practices for a specific climate regime, changing irrigation system and selecting different cropping technologies. Public adaptation involves actions taken by local, regional and or national government to provide infrastructure and institutions to reduce the negative impact of climate change. Public adaptation strategies include development of new irrigation infrastructure, transport or storage infrastructure, land use arrangements and property rights, water shed management institutions (World Bank, 2010).

According to Sathaye and Christensen (1998), Bruin (2011) adaptation options can be either proactive or anticipatory depending whether it takes place before or after climate change. Reactive adaptation options addresses effects of climate change after they have been experienced, while proactive adaptation options are engaged in anticipation of climate change. In crop production, reactive adaptation options include control of soil erosion, construction of irrigation dams, improving soil fertility, development of new varieties, shifting planting and harvesting time. Anticipatory adaptation options on the other hand involve the development of tolerant cultivars, research development, policy measures on taxation and incentives. Gbetibouo (2009) suggested that smallholder farmers can adapt to climate change by changing planting dates and diversifying crops.

This can be possible if government provides them with the necessary support. Smallholder farmers can also adapt to climate change by practicing soil and water conservation measures and planting trees (Yesuf *et al.*, 2008).

### **2.3. Determinants of Adaptation to Climate Change**

Several factors have been put forward to explain the presence or absence of adaptation to climate change. Downing *et al.* (1997) explore fairly standard variables to explain adaptation in Africa. Nhemachena and Hassan (2007) identified the important determinants of adaptation to climate change in South Africa, Zambia and Zimbabwe to be access to credit and extension, and also farmers' awareness about climate change. As such, that study suggested enhancing access to credit and information about climate and agronomy so as to boost farmers' adaptation to climate change. Ishaya and Abaje (2008) found that lack of awareness and knowledge about climate change and adaptation strategies, lack of capital and improved seeds, and lack of water for irrigation played an important role in hindering adaptation to climate change in Jema'a Nigeria.

Gbetibouo (2009) proposed that the major driver influencing farmers' adaptation to climate change in Limpopo basin, South Africa, is the way that they formulate their expectations of future climate in dealing with the changing weather patterns. According to that study, the major factor restraining farmers' adaptation to climate change is inadequate access to credit. He argued as well that among other things, the main factors that promote adaptive capacity are farmers' income, the size of the household, farmers' experience, and engaging in non-farm activities

According to Yesuf *et al.* (2008) farmers' adaptation of climate change adaptation strategies is influenced by frequent and more accurate climate information from meteorological centres, formal and informal institutions, access to credit and extension information, amount of seasonal rainfall, geographical location, household size, age and literacy of household head. Deressa *et al.* (2008) urged that livestock ownership, local temperatures and amount of precipitation also determines the choice of households when adapting to climate change.

## **2.4. Studies Related to Women in Climate Change Adaptation**

In Ethiopia among the total heads of households, 25.5% are females with 23% of them rural and 39% in urban areas (Teya, 2009). Like many of their counterparts in developing countries, women in Ethiopia face a set of multiple, crosscutting and interrelated problems. These problems limit Ethiopian women's access to productive resources. Most of them do not participate in planning and decision-making process. They also lack necessary information and participation on important development issues which climate change represents one of the biggest constraints for it (Teya, 2009).

Women in rural areas can do possible roles which they can realistically play and hence demonstrate their capacity to adapt to changes of climate. Nobody at this time has an answer on how best to handle this problem, so although these are local strategies -it is better to be on the road to addressing climatic change. What are these roles women can play in climate change adaptation? Adaptation involves a range of activities to reduce vulnerability and build resilience. The key sectors concerning women's activities to adapt to climate change are agriculture, water, food Security, forests, health and the economy. Traditionally, women have been working and are still assuming their responsibilities in these sectors in most communities, so one needs to underline, that in these areas women are already very active and innovative in order to secure the survival of their families and communities (Frank, 2009).

The multiple family, community and productive functions that women perform in society are sources of knowledge and abilities to take action in the processes of adaptation and risk reduction. At the same time, however, this can also make them more vulnerable if there is no equity between men and women with respect to the responsibilities that they should assume in those processes. Adaptation strategies led by women can benefit the household or the community. Strategies of adaptation where women are overburdened with work in the domestic, labor and community circles are an example (UNISDR, 2003).

Women's capacity to adapt is reflected in the saying that necessity is the mother of invention. In conditions of vulnerability, poverty and limited resources - in which climate change is experienced as an exacerbating stress factor - women are forced, in the face of necessity and of a challenging situation - to turn to indigenous innovations (which often tend to be cost-effective and very efficient) so as to solve their own and their communities' problems. Women-led adaptation to climate change should not be seen in isolation from adaptation in related fields, as it is as much a developmental issue as an environmental one (WFO, 2012).

## **2.5. Conceptual Framework**

Literature review on climate change adaptation indicated that, adaptation to climate change is vital for rural people, which they can use to improve their productivity, income and to manage the resources, on which they depend, in sustainable way. Adaptation to climate change is the subject of considerable importance to rural population, especially to rural women who commonly suffer from isolation and have difficulties in communicating their priorities to decision makers adaptation to climate change depends to large extent on the extent of understanding of climate change, how to adapt with it and climatic information exchange between and among women farmers on the one hand, and a broad range of other actors on the other hand to plan effective adaptation activities.

The conceptual framework used in the present study portrays links between factors that affect the adaptation options of women farmers to climate change. Figure-1 portrays the conceptual framework that has been constructed based on the assumption that there are various driving forces behind women households' decisions to choose adaptation options to climate change. Some of the influencing factors that lead to adaptation options are economic factors such as Livestock holding, Farm size, Annual income and Non-farm income. The Institutional factors such as Access to market, Extension services, Access to credit, Exposure to information on climate change and Training. Demographic factors such as Sex of HHH, Family size, Education of women, Age of women and Farming experience. Psychological factors is Perception of women about climate change

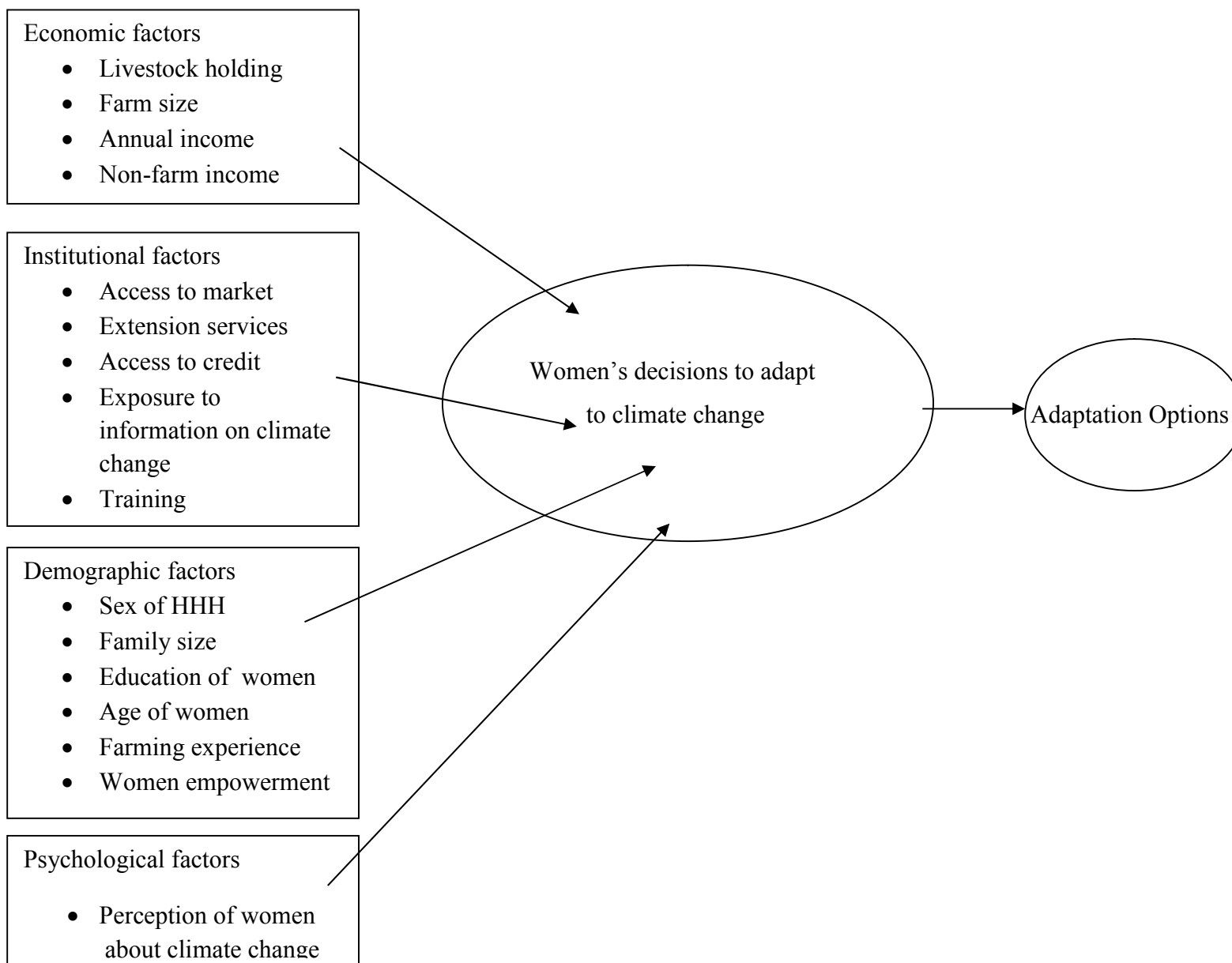


**Figure 1. Conceptual frame work showing factors influencing women decision to adapt to climate change**

### 3. METHODOLOGY

#### 3.1. Description of the Study Area

Haramaya is one of the districts in eastern Hararghe, Oromia National Regional State, Ethiopia. It is named after the non-existent lake, Haramaya. Haramaya is bordered on the south by Kurfa Chele district, on the west by Kersa district, on the north by Dire Dawa administration council, on the east by Kombolcha district, and on the southeast by the Harari National Regional State. Towns include Haramaya, Bati and Awoday.

The altitude of this district ranges from 1400 to 2340 meters above sea level; the highest points include Dof and Jeldo. The major river is Amaresa; a body of water used to include the disappeared Lake haramaya which has become history, as it stands now. (Socio economic profile of east Hararghe zone, 2006).

The predominant soil types of the district are Rigo soil (Haramayan series) 60% and heavy black clay soils (Vertisols) 40%. Soil texture is sandy loam. The rainfall of the District is bimodal, the short rain occurring between the months of February to May and the long rain occurring between the months of June to September. The mean annual rain fall is 492 mm ranging from 118-866 mm. The mean maximum and minimum temperatures are 24 and 9 degree Celsius respectively.

The 2007 national census reported a total population of this district to be 271, 018 persons of which 138,282 were men and 132,736 were women; and 50,032 or 18.46% of its population were urban dwellers. The majority of the inhabitants (96.7%) of the population are Muslims, while 2.7% of the population practices Ethiopian Orthodox Christianity (CSA, 2007).

Smallholder mixed farming system is the dominant mode of production of the farmers in the area. According to the information obtained from the districts office of agriculture, the farmers practice a cereal dominated cropping system with Sorghum (*Sorghum bicolor*), as the most important crop followed by maize (*zea mays*), groundnut, and wheat.

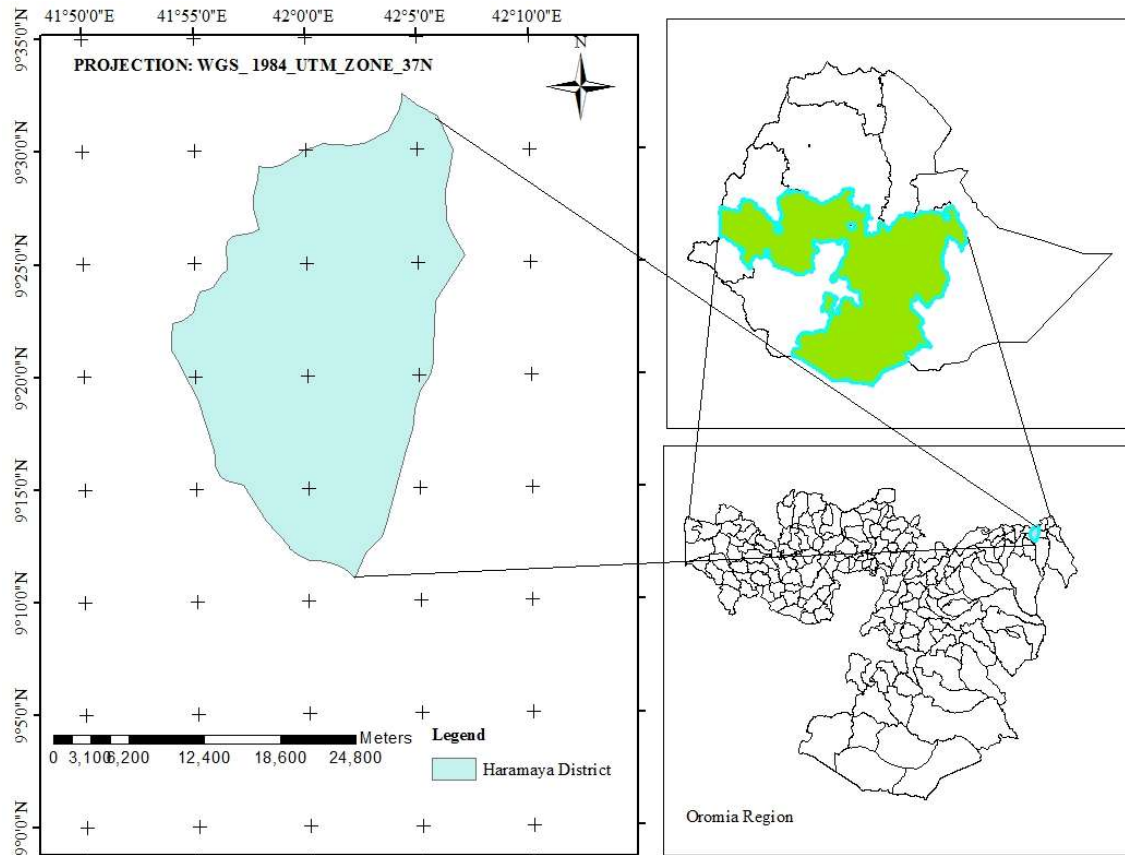


Figure 2. Maps of the study area

## 3.2. Research Design

With respect to the objectives and nature of the research question, this research is going to adopt a mixed research design .i.e. a combination of suitable qualitative and quantitative methods of data collection and analytic techniques. The overall framework of the study consists of qualitative and survey research approaches whereby the whole data collection processes complement each other. Hence, in this section, procedures of sample size determination, principles of data collection and method of data analysis for this study are discussed.

### 3.2.1. Sampling technique

This study was conducted in Haramaya district, Ethiopia. Haramya district was selected purposively considering the fact that it is one of the most vulnerable areas to the impacts

of climate change in eastern Hararghe, which is evidently seen by the drying of Lake Haramaya. Three kebeles (Villages) out of 33 kebeles were selected from Haramaya district purposively because they are more affected by climate change, and then a sample of 150 households was selected from the three kebeles using proportional to the size of the population.

Sample size was determined using the following formula;

$$\text{Sample size}(n) = \frac{N}{1 + N(e)^2} \quad (1)$$

Where, N is total population = 3859, e is standard error = 0.08 and n is Sample size =150

Table 1. Total and sample HHs within the selected kebeles

| Sample kebele  | Total population(HH) |                | Sample of women (HH)  |                     | Total |
|----------------|----------------------|----------------|-----------------------|---------------------|-------|
|                | Female headed HH     | Male headed HH | From female headed HH | From male headed HH |       |
| Tinike kebele  | 241                  | 979            | 9                     | 38                  | 47    |
| Finkile kebele | 301                  | 1264           | 12                    | 49                  | 61    |
| Damota kebele  | 70                   | 1004           | 3                     | 39                  | 42    |
| Total          | 612                  | 3247           | 24                    | 126                 | 150   |

Women in women headed household and women in men headed households were interviewed. A multi-stage sampling procedure was employed so as to obtain the survey data. In First stage, out of the 33 kebeles (Villages) of Haramaya District three kebeles (Tinike/Finkile/Damota) were selected purposively because they are more affected by climate change in the district. In Second stage, a list of households in the kebeles was obtained from the Kebele offices. In third stage, Male headed HHs (MHHs) and Female headed HHs (FHHs) were identified in collaboration with the administers, key informants and DAs of the respective PAs. Then, sample HHs from both MHHs and FHHs were selected using PPS sampling technique from the three kebeles. Finally a total of 150 rural women from both male and female-headed households were selected using symmetric simple random sampling technique.

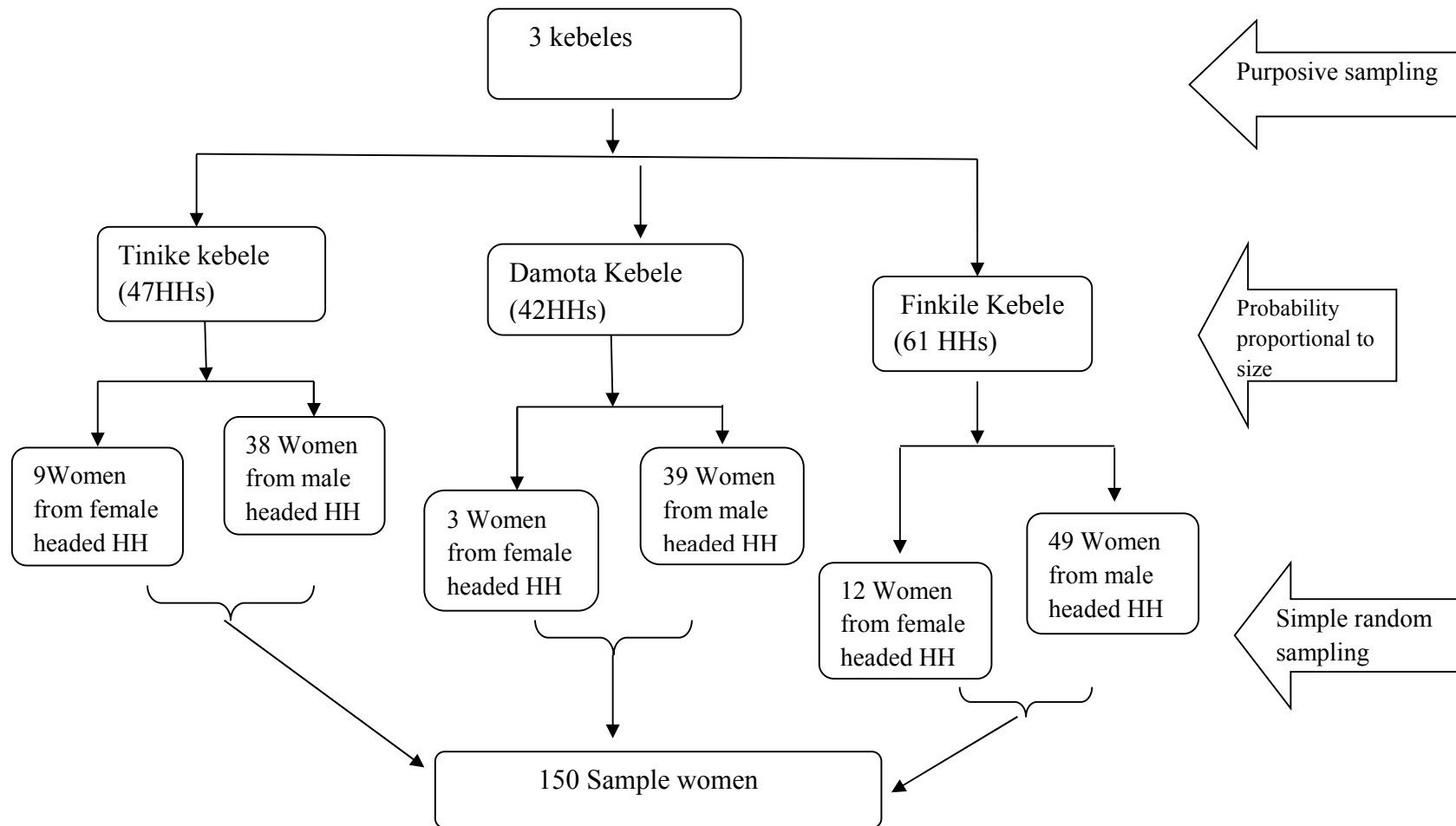


Figure 3. The sampling procedure

### **3.2.2. Sources and methods of data collection**

Data were collected from both primary and secondary sources. Primary data were collected from 150 sample rural women households drawn from three kebeles (Tinique, Finkile, Damota) out of 33 kebeles, through pre-tested interview schedule, Focus Group Discussions (FGD) and observation methods. Secondary data were collected from records of the district and regional agricultural office and related literatures prepped by governmental and non-governmental origination. In addition Statistical and meteorological data were used. The information includes the detailed data with regard to agriculture and other climate change adaptation activities of the women in the area.

Qualitative and quantitative data were collected through different methods. Qualitative data were collected through Focus Group Discussion (FGD) and observation methods. Three Focus Group Discussions were held in the three selected Kebeles, it was about how do women perceive climate change, do they believe that climate change has already happened, is climate change effect felt on their farming activities, and what are the types of climate change adaptation practices. Observation methods were used in the field to see whether women represent the largest group of labor on the farm as well observing different adaptation options practiced by women, that by employed an observation checklist. Qualitative data were used to substantiate quantitative data. Quantitative data were collected by administering a pre-tested interview schedule to the selected respondents. A questionnaire was used to collect information from the development agents, key informants. Development Agents were also consulted on identifying the appropriate time to get the sample respondents for data collection.

### **3.3. Methods of Data Analysis**

The available data were compiled using Statistical Package for Social Science (SPSS) and STATA software. The collected data were analyzed using both descriptive and inferential statistics. Multinomial Logistic Regression Model was used to identify the factors influencing women's decisions to adapt to climate change in Haramaya district. Descriptive statistics were applied, one can describe, compare, different categories of

sample units of women adaptation options to climate change. In this study, descriptive statistics such as mean, standard deviation, and percentages were employed to describe the event as it is, where as inferential statistics like independent sample t-test was used to see the difference in adaptation options from female headed households and women farmers from male headed households and  $\chi^2$ -test was also to test whether there is significance difference between women farmers who taken up adaptation options to climate change and women famers who did not take up to any measure with respect to various hypothesized discrete variables. Likert type scale was also used to measure perception of women about climate change. Qualitative data obtained from interview and discussion were analyzed and described through concepts and opinions, by sorting out, grouping and organizing in the field in order to supplement the survey result.

### **3.3.1. Econometric method**

In order to identify factors that affect women's decisions choice of adaptation options to climate change, categorical data in which the dependent variable is qualitative is deemed to be appropriate. When there are more than two alternatives among which the decision maker has to choose (i.e. unordered qualitative or polytomous variables), the appropriate econometric model would be either multinomial logit or multinomial probit regression models. However, the later, is rarely used in empirical studies due to estimation difficulties imposed by the need to solve multiple integrations related to multivariate normal distributions (Greene, 2003; Senait, 2005 and Chilot and Hassan, 2008). The dependent variable in this specific case, women's decisions to choice the adaption options to climate change. Thus, a multinomial logit model when the categorical dependent outcome has more than two levels need to be employed for such study (Alwang *et al.*, 2005; Brown *et al.*, 2006 and Jansen *et al.*, 2004). Moreover, multinomial logit model was selected not only because of the computational ease but also multinomial logit analysis exhibits a superior ability to predict the adaptation option to climate change and picking up the differences between the adaption options of rural women households. Therefore, multinomial logit model was used in this study in order to determent factors affecting rural women's to climate change adaptation options.

### 3.3.1.1. Specification of multinomial logit model

To identify the factors behind rural women's decision to adaption of climate change adaptation options the assumption is a rational women's choose among the different climate change adaptation options that offers the maximum utility which leads resilience. Following Greene (2003), suppose for the  $i^{\text{th}}$  respondent faced with  $j$  choices, we specify the utility choice  $j$  as

$$U_{ij} - Z_{ij}\beta + \varepsilon_{ij} \quad (2)$$

If the respondent makes choice  $j$  in particular, then we assume that  $U_{ij}$  is the maximum among the  $j$  utilities. So the statistical model is derived by the probability that choice  $j$  is made, which is:

$$\text{Prob}(U_{ij} > U_{ik} \text{ for all other } K \neq j) \quad (3)$$

Where,  $U_{ij}$  is the utility to the  $i^{\text{th}}$  respondent form climate change adaptation options  $j$

$U_{ik}$  the utility to the  $i^{\text{th}}$  respondent from climate change adaptation  $K$

If the household maximizes its utility defined over income realizations, then the household's choice is simply an optimal allocation of its asset endowment to choose adaption of climate change that maximizes its utility (Brown *et al.*, 2006). Thus, the  $i^{\text{th}}$  household's decision can, therefore, be modelled as maximizing the expected utility by choosing the  $j^{\text{th}}$  adaption options  $J$  discrete adaption options, i.e,

$$\max_j = E(U_{ij}) = f_j(x_i) + \varepsilon_{ij}; j = 0 \dots J \quad (4)$$

In general, for an outcome variable with  $J$  categories, let the  $j^{\text{th}}$  adaption options that the  $j^{\text{th}}$  women household chooses to maximize its utility could take the value 1 if the  $i^{\text{th}}$  women choose  $j^{\text{th}}$  adaption options and 0 otherwise. The probability that a woman with characteristics  $x$  chooses adaption options  $j$ ,  $P_{ij}$  is modeled as:

$$P_{ij} = \frac{\exp(X_i' \beta_j)}{\sum_{j=0}^J \exp(X_i' \beta_j)} \quad (5)$$

$$J = 1 \dots 3$$

With the requirement that  $\sum_{j=0}^J P_{ij} = 1$  for any  $i$

Where:  $P_{ij}$  = probability representing the  $i^{\text{th}}$  respondent's chance of falling into category  $j$   
 $X$  = Predictors of response probabilities

$\beta_j$  = Co variate effects Specific to  $j^{\text{th}}$  response category with the first category as the reference. Appropriate normalization that removes indeterminacy in the model is to assume that  $\beta_1 = 0$  (this arise because probabilities sum to 1, so only  $J$  parameter vectors are needed to determine the  $J + 1$  probabilities), (Greene, 2003) so that  $\exp(X_i' \beta_1) = 1$ , implying that the generalized equation (5) above is equivalent to

$$\Pr(y_i = j / X_i) = P_{ij} = \frac{\exp(X_i' \beta_j)}{1 + \sum_{j=1}^J \exp(X_i' \beta_j)} \text{ for } j = 0, 2 \dots J \text{ and}$$

$$\Pr(y_i = j / X_i) = P_{i1} = \frac{1}{1 + \sum_{j=1}^J \exp(X_i' \beta_j)}, \quad (6)$$

Where:  $Y$  = A polytomous outcome variable with categories coded from  $0 \dots J$ . Note: The probability of  $P_{i1}$  is derived from the constraint that the  $J$  probabilities sum to 1. That is  $P_{i1} = 1 - \sum P_{ij}$ . Similar to binary logit model it implies that we can compute  $J$  log-odds ratios which are specified as;

$$\ln\left[\frac{P_{ij}}{P_{iJ}}\right] = x'(\beta_j - \beta_J) = x\beta_j, \text{ if } J=0 \quad (7)$$

### 3.3.1.2. Coefficient interpretation

Since multinomial logit model is the extension of the binary logit models, the interpretations resemble that of binary logit models (Gujarati, 2004). The major difference is that the reference category now no longer the other choice as in binary logit. Probability in a multinomial logit model can be calculated similarly to that in a binary logit model, with the only modification being accounting for multiple sets of  $\beta$  estimates. The meaning of logit (log-odds) and odds term is identical in both models. In the binary case, the comparison is between category 1 and category 2 (or the first versus the last category). In multinomial case the comparison is between category  $j$  and  $J$  (or any category versus the last). The predicted probabilities are better interpreted using the marginal effects of the multinomial model (Greene, 2003). Therefore, every sub vector of  $\beta$  enters every marginal effect both through probabilities and through weighted averages that appears in  $\delta_{ij}$ . By differentiating equation (5) above with respect to the covariates we can find the marginal effect of the individual characteristics on the probabilities (Greene, 2003).

The marginal effects ( $\delta$ ) of the characteristics on the probabilities are specified as Where,  $\delta_i$  denotes the marginal effect (the coefficient), of the explanatory variable on the probability that alternative  $j$  is chosen.

Since the existence of strong multicollinearity seriously affects the parameter estimates of the regression models, it is necessary to check its occurrence among the explanatory variables. Accordingly, Variance Inflation Factor (VIF) technique was employed to detect the problem of multicollinearity for the continuous variables (Gujarati, 2004). Each selected variable is regressed on all the other variables, the coefficient of determination ( $R_j^2$ ) being constructed in each case.  $R_i^2$  is the square of the multiple

correlation coefficients that results when one explanatory variable ( $x_i$ ) is regressed against all the other explanatory variables. According to Gujarati (2004), VIF can be defined as:

$$VIF(x_i) = \frac{1}{1 - R_i^2} \quad (8)$$

If a strong linear relationship exists among the explanatory variables then this would result in large VIF value. A VIF value greater than 10 is used as a signal for the existence of a severe multicollinearity among explanatory variables. Likewise, there may also be interaction among in qualitative variables, which can lead to the problem of high degree of association. To detect this problem, contingency coefficients were computed from the survey data. The contingency coefficient is computed as:

$$C = \sqrt{\frac{x^2}{N + x^2}} \quad (9)$$

Where,  $C$  = Coefficient of contingency

$x^2$  = Chi-square random variable and

$N$  = total sample size.

The decision rule for contingency coefficients is that when its value approaches usually if it exceeds 0.75, there is a problem of association between the discrete variables. Data was be analyzed using both STATA13 and SPSS 20.

### **3.4. Research Hypothesis and Definitions of the Variables**

#### **3.4.1. Dependent variable**

The dependent variable for multinomial logit model is has nine choices which take nine values 1, 2, 3, 4, 5, 6, 7, 8 and 9. In this study dependent variable refers to women's decision on climate change adaptation options that are:

Y=1, Soil and water conservation

Y=2, if aforestation

Y=3, if short season varieties

Y=4, if underground water

Y=5, if water harvesting

Y=6, if intercropping

Y=7, if mixed farming

Y=8, if no adaptation option

Y=9, if all adaptation options

### 3.4.2. Independent variables

**Sex of household head (SEX):** This is a dummy independent variable, indicating the sex of the household head. A value of 1 represents if the household is male or 0, if female. Many evidences show that female household have less access to improved technologies, credit and extension service (Ellis and Mudhara, 1995). On the other hand, male-headed households have better access for information than female households that helps for adoption of climate change adaptation strategies. Therefore, male status of household head is positively correlated with adoption of climate change adaptation strategies.

**Education of women (EDUCATIONS):** This is a dummy variable which is takes value 1 if woman has educated or 0, if non- educated to. Education of women households is expected to be related positively since education is important to engage income earning potential of household. Educated women are able to acquire and process information easily which may lead to more adoption of crop. Maddison (2006) argues that education diminishes the probability that no adaptation is taken.

**Age of women (AGE):** These are the number of years of the woman and the variable is continuous. Deressa *et al.* (2010) argue that age of woman household represents experience in farming. The older the farmer, the more experienced the farmer in farming and the more she/he is exposed to past and present climatic conditions over longer horizons of her/his life spans. It is against this backdrop that this current study seeks to

establish whether age has any effect on women's adaptation in Haramaya district. The expected sign in this current study is positive.

**Total livestock ownership (NLSTLU):** It continuous variable refers to the total number of animals possessed by the household measured in tropical livestock unit (TLU). Livestock is considered as another asset which is a security against crop failure. As the total number of animals in the household increases, the household would be more likely to adapt to climate change. This can be attributed to increase wealth and income base of farm households which makes more money available in the households. (Tesfaye and Alemu, 2001) identified positive relationship between number of cattle owned and willingness to participate in climate change adaptation. Hence this variable is expected to be positive effect on adaption of climate change adaptation option.

**Access to credit (CRED):** Access to credit eases the financial constraints faced by the farmer. Availability of credit enhances probability of a woman to adapt strategies that reduce the negative impact of climate change to her/his household. Findings by Deressa *et al.* (2009), show that access to credit significantly influences the farmer to adapt to climate change. The expected sign is positive and this is a dummy variable coded 1 if the woman has access to credit and 0, otherwise.

**Exposure to information on climate change (INFOCC):** This variable measures the women's awareness to climate change information. Sources of information include media weather reports from the Department of Meteorological Service, extension officers and social networks such as farm to farm extension among others. Access to information on climate change influences the women's awareness to changes in climate and creates opportunities for the farmer to adopt suitable adaptation option that best suit the changed climatic conditions. Extension services are made available to the women farmers by the government and they serve as a source of technical information to farmers. Such services provide the farmer with information about the agricultural adaptation practices that are most suitable to their farms. Extension services also inform the farmers about the changing climatic conditions. Provision of such services enhances the chances of the women to adapt to climate change. Thus exposure to such information increases the

women's awareness. Hassan and Nhemachena (2007) find that access to information about climate change forecasting, adaptation options and other agriculture activities remain important factors determining use of various climate change adaptation option. This variable is dummy taking value of 1 if the woman is exposed to information on climate change and 0 otherwise. The expected sign is positive.

**Farming experience (EXPER):** Farming experience is the total number of years the respondents woman who has experience in farming and the variable is continuous. The more experienced the woman is likely to employ adaptation measures that reduce the effect of climate change on her agricultural activities. Hassan and Nhemachena (2008) contents that it is farming experience that matters more than merely the age of the farmer when it comes to adaptation to climate change. Study by Hassan and Nhemachena (2007) indicate that more farming experience increases the probability of a farmer adapting to climate change. This study hypothesises the same and the expected sign is positive.

**Farm size (FARMSIZ):** It is a continuous variable; farm size is the total land holding of farming household. This variable is measured in hectares. The bigger the size of the farm the greater the proportion of land allocated for improved crop varieties (Gershon *et al.*, 1985). The bigger the farm size, the more likely the farmer is to adapt suitable climate change adaptation options. The expected sign is positive and the variable is continuous recording the number of hectares of the farm.

**Family size (FASIZ):** Family size is measured by the number of members in a household. The variable is continuous. It is assumed to represent the labour input to the farm. While Mano and Nhemachena (2006) showed that large household size is mostly inclined to divert part of its labour force into non farming activities, which increases the chances of adapting to climate change, unlike the small household size. In this study to ascertain if it influences the probability of a woman to adapt to climate change in Haramaya district. The variable is expected to be positive if a woman has a large family.

**Non-farm income (NFINCO):** This is income derived from activities that are not associated with farming and it is a dummy variable which indicates whether the farmer earns income from non-farm activities or not. This variable takes a value 1 if the woman household involves in non-farm activities or 0, otherwise. Expected sign is positive. Responses to climate change through adaptation require sufficient financial well being (Deressa *et al.*, 2009), he notes that the higher income for the farmers the less risk averse. The effect is to boost the women's financial resources and hence her ability to adapt climate change options.

**Annual income of households (AINHH):** This is a continuous variable and refers to the annual income of households which is plays an important role in adaptation to climate change. Families with more annual income have more capacity to adapt to climate change. Hence, increase in the availability of family income is expected to have positive influence to woman's decision in adapting to climate change.

**Extension services (EXTENSION):** This is a dummy variable, which takes a value of 1 if the household utilize to extension service and 0, otherwise. Extension service play important role for rural farmers in terms of providing advice and information through extension agents on how to cope with climate change and how to use different improved agricultural technologies which in turn increase production and productivity of agriculture. It is therefore hypothesized that time of contact with extension agents will increase farmers knowledge of climate change adaptation. Therefore, it is hypothesized that, women who have an access to contact extension agents would have a better chance to adapt to climate change.

**Training (TRAINING):** It is dummy variable and it takes a value of 1 if the woman training on climate change adaptation and, 0 otherwise. Access to general training is expected to influence the probabilities of adaptation to climate change. Women who have got formal training are more likely to adapt to climate change (Ervin and Ervin, 1982).

**Access to the market from residence (MKACCESS):** It is a dummy variable that takes value 1 if the woman household has market access and 0, otherwise. As farm households

are nearer to market places, it is expected to be more likely participating in intensive farming activities that demands to adapt climate change and climatic information (Tesfaye, 2006). Therefore in this study, it is expected that as a given farm household gets far away from such centers the likelihood of adapting climate change adaptation options is decrease.

**Perception of women on climate change (PWOMENCC):** The farmers are assumed to hold specific perceptions regarding the effects of adaptation to climate change can be significant factors in their adaptation decisions (Wossink *et al*, 1997). In this study the perception of women is a dummy variable1 1, if the woman perceived there is change in climate and 0, otherwise. The expected sign is positive.

**Participation social organization (PARTORG):** Social participation such as (Cooperatives, women association) is important social asset and it expected to be positively influenced the probability of adaptation to climate change. It also assumed woman who has participated on social organization more likely to adapt to climate change. It will be treated as a dummy variable 1, if the woman participant in different social organization and 0, otherwise. Hence, it is hypothesized that social participation will influence adaption to climate change positively because farmers participating on social institution has a probability to get up to information about climate change for their agricultural production purpose.

**Women Empowerment (WEMPOWER):** Women empowerment is one of the factors that affect women's decision to adapt to climate change which is measured using Women's Empowerment in Agriculture Index (WEAI) . Women are more risk averse therefore, more likely to take decisions that minimize risks. It has also been found that women are more open to advice and are more willing to change their strategies in response to adapt to climate change (CARE, 2010). This variable is considered as a continuous variable and positively related to climate change adaptation.

## 4. RESULTS AND DISCUSSION

This chapter presents the finding of the study. The chapter is organized as follows. First, it presents socio-demographic characteristics of the sample respondents. Second, results on other key variables of the study are presented and finally, the finding from econometric model is presented.

### 4.1. Descriptive Analysis Results

#### 4.1.1. Socioeconomic and demographic characteristics of respondents

The result of the study (Table 2) showed that the mean age of the respondents laid on active age category which was 36.59 years with standard deviation of 6.13. This age makes women to utilize adaptation option to climate change. But old age has a negative relationship to adapting to climate change as agriculture is labour intensive hence it requires health individuals.

The results of the study (Table 2) showed that the average family size of the total women sample households is 5.73 with standard deviation of 1.69. Household size was one of the factors that affect women's decision to adapt to climate change. The average number of livestock which is measured in Tropical Livestock Unit (TLU) was 4.19 with standard deviation of 1.44. Concerning the livestock status of the women respondents, the number of livestock that a woman respondent is living was recorded and tropical livestock is also calculated. Accordingly, the minimum and maximum livestock ownership of the sample respondents was 1 and 9.72 by tropical livestock unit. The livestock is an asset/wealth for farmer; this means women who have the large livestock number they have more probability to adapt to climate change.

The average annual income of the women sampled households was 49645 Ethiopian Birr with standard deviation of 38050.42 (Table 2). Wealth is believed to reflect past achievement of households and their ability to bear risks. Thus, households with higher income are in a better position to adapt to climate change.

Table 2. Demographic and socio economic characteristics of respondents

| Variables | Mean   | Minimum | Maximum | Std.     |
|-----------|--------|---------|---------|----------|
| AGE       | 36.59  | 20.00   | 51.00   | 6.13     |
| FASIZ     | 5.73   | 2.00    | 8.00    | 1.68     |
| FARMSIZ   | 0.6775 | 0.12    | 3.00    | 0.47     |
| NLSTLU    | 4.19   | 1.00    | 9.72    | 1.44     |
| AINHH     | 49645  | 5000.00 | 281000  | 38050.42 |

The results of the (Table 2) shows that concerning the main occupation of the sample respondents, majority of the sample respondents 96.7% of them have depended on agriculture and as a supplementary they were engaged in many kind of business activities. Among the supplementary occupation salary employment and casual labour off farm accounts about 2.7% and 0.7% respectively. In Haramaya district women households depended on agriculture as a main occupation and agriculture is vulnerable to climate change risk hence their livelihood becomes abysmal with catastrophic poverty.

Table 3 below shows that, more than a half of the sample respondents were illiterate (70.7%) and this makes it is difficult for women households' to understand new adaptation options and those who can write and read constitute only 29.3. Education is very important for the women farmers to understand and interpret the information coming from any source. It also enhances the capacity to obtain, process, and utilize information disseminated by different sources.

The distribution of the women farmers by their years of farming experience in the table 3 below showed that the highest proportion (48%) of the women farmers had over 15 years of farming experience followed by farmers between 11-15 years (28%) of farming experience. This suggests that a higher proportion of the women farmers who had more than ten years of farming experience were likely to understand the effect of climate change and take up some measures to adapt to it.

Table 3. Demographic and socio economic characteristics of respondents

| Variables                  | N   | Percent |
|----------------------------|-----|---------|
| <b>Occupation</b>          |     |         |
| Farming crop and livestock | 145 | 96.7    |
| Salary employment          | 4   | 2.7     |
| Casual labour off farm     | 1   | 0.7     |
| Total                      | 150 | 100.0   |
| <b>Education</b>           |     |         |
| Educated                   | 44  | 29.3    |
| Non-educated               | 106 | 70.7    |
| Total                      | 150 | 100.0   |
| <b>Farm experience</b>     |     |         |
| 1-5                        | 2   | 1.3     |
| 6-10                       | 33  | 22.0    |
| 11-15                      | 42  | 28.0    |
| >15                        | 73  | 48.7    |
| Total                      | 150 | 100.0   |

Table 4 shows that women farmers' get information from Development Agents, mass media, neighbors or friends, farmers' group and NGO.

Table 4. Sources of information on climate change

| Source of information | N   | %     |
|-----------------------|-----|-------|
| Development Agents    | 30  | 20    |
| Mass media            | 48  | 32.0  |
| Neighbors or friends  | 14  | 9.33  |
| Farmers' group        | 18  | 12.0  |
| NGO                   | 20  | 13.33 |
| No information        | 20  | 13.33 |
| Total                 | 150 | 100   |

To test whether there is significance difference in the percentage of women farmers who practiced adaptation options to climate change and women farmers who did not practice any measure with respect to various hypothesized discrete variables, Chi-square analysis was conducted. The Chi-square analysis shows the existence differences between the different adaptation options taken by women farmers. The descriptive results of the study

shows that the different adaptation options (Soil and water conservation ,aforestation, short season varieties, underground water, water harvesting, intercropping, mixed farming, no adaption option and all adaption options) taken by women farmers as envisaged at less than 10% and result 13.799, 14.455 and 13.726 for education status, access to credit and extension services respectively (table5).

The  $\chi^2$  test revealed the existence of significant difference between the women farmers in choosing of climate change adaptation options ( $P < 0.000$ ) with  $\chi^2$  results of 55.998 with respect to perception on climate change and there is significance difference between women farmers in taking up adaptation options ( $P < 0.05$ ) with  $\chi^2$  results of 18.805, 17,343 for training, social participation. On the other hand the  $\chi^2$  analysis did not show statistically significant difference in percentage between women farmers who taken different adaptation option with respect to non-farm income, distance to market, and sex of the head of the household.

Table 5. Summary of descriptive analysis for dummy variables

|           |              | Adaptation options |    |    |   |    |   |    |   |    | $\chi^2$ | <i>P</i> |
|-----------|--------------|--------------------|----|----|---|----|---|----|---|----|----------|----------|
| Variables |              | 1                  | 2  | 3  | 4 | 5  | 6 | 7  | 8 | 9  |          |          |
| EDUCATION | Educated     | 5                  | 11 | 8  | 2 | 11 | 0 | 1  | 2 | 8  | 13.799   | 0.087*   |
|           | non-educated | 4                  | 20 | 9  | 7 | 40 | 3 | 9  | 2 | 8  |          |          |
| Total     |              | 9                  | 31 | 17 | 9 | 51 | 3 | 10 | 4 | 16 |          |          |
| TRAINING  | No           | 7                  | 2  | 0  | 2 | 1  | 0 | 1  | 2 | 0  | 18.805   | 0.016**  |
|           | Yes          | 50                 | 6  | 8  | 4 | 42 | 1 | 6  | 2 | 16 |          |          |
| Total     |              | 57                 | 8  | 8  | 6 | 43 | 1 | 7  | 4 | 16 |          |          |
| CRED      | No           | 8                  | 31 | 16 | 9 | 51 | 3 | 8  | 4 | 15 | 14.455   | 0.071*   |
|           | Yes          | 1                  | 0  | 1  | 0 | 0  | 0 | 2  | 0 | 1  |          |          |
| Total     |              | 9                  | 31 | 17 | 9 | 51 | 3 | 10 | 4 | 16 |          |          |
| PARTORG   | No           | 2                  | 0  | 3  | 0 | 2  | 0 | 0  | 1 | 0  | 17.343   | 0.027**  |
|           | Yes          | 7                  | 31 | 14 | 9 | 49 | 3 | 10 | 3 | 16 |          |          |
| Total     |              | 9                  | 31 | 17 | 9 | 51 | 3 | 10 | 4 | 16 |          |          |
| PWOMENCC  | No           | 23                 | 6  | 4  | 4 | 18 | 0 | 1  | 3 | 11 | 55.998   | 0.000*** |
|           | Yes          | 34                 | 2  | 4  | 2 | 25 | 1 | 6  | 1 | 5  |          |          |
| Total     |              | 57                 | 8  | 8  | 6 | 43 | 1 | 7  | 4 | 16 |          |          |
| NFINCO    | No           | 47                 | 4  | 4  | 6 | 37 | 1 | 6  | 4 | 15 | 15.984   | 0.04     |
| Total     | Yes          | 10                 | 4  | 4  | 0 | 6  | 0 | 1  | 0 | 1  |          |          |
| MKACCESS  | Near         | 9                  | 27 | 11 | 7 | 32 | 2 | 4  | 2 | 14 | 17.758   | 0.023    |
|           | Far          | 0                  | 4  | 6  | 2 | 19 | 1 | 6  | 2 | 2  |          |          |
| Total     |              | 9                  | 31 | 17 | 9 | 51 | 3 | 10 | 4 | 16 |          |          |
| EXTENSION | No           | 25                 | 0  | 2  | 2 | 13 | 1 | 2  | 1 | 3  | 13.726   | 0.089*   |
|           | Yes          | 32                 | 8  | 6  | 4 | 30 | 0 | 5  | 3 | 13 |          |          |
| Total     |              | 57                 | 8  | 8  | 6 | 43 | 1 | 7  | 4 | 16 |          |          |
| SEX       | Male         | 44                 | 6  | 6  | 5 | 33 | 1 | 5  | 2 | 16 | 7.162    | 0.519NS  |
|           | Female       | 13                 | 2  | 2  | 1 | 10 | 0 | 2  | 2 | 0  |          |          |
| Total     |              | 57                 | 8  | 8  | 6 | 43 | 1 | 7  | 4 | 16 |          |          |

The descriptive result on (Table 6) shows that Age, farm experience, annual income, family size and women empowerment are the essential factors that enhance or inhibiting climate change adaptation. Therefore, this study depicted that annual income and family size and women empowerment significantly explain climate change adaptation options. The younger women household with more farm experience, the likelihood of adapting to climate change is increased. As the women farmers income increase the probability to adapt to climate change increased. When women are empowered, the likelihood of adapting to climate change is increased.

Table 6. Summary of descriptive analysis for continuous variables

|        | Adaptation options | N   | Mean    | Std. Deviation | F     | P value |
|--------|--------------------|-----|---------|----------------|-------|---------|
| AGE    | 1                  | 18  | 36.3333 | 6.78233        | 2.291 | .025**  |
|        | 2                  | 9   | 40.667  | 5.28982        |       |         |
|        | 3                  | 12  | 35.5833 | 5.58339        |       |         |
|        | 4                  | 11  | 35.2727 | 6.08426        |       |         |
|        | 5                  | 61  | 37.3443 | 5.87618        |       |         |
|        | 6                  | 5   | 35.4000 | 8.08084        |       |         |
|        | 7                  | 14  | 37.0714 | 5.69027        |       |         |
|        | 8                  | 4   | 38.5000 | 5.74456        |       |         |
|        | 9                  | 16  | 32.8750 | 6.08687        |       |         |
|        | Total              | 150 | 36.5933 | 6.12958        |       |         |
| EXPER  | 1                  | 18  | 15.9444 | 9.08439        | 1.818 | 0.078*  |
|        | 2                  | 9   | 17.333  | 7.59934        |       |         |
|        | 3                  | 12  | 15.0833 | 4.37884        |       |         |
|        | 4                  | 11  | 15.2727 | 9.19881        |       |         |
|        | 5                  | 61  | 15.8852 | 6.51434        |       |         |
|        | 6                  | 5   | 18.2000 | 7.49667        |       |         |
|        | 7                  | 14  | 16.0000 | 4.47214        |       |         |
|        | 8                  | 4   | 18.5000 | 14.36431       |       |         |
|        | 9                  | 16  | 16.3125 | 8.11352        |       |         |
|        | Total              | 150 | 16.4933 | 6.70643        |       |         |
| NLSTLU | 1                  | 18  | 4.3976  | 1.29347        | .643  | .741    |
|        | 2                  | 9   | 4.3718  | 0.70288        |       |         |
|        | 3                  | 12  | 3.8178  | 1.41044        |       |         |
|        | 4                  | 11  | 3.6227  | 1.04978        |       |         |
|        | 5                  | 61  | 4.1970  | 1.53642        |       |         |
|        | 6                  | 5   | 4.1846  | 2.12297        |       |         |
|        | 7                  | 14  | 4.7355  | 1.86669        |       |         |
|        | 8                  | 4   | 3.7990  | .69952         |       |         |
|        | 9                  | 16  | 4.1489  | 1.34659        |       |         |
|        | Total              | 150 | 4.1932  | 1.44242        |       |         |

Table 6. (Continued)

| Adaptation options |       | N   | Mean     | Std. Deviation | F     | P value   |
|--------------------|-------|-----|----------|----------------|-------|-----------|
| FARMSIZ            | 1     | 18  | 0.5875   | 0.36322        | 1.158 | .329      |
|                    | 2     | 9   | 0.7761   | 0.53006        |       |           |
|                    | 3     | 12  | 0.8854   | 0.68973        |       |           |
|                    | 4     | 11  | 0.6155   | 0.24905        |       |           |
|                    | 5     | 61  | 0.7297   | 0.49813        |       |           |
|                    | 6     | 5   | 0.6150   | 0.54245        |       |           |
|                    | 7     | 14  | 0.5781   | 0.32614        |       |           |
|                    | 8     | 4   | 0.2800   | 0.06000        |       |           |
|                    | 9     | 16  | 0.6169   | 0.43192        |       |           |
|                    | Total | 150 | 0.6775   | 0.46639        |       |           |
| AINHH              | 1     | 18  | 9.9497E3 | 7599.08881     | 6.243 | 0.002 *** |
|                    | 2     | 9   | 8.7587E3 | 2717.12863     |       |           |
|                    | 3     | 12  | 1.5563E4 | 14339.45221    |       |           |
|                    | 4     | 11  | 7.6331E3 | 2499.40991     |       |           |
|                    | 5     | 61  | 1.2158E4 | 9898.51936     |       |           |
|                    | 6     | 5   | 8.4840E3 | 4690.04307     |       |           |
|                    | 7     | 14  | 1.0887E4 | 7850.68046     |       |           |
|                    | 8     | 4   | 6.4980E3 | 3841.23105     |       |           |
|                    | 9     | 16  | 9.8738E3 | 8557.84745     |       |           |
|                    | Total | 150 | 1.0994E4 | 8948.2031      |       |           |
| FASIZ              | 1     | 18  | 5.8333   | 1.79050        | 3.890 | 0.023**   |
|                    | 2     | 9   | 5.0000   | 2.29129        |       |           |
|                    | 3     | 12  | 5.9167   | 1.50504        |       |           |
|                    | 4     | 11  | 5.4545   | 1.57249        |       |           |
|                    | 5     | 61  | 5.7869   | 1.71381        |       |           |
|                    | 6     | 5   | 6.0000   | 2.00000        |       |           |
|                    | 7     | 14  | 5.3571   | 1.82323        |       |           |
|                    | 8     | 4   | 6.5000   | 1.00000        |       |           |
|                    | 9     | 16  | 5.8750   | 1.31022        |       |           |
|                    | Total | 150 | 5.7267   | 1.68251        |       |           |
| EMPOWERMENT        | 1     | 57  | .6633    | .05959         | 4.448 | .000***   |
|                    | 2     | 8   | .6799    | .04384         |       |           |
|                    | 3     | 8   | .7132    | .06732         |       |           |
|                    | 4     | 6   | .6713    | .05894         |       |           |
|                    | 5     | 43  | .6345    | .05910         |       |           |
|                    | 6     | 1   | .6000    | -              |       |           |
|                    | 7     | 7   | .6437    | .07491         |       |           |
|                    | 8     | 4   | .5333    | .14186         |       |           |
|                    | 9     | 16  | .6833    | .03496         |       |           |
|                    | Total | 150 | .6562    | .06614         |       |           |

## 4.2. Women Perception on Change of Temperature

Table 7 presents sampled women's perception of change on temperature. 52% of the interviewed women households perceived and agreed an “increase” in temperature. 15.33% of the interviewed women households perceived and strongly agreed an “increase” in temperature. 14% of respondents somewhat agreed there is change in temperature. 0.67% of respondents did not perceive an increase in temperature. 18% of respondents perceived “no change” in temperature at all. On the other hand 81.33% of respondents perceived an increase in temperature, while only of respondents disagreed or in contrary to this opinion (i.e. the change in climate). However, all the farmers have perceived change in temperature. To verify women farmers perceived long-term change in temperature, the historical mean annual temperature data in Haramaya from 1991 to 2014 (20 years), with omission from 1993 up to 1996, were analyzed. The data shows a slight increasing trend in temperature starting from 1991 to 2014 (Figure 4). Coinciding with the finding from the majority of the respondents from the focus group discussion it was also found that most people have observed changes in climate such as higher temperature (hotter), shortage of rainfall, drought, and changes in timing of rain. Women farmers in all studied area realized that the causes of climate change are forest degradation, chemical fertilizer and pesticide and other human activities.

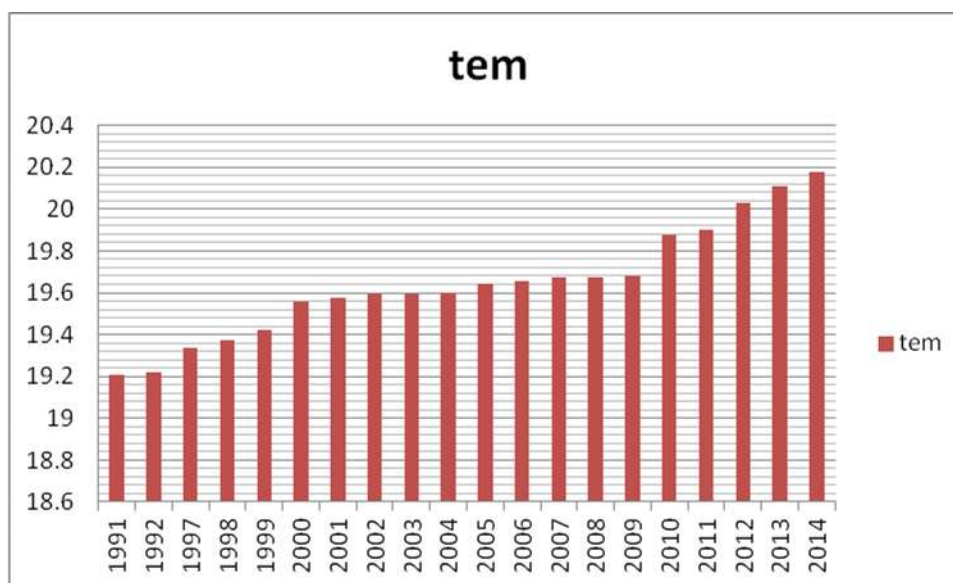


Figure 4. long term changing in mean temperature

There was a clear resemble between the majority of the farmers' perception towards increase in temperature and temperature trend over the past 20 years. The likeness in farmers' perception and the actual temperature data could be seen from one perspective.

Table 7. Women's perception on change of temperature

| Perception        | WFFHH     |        | WFMHH |       | Total |       |
|-------------------|-----------|--------|-------|-------|-------|-------|
|                   | N         | %      | N     | %     | N     | %     |
| strongly disagree | 4         | 16.70  | 23    | 18.30 | 27    | 18    |
| Disagree          | 0         | 0.00   | 1     | 0.80  | 1     | 0.67  |
| somewhat agree    | 3         | 12.50  | 18    | 14.30 | 21    | 14    |
| Agree             | 10        | 41.70  | 68    | 54.00 | 78    | 52    |
| strongly agree    | 7         | 29.20  | 16    | 12.70 | 23    | 15.33 |
| Total             | 24        | 100.00 | 126   | 100   | 150   | 100   |
| Mean              | 3.67      |        | 3.42  |       | 3.46  |       |
| SD                | 1.37      |        | 1.27  |       | 1.288 |       |
| $\chi^2$          | 32.811*** |        |       |       |       |       |
| P-value           | 0.001     |        |       |       |       |       |

### 4.3. Women Perception on Change of Rainfall

Results in (Table 8) revealed that most of the interviewed women farmers perceived rainfall changes, quantity of rainfall in the study area over the last 20 years. Substantial percentage of respondents (93.33%) perceived a decrease in the amount of rainfall, while very few (6.66%) perceived no change in rainfall amount at all. Out of 93.33% respondents who perceived the change in rainfall amount, 51.3% of the respondents felt a decrease in the amount of rainfall, and 9.3% of respondents strongly agreed there is a decrease in the amount of rainfall, 32.7% of the respondents somewhat agreed that there is change in the amount of rainfall; on the contrary, out of 6.66% of the respondents who noticed no change in the amount of rainfall; 5.3% of the respondents disagreed there is change in the amount of rainfall and 1.3% of respondents strongly disagreed that there is change in the amount of rainfall.

Coinciding with the finding from the focus group discussion, all the women farmers have perceived temperature and rainfall changes in the study area over the last 20 years. The majority of the respondents said the main effect of climate change in Haramaya due to shortage of rainfall and drought occurred in all kebeles, women farmers in all kebeles realized that they will gain less yield of sorghum, maize and damaged crops because of insufficient water for crops. Once their crops were damaged, they have to replant crops by the same varieties of the previous crops. Some women farmers are facing with drought or lacking of water, they have tried using short season varieties. All respondents have considered that they are most vulnerable to climate change due to rise in temperature, shortage of rainfall, no sufficient water sources both for domestic use and crops, lack of awareness and understanding on climate change.

Table 8. Women's perception on change of rainfall

| Perception        | WFFHH   |        | WFMHH   |         | Total  |         |
|-------------------|---------|--------|---------|---------|--------|---------|
|                   | N       | %      | N       | %       | N      | %       |
| strongly disagree | 1       | 4.20   | 1       | 4.20%   | 2      | 1.3     |
| Disagree          | 0       | 0.00   | 8       | 0.00%   | 8      | 5.3     |
| somewhat agree    | 10      | 41.70  | 39      | 41.70%  | 49     | 32.7    |
| Agree             | 11      | 45.80  | 66      | 45.80%  | 77     | 51.3    |
| strongly agree    | 2       | 8.30   | 12      | 8.30%   | 14     | 9.3     |
| Total             | 24      | 100.00 | 126     | 100.00% | 150    | 100     |
| Mean              | 3.5417  |        | 3.5417  |         | 3.6200 | 0.78296 |
| SD                | 0.83297 |        | 0.83297 |         |        |         |
| $\chi^2$          | 10.061  |        |         |         |        |         |
| P-value           | 0.018** |        |         |         |        |         |

#### 4.4. Distribution of Women Farmers by Adaptation Options

The distribution of farmers by their choices of adaptation methods presented in Table 9 revealed that a larger proportion (37.3%) of the farmers preferred soil and water conservation adaptation methods to climate change because it is cheaper than others followed by water harvesting (28.7% )of the respondents. However, intercropping (0.7%), mixed farming (4.7%), underground water (4%), afforestation (5.3%) and short season varieties (5.3%) were the least preferred adaptation measures by the farmers.

According to the result from group discussion most of respondents perceived there is a change in climate and they are aware of how to deal with it by storing rain water, using short season varieties, planting trees, use of soil and water conservation practices, underground water, mixed farming, and intercropping.

Table 9. Distributions of farmers by adaptation methods

| ADAPTATION METHOD           | WFFHH |       | WFMHH |       | Total |       |
|-----------------------------|-------|-------|-------|-------|-------|-------|
|                             | N     | %     | N     | %     | N     | %     |
| Soil and Water Conservation | 12    | 50    | 45    | 35.71 | 57    | 37.3  |
| Aforestation                | 1     | 4.17  | 7     | 5.56  | 8     | 5.3   |
| Short season varieties      | 0     | 0     | 8     | 6.35  | 8     | 5.3   |
| Under ground water          | 0     | 0     | 6     | 4.76  | 6     | 4.0   |
| Water harvesting            | 7     | 29.17 | 36    | 28.57 | 43    | 28.7  |
| Inter cropping              | 0     | 0     | 1     | 0.79  | 1     | 0.7   |
| Mixed farming               | 2     | 8.33  | 5     | 3.97  | 7     | 4.7   |
| No adaptation option        | 2     | 8.33  | 2     | 12.50 | 4     | 2.7   |
| All adaptation options      | 0     | 0     | 16    | 12.70 | 16    | 10.7  |
| Total                       | 24    | 100   | 126   | 100   | 150   | 100.0 |

Table 9 depicted that the soil and water conservation measures mainly adopted by the women farmers (37.3%) of the respondents, shown in (Table.10) soil and water conservation measures include terracing (43.9%), while mulching (35.08%) and a combination of mulching and terracing (21.03%).

Table 10. Distribution of women farmers by soil and water conservation measures

| Variables              | N         | %            |
|------------------------|-----------|--------------|
| Terracing              | 25        | 43.9         |
| Mulching               | 20        | 35.08        |
| Mulching and terracing | 12        | 21.03        |
| <b>Total</b>           | <b>57</b> | <b>100.0</b> |

#### 4.5. The Multinomial Logit Model Results

The Multinomial Logit Model was run taking ‘all adaptation options’ as the base category against which the remaining outcomes are compared with (Table 11). Prior to running the regression model, the explanatory variables were checked for the existence of multicollinearity and heteroscedasticity and there is no problem of multicollinearity and heteroscedasticity problems was found. The VIF values of the variables in the model as shown in Appendix Table 2 and Appendix Table 3 are less than the critical values showing that there is no problem of multicollinearity and heteroscedasticity problem.

For ease of interpretation, marginal effects were computed for each outcome in the dependent variable (see Table 11). The marginal effects show the change in probability of a particular choice of climate change adaptation for a unit change in the explanatory variables.

Age of the women affected adaptation to climate change. The result of this study depicted that a one percent increase in the age level of women results in a 0.02% increase in the probability of adapting soil and water conservation, a 0.04% increase in afforestation, a 3.41% increase in short season varieties and a 0.1% increase in mixed farming. This means that the age of the farmers was positively related to soil and water conservation, afforestation, short season varieties and mixed farming activities. Thus, increase in age of the women increases the use of soil and water conservation, afforestation, short season varieties and mixed farming activities relative to all adaptation options as adaptation measures to climate change. In other words, women farmers are more likely to use soil and water conservation, afforestation, short season varieties and mixed farming activities with increase in age.

Education of women increases the probability of adapting to climate change. As can be observed in (Table 11) education significantly increases soil and water conservation and water harvesting as an adaptation method. A percentage increase in the education level of the women farmers would result in a 32.55% increase in the probability of soil and water conservation and a 33.75% increase in utilization of a water harvesting practice to adapt

to climate change. Moreover, almost all of the marginal values of education are positive across all adaptation options indicating the positive relationship between education and adaptation to climate change.

The years of farming experience of the women farmers had a positive influence on the use of soil and water conservation, short season varieties and mixed farming activities. Highly experienced farmers tend to have more information about changes in climatic conditions and the relevant response measures to take. The results of this study reveals that as women farmers advance in years of farming experience increase the adaptation of soil and water conservation practices by 0.09%, increase the adaptation of short season varieties by 3.95% and increase the adaptation of mixed farming activities by 0.32% as an adaptation options to climate change.

Household size had a positively relationship with soil and water conservation as an adaptation measure to climate change. An increase of family size by one more member of the household would result in a 0.41% increase in the probability of soil and water conservation practices and 7.02% increase in the probability of underground water practices. Thus, large family sizes could increase the use of soil and water conservation and underground water measures as compared to all adapting option. This is because farming in Haramaya district is mostly labour intensive and farmers tend to employ labour intensive adaptation options such as soil and water conservation and underground water.

Access to credit had a positive and significant impact on the likelihood of using short season varieties, underground water, water harvesting, inter cropping and mixed farming activities. This result implies the important role of increased institutional support in promoting the use of adaptation options to reduce the negative effect of climate change. Therefore access to credit has a strong influence on women's' decisions to adapt to climate change. Based on the results of this study a percentage increase in access to credit results in an increase of the adaptation of using short season varieties by 0.26%, a percentage increase in access to credit results an increase of the adaptation of using underground water by 1.76%, a percentage increase in access to credit results an increase

of the adaptation of using water harvesting by 1.96%, and a percentage increase in access to credit results an increase of the adaptation of using mixed farming activates by 7.41%.

Women's empowerment had a positive and significant effect on soil and water conservation, short season varieties, underground water, water harvesting and mixed farming practices and also has a negative and significant effect on no adaptation option. That means when woman farmer are empowered to make decision her probability to adapt soil and water conservation increased by about 23.96%, short season varieties increased by about 14.36%, underground water increase by about 33%, water harvesting increased by about 9.16% and mixed farming practices increased by about 6.31% as compared to taking up all adaptation options. This implies that the more women's are empowered the likelihood of women to adapt to climate change is increased.

In line with the hypothesis, income was found to be positively related with adaptation either by underground water or water harvesting practices. Income is believed to reflect past achievement of households and their ability to bear risks. Thus, households with higher income in a better position to adapt underground water and water harvesting practices. Results showed that increase in total income improved the use of underground water by about 26.46% and water harvesting practices by about 37.84% as compared to adapting all adaptation option.

The results of the study show that perception of households towards climate change had significant and positive effect on soil and water conservation, short season varieties, water harvesting and mixed farming practices and also has a negative and significant effect on no adaptation option. The results showed that when women perceive that there is a change in climate, the probability for adapting to it increases. The results also showed that if woman farmer perceives there is a change in climate then her probability of adapting soil and water conservation increased by about 7.41%, short season varieties increases by about 1.76%, water harvesting increases by about 9.167% and mixed farming practices increases by about 6.31% as compared to all adaptation options.

Information on climate change had a positive and significant effect on soil and water conservation, short season varieties, water harvesting and mixed farming practices and also has a negative and significant effect on no adaptation option. That means if women farmers are exposed to information on climate change then their probability of use soil and water conservation increased by about 1.63%, short season varieties increased by about 35.37%, water harvesting increased by about 6.89% and mixed farming practices increased by about 54.69% as compared to all adaptation option. This implies that more climate change information dissemination through different means increase the likelihood of women to adapt to climate change. These results could be explained by the fact that women farmers in the Haramaya district are to some extent exposed to climate change information through extension services, radio, TV, farmers group and development agents.

Table 11. Multinomial logistic regression estimates for the choice of adaptation options

| Variables      | Soil and water conservation |         |                  | Aforestation        |         |                  | Short season varieties |         |                  | Underground water    |         |                  |
|----------------|-----------------------------|---------|------------------|---------------------|---------|------------------|------------------------|---------|------------------|----------------------|---------|------------------|
|                | Coefficient                 | Z-value | Marginal Effects | Coefficient         | Z-value | Marginal Effects | Coefficient            | Z-value | Marginal Effects | Coefficient          | Z-value | Marginal Effects |
| SEX            | -21.809<br>(21291.92)       | -0.03   | -.0926           | .640<br>(.7141)     | 0.90    | .1774            | -19.772<br>(7046.119)  | -0.01   | -.1481           | .730<br>(1.0677)     | 0.68    | .0240            |
| AGE            | .1404<br>(.0749)            | 1.87*   | .0002            | .176<br>(.0696)     | 2.52**  | .0004            | .148<br>(.0510)        | 2.91*** | .0341            | -.069<br>(.10984)    | -0.63   | -.0008           |
| EDUCATION      | 1.407<br>(.5854)            | 2.40**  | .3255            | .842<br>(1.048)     | 0.80    | .0044            | .127<br>(.7239)        | 0.18    | -.0004           | -.549<br>(.6330)     | -0.87   | -.0680           |
| EXPER          | .21809<br>(.1064)           | 2.05**  | .0009            | .047<br>(.0704)     | 0.66    | .0001            | .184<br>(.0517)        | 3.55*** | .0395            | .058<br>(.0493)      | 1.17    | .0081            |
| FASIZ          | .779<br>(.4611)             | 1.69*   | .0041            | .2821<br>(.2945)    | 0.96    | .0033            | .293<br>(.2369)        | 1.24    | .0004            | .339<br>(.1726)      | 1.97**  | .0702            |
| CRED           | -21.017<br>(57511.92)       | -0.00   | -.0124           | -2.103<br>(1.9417)  | -1.08   | -.3146           | .2454<br>(.1174)       | 2.09**  | .0026            | .082<br>(.0358)      | 2.29**  | .0176            |
| FARMSIZ        | -.274<br>(.8388)            | -0.33   | -.0005           | -.656<br>(.7954)    | -0.82   | -.0690           | -.623<br>(.8178)       | -0.76   | -.0009           | 1.058<br>(.9379)     | 1.13    | .0189            |
| NLSTLU         | .091<br>(.2251)             | 0.40    | .0124            | -.348<br>(.2820)    | -1.23   | -.0009           | -.075<br>(.1907)       | -0.39   | -.0184           | .363<br>(.4341)      | 0.84    | .0023            |
| WEMPOWER       | 9.940<br>(4.597)            | 2.16**  | 0.2396           | 17.394<br>(10.7365) | 1.62    | .1222            | 12.500<br>(5.7769)     | 2.16**  | 0.1436           | 16.998<br>(7.284)    | 2.33**  | .0330            |
| EXTENSION      | -.5763<br>(.6586)           | -0.88   | -.0105           | .156<br>(.3018)     | 0.52    | .0322            | -.041<br>(.3638)       | -0.11   | -.00011          | .156<br>(.3353)      | 0.47    | .0280            |
| AINHH          | .000013<br>(.00002)         | 0.93    | -0.6752          | .000011<br>(.00001) | 0.88    | 0.0043           | .00002<br>(.00002)     | 0.95    | 0.1745           | 3.842**<br>(2.158)   | 2.56    | 0.2646           |
| NFINCO         | .00001<br>(.00002)          | 0.93    | 0.0024           | .00004<br>(.00004)  | 0.97    | 0.0041           | -.0002<br>(.0003)      | -0.68   | -0.0291          | -.000035<br>(.00004) | -0.83   | -0.0145          |
| PWOMENCC       | .368<br>(.1752)             | 2.10**  | .0741            | .760<br>(.6995)     | 1.09    | .0142            | .082<br>(.0358)        | 2.29**  | .0176            | .687<br>(.8005)      | 0.86    | .0030            |
| TRAINING       | .730<br>(1.0677)            | 0.68    | .0240            | -.039<br>(1.3557)   | -0.03   | .0002            | -.016<br>(.6771)       | -0.02   | .0245            | -1.737<br>(2.1499)   | -0.81   | -.0062           |
| PARTORG        | -.412<br>(.4552)            | -0.90   | -.0776           | .108<br>(.4317)     | 0.25    | .0373            | 1.005<br>(1.3826)      | 0.73    | .1267            | .433<br>(1.5160)     | 0.29    | .0997            |
| INFOCC         | 3.539<br>(1.2729)           | 2.78*** | .0163            | .555<br>(1.0206)    | 0.54    | -.00028          | 2.437<br>(1.1426)      | 2.13**  | .3537            | 1.517<br>(1.1472)    | 1.32    | .0088            |
| _cons          | 10.811<br>(7.2702)          | 1.49    |                  | -5.529<br>(8.2132)  | -0.67   |                  | -.628<br>(3.9695)      | -0.16   |                  | 2.829<br>(7.5611)    | 0.37    |                  |
| Log likelihood | -153.490                    |         |                  | Prob > chi2         |         | 0.0000           | Pseudo R2              |         | 0.3906           |                      |         |                  |
| LR chi2(128)   | 196.74                      |         |                  | Number of obs.      |         | 150              |                        |         |                  |                      |         |                  |

Table 11. (Continued)

|                | Water harvesting    |         |                  | Inter cropping      |         |                  | Mixed farming        |         |                  | No adaptation options |         |                  |
|----------------|---------------------|---------|------------------|---------------------|---------|------------------|----------------------|---------|------------------|-----------------------|---------|------------------|
|                | Coefficient         | Z-value | Marginal Effects | Coefficient         | Z-value | Marginal Effects | Coefficient          | Z-value | Marginal Effects | Coefficient           | Z-value | Marginal Effects |
| SEX            | .640<br>(1.06181)   | 0.60    | .0242            | -.319<br>(1.2474)   | -0.26   | -.0012           | -.088<br>(.6689)     | -0.13   | .0107            | -.418<br>(1.373)      | -0.30   | -.0041           |
| AGE            | -.054<br>(.0396)    | -1.36   | -.0132           | -.060<br>(.0375)    | -1.61   | -.0137           | .236<br>(.1211)      | 1.95*   | .0010            | -.153<br>(.0785)      | -1.95*  | -.0001           |
| EDUCATION      | 1.420<br>(.5886)    | 2.41**  | .3375            | .193<br>(.9284)     | 0.21    | -.0103           | -.097<br>(.4480)     | -0.22   | -.0377           | -2.672<br>(1.1869)    | -2.25** | -.0087           |
| EXPER          | .103<br>(.0649)     | 1.59    | .0002            | .046<br>(.0703)     | 0.65    | .0001            | .201<br>(.0939)      | 2.14**  | .0032            | .109<br>(.7248)       | 0.15    | .0002            |
| FASIZ          | .040<br>(.1816)     | 0.22    | .0148            | .210<br>(.2258)     | 0.93    | .00067           | -.272<br>(.3027)     | -0.90   | -.0027           | .254<br>(.2407)       | 1.06    | .00019           |
| CRED           | .360<br>(.1739)     | 2.07**  | .0792            | 1.224<br>(.5779)    | 2.12**  | .0061            | .368<br>(.1752)      | 2.10**  | .0741            | -22.197<br>(94420.37) | -0.00   | -.0534           |
| FARMSIZ        | .969<br>(.9058)     | 1.07    | .0196            | -.4385<br>(1.1985)  | -0.37   | -.0045           | .6510<br>(.5705)     | 1.14    | .1574            | -1.839<br>(1.8774)    | -0.98   | -.0338           |
| NLSTLU         | .186<br>(.3169)     | 0.59    | .0058            | -.078<br>(.1923)    | -0.40   | -.0194           | .214<br>(.3598)      | 0.60    | .0039            | -.357<br>(.2880)      | -1.24   | -.0003           |
| WEMPOWER       | 9.311<br>(4.6316)   | 2.01**  | 2.3163           | 6.328<br>(8.1670)   | 0.77    | .2429            | 13.08637<br>(7.6700) | 1.71*   | .0077            | -12.480<br>(8.8023)   | -1.42   | -.0514           |
| EXTENSION      | -.024<br>(.3574)    | -0.07   | -.00005          | -.211<br>(.6567)    | -0.32   | -.0017           | .151<br>(.3033)      | 0.50    | .0297            | -.735<br>(.7807)      | -0.94   | -.0047           |
| AINHH          | 1.462**<br>(0.426)  | 2.65    | 0.3784           | 0.008<br>(.000012)  | 0.40    | 0.0044           | 0.228<br>(0.9316)    | 0.04    | 0.07.16          | -0.072<br>(.000012)   | -0.60   | -0.8171          |
| NFINCO         | -.00001<br>(.00004) | -0.39   | -0.0005          | -.00003<br>(.00005) | -0.69   | -0.00003         | .00004<br>(.00004)   | 0.91    | 0.00034          | -.00004<br>(.00003)   | -1.41   | -0.0009          |
| PWOMENCC       | .496<br>(.2485)     | 2.00**  | .0916            | .415<br>(.4006)     | 1.04    | .0943            | -.327<br>(.1675)     | 1.96*   | .0631            | -1.881<br>(.3956)     | -2.23** | -.0150           |
| TRAINING       | -1.354<br>(.6222)   | -2.18** | -.2620           | -.054<br>(.0396)    | -1.36   | -.0132           | -.097<br>(.4480)     | -0.22   | -.0377           | -.108<br>(.4317)      | -0.25   | -.0373           |
| PARTORG        | -.025<br>(.3252)    | -0.53   | -.0040           | -.00005<br>(.00004) | -0.95   | -0.0010          | .009<br>(.3746)      | 0.02    | -.00003          | 1.575<br>(.9804)      | 1.61    | .0101            |
| INFOCC         | .435<br>(.2334)     | 1.86*   | .0689            | .599<br>(.4942)     | 1.21    | .1281            | 2.463<br>(.6735)     | 3.66*** | .5469            | -2.712<br>(1.1181)    | -2.43** | -.0267           |
| _cons          | -5.065<br>(5.3425)  | -0.95   |                  | -6.626<br>(4.9433)  | -1.34   |                  | -4.447<br>(5.461)    | -0.81   |                  | 9.558<br>(7.5598)     | 1.26    |                  |
| Log likelihood | -153.490            |         |                  | Prob > chi2         |         |                  | Pseudo R2            |         |                  |                       |         |                  |
| LR chi2(128)   | 196.74              |         |                  | Number of obs.      |         |                  | 150                  |         |                  |                       |         |                  |

#### 4.6. Women Empowerment in Haramaya District

The Women's Empowerment in Agriculture Index (WEAI) is the first-ever measure to directly capture women's empowerment and inclusion levels in the agricultural sector. This innovative tool tracks women's engagement in agriculture in five domains: production, resources, income, leadership and time use, and they comprise ten indicators (see Figure 5).

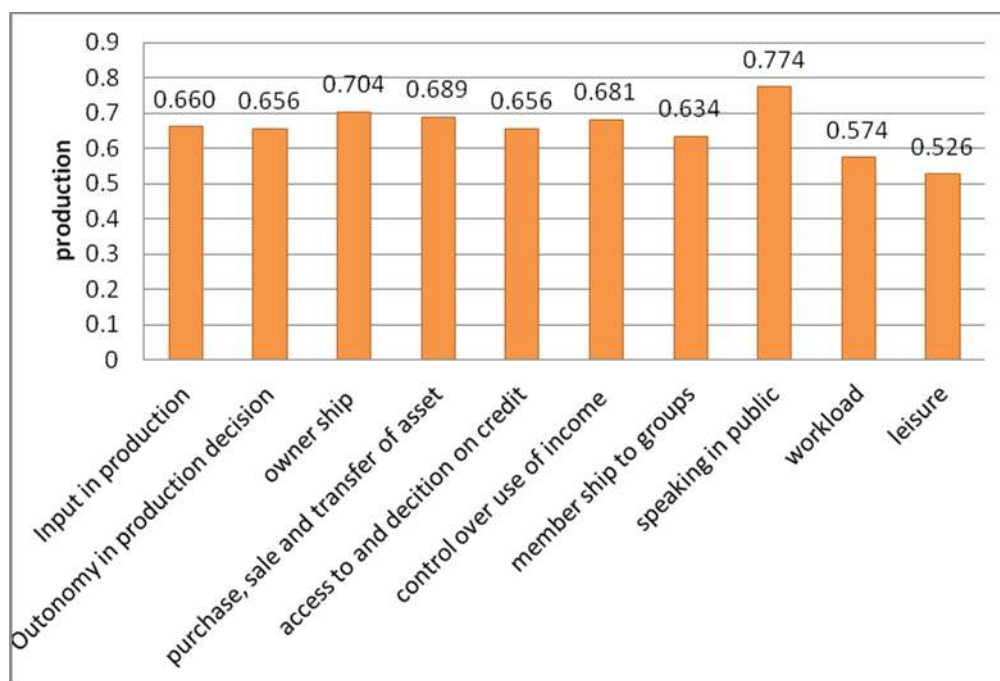
The result in (Table12) shows that there was no statistical significant difference between the two groups of sample respondents with respect to women's empowerment. The findings of the study show that woman from female headed HH and woman from male headed HH had a women empowerment of 0.6451 and 0.6583, respectively. The mean values for both categories of women show that women did not achieve empowerment.

Table 12. Women empowerment of the two samples category of women

| Variables | WFFHHs |       | WFMHHs    |       | Sample household |       | Means Difference |       | T       |
|-----------|--------|-------|-----------|-------|------------------|-------|------------------|-------|---------|
|           | N=(24) |       | N = (126) |       | N=(150)          |       |                  |       |         |
|           | Mean   | STD   | Mean      | STD   | Mean             | STD   | Mean             | STD   |         |
| WEMPOWER  | .6451  | .0947 | .6583     | .0595 | .656             | .0661 | -                | .0352 | -.895NS |
|           |        |       |           |       |                  |       | .0132            |       |         |

Figure 5 depicted that the results obtained on indicators used to assess women's empowerment. The overall results of mean= vale of 0.656 shows the sampled women did not achieve empowerment. For women to achieve empowerment in each domain and or overall WEI index should be 0.85 (IFPRI, 2012). Accordingly, in the case of this study the result implies that limited input and autonomy of women in production decision, lack of control over resources and making ability over credit and lock of leadership role in the community.

Figure 6. Proportion of women not empowered and who have inadequate achievements by 5ED in Haramaya for rural women sample



## 5. SUMMARY AND CONCLUSIONS

The study analyzed the factors affecting the women's decision of adaptation options to climate change based on a cross-sectional survey data collected during the year 2015 in Haramay district, Ethiopia. The surveyed women were asked if they have observed any change in temperature and rainfall over the past 20 years. Those who responded to have observed changes over the past 20 years were asked if they have responded to climatic conditions through adaptation. Those who could afford to adapt indicated that they undertake soil and water conservation, forestation, short season varieties, water harvesting, underground water, intercropping and mixed farming to reduce the negative effect of climate change. Those who did not adapt mentioned lack of information on adaptation options. The results showed that women in Haramaya perceived there is a change in climate and they are aware of how to deal with it by storing rain water, using short season varieties, planting trees, use of soil and water conservation practices, underground water, mixed farming, and intercropping. Explanatory variables that were significant in influencing decision of women households when adapting to climate change were; age of household head, education, family size, farming experience, access to credit, women empowerment, information to climate change, total annual income and perception of women households towards climate change.

The results of this study indicate that household characteristics such as education affect soil and water conservation and water harvesting practices as an adaptation option to climate change. An annual income also has a positive and significant effect on underground water and water harvesting practices. Thus, Investment in education systems, sufficient input supply which increases farmers' income and create employment opportunities in the rural areas can be underlined as a policy option in the reduction of the negative effect of climate change, in this regard, a lot of effort is needed from governmental, non-governmental organization and research institution.

The fact that family size has a positive effect on adaptation options that the large family size has more probability of use soil and water conservation and underground water as adaptation options to climate change. This regard, a lot of effort is needed from

governmental, non-governmental organization and research institution to develop labour intensive for climate change adaptation options.

The study further revealed that access to credit enhanced short season varieties underground water, water harvesting, inter cropping and mixed farming practices as an adaptation options to climate change. Consequently, policies aiming at promoting adaptation to climate change need to emphasize the crucial role of providing information on better production techniques (through extension) and creating the financial means through affordable credit schemes to enable farmers to adapt to climate change.

Age of the women farmers has a positive related to soil and water conservation, aforestation, short season varieties and mixed farming activities and the years of farming experience of the women farmers has a positive influence on the use of soil and water conservation, short season varieties and mixed farming activities therefore, policies aiming at promoting adaptation to climate change need to emphasize the crucial role of providing information on better production techniques which is related to women age.

Women empowerment has a positive related to soil and water conservation, short season varieties, underground water, water harvesting and mixed farming practices and also has a negative and significant effect on no adaptation option, therefore the government can play a significant role by promoting policies aimed to enhance adaptation measures at household level through empowering women in agriculture sector by reporting and alerting households about weather changes in an understandable way so that they can be able to plan for their future farming.

Information on climate change had a positive and significant effect on soil and water conservation, short season varieties, water harvesting and mixed farming practices and also has a negative and significant effect on no adaptation option. This implies that more climate change information dissemination through different means increase the likelihood of farmers to adapt the climate change. Therefore, there is a need for policies aimed at enhancing household level adaptation through the support of extension services and meteorological services.

## 6. REFERENCES

- Adger WN, Agrawala S, Mirza MMQ, Conde C, O'Brien K, Pulhin J, Pulwarty R, Smit B and Takahashi K. 2007. Assessment of adaptation practices, options, constraints and capacity. P 717–743.
- Agrawal, A. and N. Perrin. 2008. Climate adaptation, local institutions, and rural live
- Alwang, J., G.P Hans. Jansen, Paul B., Seigel, 2005. Geographic space, assets, livelihoodsand wellbeing in rural Central America: empirical evidence from Guatemala Honduras andNicaragua.
- Beddington J, Asaduzzaman M, Clark M, Fernandez A, Guillou M, Jahn M, Erda L, Mamo T, Van Bo N, Nobre CA, Scholes R, Sharma R, Wakhungu J,. 2012. *Achieving Food Security in the Face of Climate Change: Final Report from the Commission on Sustainable Agriculture and Climate Change*. [www.ccafs.cgiar.org/commission\\_website](http://www.ccafs.cgiar.org/commission_website) . Accessed on July, 2014
- Brown, D.R., Stephens, E., C., Okuro, M.J., Murithi, F.M., Barrette, C.B, 2006. Livelihood Strategies in the Rural Kenyan Highland.
- Bruin, K. 2011. An Economic Analysis of Adaptation to climate Change under Uncertainty. Unpublished Doctoral Dissertation, University of Wageningen, the Netherlands.
- Bryant, R.C., B. Smit, M. Brklacich, R.T. Johnston, J. Smithers, Q. Chiotti, and B. Singh. 2000. Adaptation in Canadian agriculture to climatic variability and change. Climatic Change.
- CARE (Cooperative for Assistance and Relief Everywhere International Climate Change) 2010. Adaptation, gender and women's empowerment [www.careclimatechange.org](http://www.careclimatechange.org). Accessed on March, 2015.

- Central Statistics Agency (CSA, 2007). Summary and statistical report of population and housing census, Addis Ababa, Ethiopia
- Chilot Yirga and Hassan, R.M., 2008. Multinomial Logit Analysis of Farmers' choice Between Short and Long- Term Soil Fertility Management Practices in the Central Highlands of Ethiopia. *Eth. J. Agric. Econ.* 7 (1), 87-107.
- Deressa, T. T., Hassan R. M. and Ringler, C. 2010. Perception and Adaptation to Climate Change: The Case of Farmers in the Nile Basin of Ethiopia, *The Journal of Agricultural Science*, 149, 23-31.
- Deressa, T. T., Hassan, R. M., Ringler, C., Alemu, T., & Yesuf, M. (2008). Analysis of the Determinants of Farmers' Choice of Adaptation Methods and Perceptions of Climate Change in the Nile Basin in Ethiopia. IFPRI Discussion Paper No:798, Washington D.C., 2008.
- Deressa, T.T., Hassan, R.M., Ringler, C., Alemu, T., and Yesuf, M., 2009. Determinants of Farmers' choice of adaptation methods to Climate change in the Nile Basin of Ethiopia. *Global Environmental Change* 19, 248-255.
- Ellis J., and M. Mudhara. 1995. Factors Affecting the Adaptation of Soil and Water Conservation Technologies in Semi-arid Zimbabwe. Bedford United Kingdom, Silsoe Research Institute. 115-175pp.
- Emmeline Skinner. 2011. Gender and Climate Change, Institute of Development Studies, UK.
- Enarson, E. 2000. Gender issues in natural disasters, Talking points and research needs, in: Focus Programme on Crisis Response and Reconstruction Workshop, 48, ILO, Geneva, 30 pp.
- Enete AA, Amusa TA. 2010. Determinates of women's contribution to farming decision in cocoa based agro forestry household of Ekiti State, Nigeria. *Journal of Field Actions*, 6(4): 23-29.

- EPA (United States Environmental Protection Agency). 2011. Climate Change Science Overview.
- Ervin, C.A and D.E. Ervin. 1982. Factors affecting the use of soil conservation practices: hypotheses, evidence, and policy implication. 58(3), 277-292.
- FAO (Food and Agricultural Organization). 2008. Climate Change Adaptation and Mitigation in the Food and Agriculture Sector: High - level conference on food security: the challenges of climate change and bioenergy. P,56.
- Frank, E., 2009. Gender, agricultural development and food security in Amhara, Ethiopia: The contested identity of women farmers in Ethiopia.
- Gbetibouo, G. A. 2009. Understating Farmers' Perceptions and Adaptation to Climate Change and Variability: The Case of the Limpopo Basin. IFPRI, Discussion Paper Washington, D.C., IFPRI.
- Gershonet Feder, Lau L. J, and Slade R. 1985. Agricultural Extension: A case study of the Training and Visit (T and V) system in Haryana, India," World Bank Working Paper, No 756, World Bank, Washington D.C. USA.
- Getachew Shambe. 2012. The Gender dimension of Climate change and women's role in Environmental protection and Natural Resource Management. Research on Humanities and Social Sciences. ISSN 2222-1719 (Paper) ISSN 2222-2863. Vol 2, No.9.
- Green, H.W., 2003. Econometric Analysis: Fourth Edition. New York University Macmillan Publishing Company.
- Gujarati, D.N., 2004. Basic Econometrics: forth edition, MacGraw-Hill, New York.
- Hassan, R., and Nhemachena, C. 2008. Determinants of African Farmers' Strategies for Adapting to Climate Change: Multinomial Choice Analysis, AfJARE Vol 2, No.1, March 2008, page 83-104.

- Hassan, R., and Nhemachena, C. 2007. Micro-Level Analysis of Farmers' Adaptation to Climate Change in Southern Africa, IFPRI Discussion Paper 00714, August 2007.
- IPCC (Intergovernmental Panel on Climate Change). 2007. Summary for Policymakers. In: Climate Change : Impacts, Adaptation and Vulnerability . Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, United Kingdom and New York, US.
- Ishaya, S. and I. B. Abaje .2008. "Indigenous People's Perception on climate Change and Adaptation Strategies in Jema'a Local Government area of Kaduna State in Nigeria" *Journal of Geography and Regional Planning*, Vol. 1(8), pp. 138-143
- Lambrou, Y. and Piana, G. 2005. Gender: the missing component in the response to climate change, Food and Agriculture Organization of the United Nations, Rome, available at: [http://www.fao.org/sd/dim\\_pe1/docs/pe1\\_051001d1b.pdf](http://www.fao.org/sd/dim_pe1/docs/pe1_051001d1b.pdf), 46 pp .
- Maddison, D. 2006. The Perception and Adaptation to Climate Change in Africa, CEEPA Discussion Paper No. 10 Special Series on Climate Change and Agriculture in Africa ISBN 1-920160-01-09.
- Maddison, D. 2007. The Perception and Adaptation to Climate Change in Africa, CEEPA Discussion Paper No. 10 Special Series on Climate Change and Agriculture in Africa ISBN 1-920160-01-09.
- Maharjan SK, Sigdel ER, Sthapit BR, Regmi BR. 2011. Tharu community's perception on climate changes and their adaptive initiatives to withstand its impacts in Western Terai of Nepal. *Int NGO J* 6(2):35–42.
- Mano, R., and Nhemachena, C. 2006. Assessment of the Economic Impacts of Climate Change on Agriculture in Zimbabwe: A Ricardian Approach. CEEPA Discussion Paper No. 11, Centre for Environmental Economics and Policy in Africa, University of Pretoria.

- Messay Tegegne. 2012. An Assessment on the Role of Women in Agriculture in Ethiopia. Indira Gandhi National Open University, India.
- Nelson V, Morton JF, Burt P, Chancellor T and Pound B. 2010. Climate change, agriculture and fairtrade: identifying the challenges and opportunities. NRI Working Paper Series: Climate Change, Agriculture and Natural Resources. Natural Resources Institute, Chatham, UK. [www.nri.org/docs/d4679-10\\_ftf\\_climate\\_agri\\_web.pdf](http://www.nri.org/docs/d4679-10_ftf_climate_agri_web.pdf) . Accessed on April, 2014.
- Noor Parvin and Keerty Nakray. 2011. Rethinking Development in an Age of scarcity and Uncertainty, New Values and Alliances for Increased Resilience. Universtiy of New York.
- OECD (Organization for Economic Cooperation and Development). 2012. Women's economic empowerment. [www.oecd.org/edu/EAG%202012](http://www.oecd.org/edu/EAG%202012) . Accessed on Join, 2014.
- ONRSPO (n.d) Socio-economic Profile of East Hararghe. Oromia National Reginal State President Office, 2006. Available via [http://www.oromiyaa.com/index.php?option=com\\_content&view=category&layout=blog&id=114&Itemid=788](http://www.oromiyaa.com/index.php?option=com_content&view=category&layout=blog&id=114&Itemid=788) website. Accessed 10 August 2014.
- Parry ML, Canziani OF, Palutikof JP and co-authors. 2007. *Technical summary*. p 23–78. In: Parry Printed in Gävle, Sweden, in 2011. Report: agriculture for development. The World Bank, Washington, DC, USA.
- PCGCC (Pew Center on Global Climate Change). 2008. Coping with global climate change: The role of adaptation in the United States. PCGCC: Arlington.
- Petrie, B. 2010. Gender and Climate Change: Regional Summary. Southern Africa: Heinrich Boll Stiftung. <http://www.boell.org.za/web/144-496.html> . Accessed on August, 2014.

- Rasmus.H, Paul.B.S, Steen.L.J. 2009. Addressing human vulnerability to climate change. Global Environmental Change.
- Rohr, U. 2007. Gender, climate change and adaptation. Introduction to the gender dimensions, available at: [http://www.bothends.org/service/casestudy\\_genanet.pdf](http://www.bothends.org/service/casestudy_genanet.pdf), 11 pp.
- Sathaye, J. A., and Christensen, J. 1998. Mitigation and Adaptation Cost Assessment: Methods and Approach Use. UNEP Collaborating Centre on Energy and Environment, Riso National Laboratory, Denmark.
- Senait Regassa, 2005.Determinants of Choice of Land Management Practices: the case of Ankober District. Ethiopian Journal of Agricultural Sciences, Vol. 18.
- Smit, B., and M.W. Skinner. 2002. Adaptations options in Agriculture to climate change: a typology. Mitigation and Adaptation Strategies for Global Change.
- Smith, J.B., Vogel, J.M. & J.E. Cromwell II,. 2009. An architecture for government action on adaptation to climate change. An editorial comment. In: Climatic Change 95:53-61
- SOFA Team and Cheryl Doss. 2011. The role of women in agriculture. ESA Working Paper No.1102.Food and Agric. Org. Agric. Devel. Econ. Division, P. 47.
- Taye Assefa,. 2009. Digest of Ethiopia's National Policies, Strategies and Programs, Addis Ababa, Ethiopia. Page No.93, 110, 111.
- Tesfaye Zegeye and Alemu Haileye, 2001.Adoption of improved maize technologies and inorganic fertilizer in Northwestern Ethiopia. Ethiopian Agricultural Research Organization (EARO). Research report No.40, Addis Ababa, Ethiopia. 51p.
- Tol and Yohe. 2007. Richard S. J. Tol and Gary W. Yohe. The weakest link hypothesis for adaptive capacity: An empirical test. GLOBAL ENVIRONMENTAL

CHANGE-HUMAN AND POLICY DIMENSIONS, 17(2):218–227, MAY 2007.  
ISSN 0959-3780. doi: 10.1016/j.gloenvcha.2006.08.001.

Tubiello, F. 2012. Climate change adaptation and mitigation: challenges and opportunities in the food sector. Natural Resources Management and Environment Department, FAO, Rome. Prepared for the High-level conference on world food security: the challenges of climate change and bioenergy, Rome, 3-5 June 2008. pp 1-5.

UNDP (United Nations Development Programme). 2007. Fighting climate change: Human solidarity in a divided world, Human Development Report, New York.

UNFCCC (United Nations Framework Convention on Climate Change). 2007. Climatic Change Impact, Vulnerabilities and Adaptation in Developing Countries UNFCCC Secretariat, Martin-Luther-King-Straat 8 53175 Bonn, Germany.  
<http://www.unfccc.int>. Accessed on July, 2014

UNISDR. 2008. Annual report. The secretariat of the United Nations International Strategy for Disaster Reduction. [www.unisdr.org/campaign/iddr-2008/2008-iddr.htm](http://www.unisdr.org/campaign/iddr-2008/2008-iddr.htm). Accessed on April, 2014

USGCRP,.2009. United States Global Change Research Program. Global Climate Change Impacts in the United States . Karl, Program. Cambridge University Press, New York, NY, USA.

WFO (World Farmers' Organization). 2012. Women Adapt to Climate Change. [www.wfo-oma.com/change/articles/women-adapt-to...](http://www.wfo-oma.com/change/articles/women-adapt-to...) Accessed on August, 2014.

WFP (World Food Program). 2011. Ethiopia: Overview. [www.generation.org/publications/fdsec/ethioa](http://www.generation.org/publications/fdsec/ethioa). Accessed on April ,2014

World Bank, 2010. The Economics of Climate Change. A Synthesis Report. Final Constitution Draft. EACC.

Yesuf, M., Falco, D. S., Deressa, T., Ringler, C., & Kohlin, G., 2008. The Impact of Climate Change and Adaptation on Food Production in Low-Income Countries. Ethiopia Development Research Institute. International Food Policy Research Institute. Discussion Paper No: 828, Washington D.C. IFP.

## **7. APPENDIX**

### Appendix 1. Conversion factors used to calculate TLU

| Livestock category | TLU   |
|--------------------|-------|
| Calf               | 0.2   |
| Heifer             | 0.75  |
| Cow and Ox         | 1     |
| Donkey             | 0.7   |
| Sheep and Goat     | 0.13  |
| Chicken            | 0.013 |

### Appendix 2. Multi-Collinearity Test with VIF

| Variables | Tolerance | VIF   |
|-----------|-----------|-------|
| AGE       | .877      | 1.141 |
| EXPER     | .858      | 1.166 |
| AINHH     | .929      | 1.077 |
| FARMSIZ   | .967      | 1.035 |
| FASIZ     | .923      | 1.084 |
| NLSTLU    | .938      | 1.066 |
| WEMPOWER  | .929      | 1.077 |

### Appendix 3. Multi-Collinearity Test with Contingency Coefficient

|           | SEX   | EDUCATION | PWOMENCC | CRED  | EXTENSION | TRAINING | PARTORG | INFOCC | NFINCO |
|-----------|-------|-----------|----------|-------|-----------|----------|---------|--------|--------|
| SEX       | 1     |           |          |       |           |          |         |        |        |
| EDUCATION | 0.022 | 1         |          |       |           |          |         |        |        |
| PWOMENCC  | 0.141 | 0.85      | 1        |       |           |          |         |        |        |
| CRED      | 0.006 | 0.038     | 0.182    | 1     |           |          |         |        |        |
| EXTENSION | 0.18  | 0.052     | 0.264    | 0.159 | 1         |          |         |        |        |
| TRAINING  | 0.202 | 0.02      | 0.121    | 0.062 | 0.85      | 1        |         |        |        |
| PARTORG   | 0.164 | 0.043     | 0.194    | 0.044 | 0.129     | 0.384    | 1       |        |        |
| INFOCC    | 0.311 | 0.154     | 0.326    | 0.204 | 0.327     | 0.199    | 0.21    | 1      |        |
| NFINCO    | 0.368 | 0.3.3     | 0.461    | 0.452 | 0.491     | 0.416    | 0.391   | 0.52   | 1      |

### Appendix 4. Heteroskedasticity Test

Hettest

Breush-pagant/ kook-weisberg test for heteroskedasticity

Ho: Constant Variance

Variables: fitted values of Adoptionmeasuer

Chi2(1)=3.42

prob Chi2(1)=0.0034

### Appendix 5.Omitted variables Test

Ovtest

Rasey RESET test using powers of the fitted values of Adaptationsmeasure

Ho: the model has no omitted variables

Chi2(1)=2.41

prob >F =0.001

## Appendix 6. : Interview Schedule

Serial No of the Interview Schedule \_\_\_\_\_

### General Information

Peasant Association/Kebele: \_\_\_\_\_

Village: \_\_\_\_\_

Respondent's Name: \_\_\_\_\_

Number of years the respondent is living in the village: \_\_\_\_\_

Date of Interview: \_\_\_\_\_

Enumerator's Name: \_\_\_\_\_

### A. Interview for Rural Women Households

#### I. General Questions on Demographic and Socioeconomic Characteristics

| Sex of household head<br>(0=male;1=female) | Category of women<br><br>Code A | Marital status<br><br>Code B | Age (years) | Education<br><br>Code C | Experience in agriculture (years) | Main occupation<br><br>Code D | Land tenure<br><br>Codes E | Religion<br><br>Code F | Family size |        |       |
|--------------------------------------------|---------------------------------|------------------------------|-------------|-------------------------|-----------------------------------|-------------------------------|----------------------------|------------------------|-------------|--------|-------|
|                                            |                                 |                              |             |                         |                                   |                               |                            |                        | Male        | Female | Total |
|                                            |                                 |                              |             |                         |                                   |                               |                            |                        |             |        |       |

#### Codes A

1 Women from female headed HH  
2 Women from male HH

#### Codes B

1 Married living with spouse  
2 Married but spouse away  
3 Divorced/separated  
4 Widow  
5 Never married  
6 Other, specify...

#### Code C

1 Educated  
2 Non-educated

#### Codes D

0 No occupation  
1 Farming (crop + livestock)  
2 Salaried employment  
3 Self-employed off-farm  
4 Casual labourer on farm  
5 Casual labourer off-farm  
6 Herds girl  
7 Housekeeping  
8 Non-farm agribusiness  
9 Other business (shops, trade, tailor, etc)  
10 Other, specify.....

#### Code E

1 Owned  
2 Rent in  
3 Share in  
4 Share out

#### Codes F

0 Moslem  
1 Christian  
2 Other, specify  
.....

2. What type of agricultural production do you produce?

| Agricultural production   | Mark |
|---------------------------|------|
| Crops production only     |      |
| Livestock production only |      |
| Mixed agricultural        |      |
| Others, _____             |      |

3. How much your farm size is if you have any?

| S/No | Crops grown | Area coverage (ha) | Purpose |
|------|-------------|--------------------|---------|
| 1    |             |                    |         |
| 2    |             |                    |         |
| 3    |             |                    |         |
| 4    |             |                    |         |
| 5    |             |                    |         |

2. Do you own livestock? Yes ☐ / No ☐

3. If the answer to Q.2 is yes how many livestock do you own?

| S/No | Livestock type            | Quantity |
|------|---------------------------|----------|
| 1    | Cows                      |          |
| 2    | Oxen                      |          |
| 3    | Sheep                     |          |
| 4    | Goat                      |          |
| 5    | Poultry                   |          |
| 6    | Others (specify)<br>_____ |          |

4. Household's annual farm income from sale of crops last year in quintals?

| Types of crops grown |  | Annual harvest | Consumed | Sold   |                 | Total price Birr |
|----------------------|--|----------------|----------|--------|-----------------|------------------|
|                      |  |                |          | Amount | Unit price Birr |                  |
| 1                    |  |                |          |        |                 |                  |
| 2                    |  |                |          |        |                 |                  |
| 3                    |  |                |          |        |                 |                  |
| 4                    |  |                |          |        |                 |                  |
| 5                    |  |                |          |        |                 |                  |
| 6                    |  |                |          |        |                 |                  |

## 5. Income from sale of livestock last year?

| No | Animal type            | Number | Number sold | Unit price | Total price |
|----|------------------------|--------|-------------|------------|-------------|
| 1  | Cows                   |        |             |            |             |
| 2  | Oxen                   |        |             |            |             |
| 3  | Sheep                  |        |             |            |             |
| 4  | Goat                   |        |             |            |             |
| 5  | Poultry                |        |             |            |             |
| 6  | Others (specify) _____ |        |             |            |             |
| 7  | Total                  |        |             |            |             |

## 6. Income from sale of livestock products last year?

| No | Product       | Amount collected per year | Amount consumed | Amount sold | Unit price | Total price |
|----|---------------|---------------------------|-----------------|-------------|------------|-------------|
| 1  | Milk          |                           |                 |             |            |             |
| 2  | Hide and skin |                           |                 |             |            |             |
| 3  | Egg           |                           |                 |             |            |             |
| 4  | Honey         |                           |                 |             |            |             |
| 5  | Butter        |                           |                 |             |            |             |
| 6  | Others        |                           |                 |             |            |             |

7. Do you or any member of your family have off-farm activities? Yes ☐ No ☐

8. If the answer to Q.7 is yes, indicate the type of activities

| No.   | Family member | Type of activities | Annual income (Birr) |
|-------|---------------|--------------------|----------------------|
| 1     |               |                    |                      |
| 2     |               |                    |                      |
| 3     |               |                    |                      |
| 4     |               |                    |                      |
| Total |               |                    |                      |

9. Do you have access to nonfarm employment? Yes ☐ No ☐

10. If yes type of work? ☐ Hand Craft / ☐ Trading / ☐ Casual labor

☐ Others specify \_\_\_\_\_

11. How many members of your family engage in nonfarm activities? \_\_\_\_\_

12. Total annual income earned from nonfarm activities during this year? \_\_\_\_\_ Birr

13. Total house hold income of the household from all sources \_\_\_\_\_ Birr

## II. Questions related to first objective of the Study.

- To assess rural women's perception and awareness on climate change

Use the options below to answer the following questions according to your level of agreement or disagreement:

5-Strongly Agree, 4- Agree, 3- Somewhat Agree

2- Disagree 1–Strongly Disagree

| S/No | Description of statements                                                 | Options |   |   |   |   |
|------|---------------------------------------------------------------------------|---------|---|---|---|---|
|      |                                                                           | 5       | 4 | 3 | 2 | 1 |
| 1.   | Temperature is rising in the last two decades                             |         |   |   |   |   |
| 2.   | Rainfall is decreasing every year in the last two decades                 |         |   |   |   |   |
| 3.   | The Environment suffers from excessive devastation due to climate change. |         |   |   |   |   |
| 4.   | There is change in both temperature and rainfall in the last two decades  |         |   |   |   |   |
| 5.   | Climate change has led to the decline of forest resources.                |         |   |   |   |   |
| 6.   | Climate change has led to the change of farming system.                   |         |   |   |   |   |
| 7.   | Frequencies of floods during raining season have increased.               |         |   |   |   |   |
| 8.   | Occurrence of livestock diseases has increased due to climate change.     |         |   |   |   |   |
| 9.   | Food insecurity has increased due to climate change.                      |         |   |   |   |   |
| 10.  | The community here are aware of the effects of climate change             |         |   |   |   |   |

11. Do you think climate change has already happened? Yes ☐ No ☐

12. If the answer to Q.11 is yes how did you feel that on your farming activities?

\_\_\_\_\_

\_\_\_\_\_

13. Did you face any crop shortage during the last five crop season due to any effect of climate change? Yes ☐ ☐

14. If the answer to Q13. is yes for which of the following options did you face?

Fluctuation of onset date ☐ High temperatures ☐ / Increase the rainfall ☐ Short rainy season ☐ / Lack of irrigation water ☐

Other specify \_\_\_\_\_

15. How did you solve the above problem? \_\_\_\_\_

\_\_\_\_\_

16. How do you evaluate the trend of crop production for the last ten years?

Increasing ☐ / Decreasing ☐ The same ☐ do not know ☐

17. Have you faced any disaster or failures in crop production in recent years?

Yes ☐ / No ☐

18. If the answer to Q.17 is yes quantify the failure in crop production \_\_\_\_\_

19. Have you ever faced any climate related effect in last 10 years? Yes/No, ☐ if yes, what type of climatic shock?

\_\_\_\_\_

20. If the answer to Q19 is yes, did it affect your cattle or/and crop and other types of your livelihood? Yes/No ☐ , if yes how much?

\_\_\_\_\_

21. How do you see the trend in distance you travel to locate the grazing land for livestock through time? Increased ☐ / Decreased ☐

/ The same ☐ I do not know ☐

22. If say 'increased', why? \_\_\_\_\_

23. What are the measure challenges you face in livestock production?

\_\_\_\_\_

24. Did you lose any of your livestock in the last drought year? Yes/ No ☐

25. Which season (s) is/are rainy season? \_\_\_\_\_

26. Have you noticed any change in the length of dry seasons and the temperature to it in recent years? Yes / ☐ ☐

27. If “yes”, specify the changes \_\_\_\_\_

28. In what way the changes “above” affect farming and livestock production?

29. Is there any governmental body that warns you of any unexpected weather and related disasters? Yes ☐ ☐

30. If “No”, how do you know such unexpected weather before occurring

\_\_\_\_\_

31. Did you observe changes in cropped areas? ☐ If yes, Decrease ☐ crease ☐

32. Did you observe changes in types of crop grown? ☐ es, Decrease ☐ ease ☐

### III. Questions related to second objective of the Study.

- To identify the factors influencing women's decisions in adaptation to climate change

#### 1. Decision making in the household

| Resources           | Ownership<br>0=male; 1=female; 2=both | Decision making<br>0=male; 1=female; 2=both |         |                                       |
|---------------------|---------------------------------------|---------------------------------------------|---------|---------------------------------------|
| 1. ASSETS:          |                                       | Buying                                      | Selling | Utilization/ undertaking the activity |
| Land                |                                       |                                             |         |                                       |
| Livestock           |                                       |                                             |         |                                       |
| Credit              |                                       |                                             |         |                                       |
| Farm equipment      |                                       |                                             |         |                                       |
| Household equipment |                                       |                                             |         |                                       |
| Investment (money)  |                                       |                                             |         |                                       |
| Other, specify      |                                       |                                             |         |                                       |
| 2. INPUTS:          |                                       |                                             |         |                                       |
| Seeds               |                                       |                                             |         |                                       |
| Fertilizers         |                                       |                                             |         |                                       |
| Pesticides          |                                       |                                             |         |                                       |
| Own labor           |                                       |                                             |         |                                       |
| Hired labor         |                                       |                                             |         |                                       |
| Others (specify)    |                                       |                                             |         |                                       |
| 3. OUTPUTS:         |                                       |                                             |         |                                       |
| Crop produce        |                                       |                                             |         |                                       |
| Storage             |                                       |                                             |         |                                       |
| Sale quantity       |                                       |                                             |         |                                       |
| Marketing           |                                       |                                             |         |                                       |
| Fodder              |                                       |                                             |         |                                       |
| 4. POST HARVEST     |                                       |                                             |         |                                       |
| Threshing           |                                       |                                             |         |                                       |

|                                      |  |  |  |  |
|--------------------------------------|--|--|--|--|
| Seed cleaning and purification       |  |  |  |  |
| Milling                              |  |  |  |  |
| Other processing activities.....     |  |  |  |  |
| Marketing                            |  |  |  |  |
| Other post harvest activities.....   |  |  |  |  |
| <b>5. OTHERS:</b>                    |  |  |  |  |
| Household maintenance                |  |  |  |  |
| Education of children                |  |  |  |  |
| Children's marriage                  |  |  |  |  |
| Migration                            |  |  |  |  |
| Cash income from farm activities     |  |  |  |  |
| Cash income from off-farm activities |  |  |  |  |
| Others                               |  |  |  |  |

## 2. Access to credit

2.1. Did you receive any type of credit?    Yes    ☐    No    ☐

2.2. If the answer to Q2.1. is yes, would you please give us the following details?

| Source of credit   | Mark | Purpose of credit                      | Mark |
|--------------------|------|----------------------------------------|------|
| Micro-finance      |      | To purchase Farm animals               |      |
| Cooperatives       |      | To purchase grain for food             |      |
| Bank               |      | To purchase modern agricultural inputs |      |
| Individual lenders |      | To purchase farm implements            |      |
| Others, specify    |      | Others , specify<br>_____              |      |

2.3. If the answer to 2.1. is no Why? (Multiple answers are possible)

☐
☐

Fear of inability to pay ☐ / Lack of asset for collateral ☐  
 No one to give credit ☐ / High interest rate ☐ No need for credit ☐  
 I can use other sources ☐ Others (specify) ☐ \_\_\_\_\_

### 3. Extension services

3.1. Have you got advice in agricultural activities from extension service?

Yes ☐ / No ☐

3.2. If the answer to Q3.1. is yes who provided you the advice? (Multiple choices is possible)

Government extension officers ☐ Farmer group ☐ / NGOs (specify) \_\_\_\_\_  
 \_\_\_\_\_ / Marketing agents ☐ / Others (specify) ☐ \_\_\_\_\_

3.3. On which area the advice was given? Crop husbandry ☐ / Crop diversification ☐ Animal husbandry ☐ / Marketing ☐ / Irrigation ☐ / Post harvest ☐ / Climatic information ☐ / Others ☐ \_\_\_\_\_

3.4. If the answer to Q3.1. is no why you are not getting the service from agents on different agricultural products? \_\_\_\_\_

### 4. Training

4.1. Have you participate in any of the climate change adaptation trainings organized by NGO, government, etc? Yes ☐ / No ☐

4.2. Do you think the training was helpful for your practical problem? Yes ☐ No ☐

4.3. If the answer to Q.4.2 is yes what was your reason to adapt to climate change?  
 \_\_\_\_\_

4.4. If the answer to Q.4.2. is no, why? \_\_\_\_\_

4.5. What was your reason to adapt to climate change? \_\_\_\_\_

### 5. Access to the market

5.1. Do you sell agricultural product? Yes / No

☐ ☐

5.2. Did you face any marketing problem to your farm products? Yes / No

☐ ☐

5.3. If the answer to Q5.2. is yes, prioritize problems? Low output price /

☐

High input price ☐ / Price fluctuation for outputs ☐ / Price fluctuation for inputs ☐ Transportation cost ☐ / Lack of storage facilities ☐ / others, specify ☐

5.4. The distance of market place from your home: Near ☐ far ☐

### 6. Participation in social organization

6.1. Are you involved in any activities of formal and informal institutions /organization in your area? (social participation) Yes / No ☐ ☐

6.2. If the answer to Q6.1. is yes ,type of institution /organization and type of membership and frequency of participation in activities

| Organization/<br>institutions | Member | Committee member | Leader | Frequency of participation in activities |           |        |
|-------------------------------|--------|------------------|--------|------------------------------------------|-----------|--------|
|                               |        |                  |        | Never                                    | Sometimes | Always |
| No participation              |        |                  |        |                                          |           |        |
| Cooperatives                  |        |                  |        |                                          |           |        |
| Farmers association           |        |                  |        |                                          |           |        |
| Women                         |        |                  |        |                                          |           |        |

|                   |  |  |  |  |  |  |
|-------------------|--|--|--|--|--|--|
| association       |  |  |  |  |  |  |
| Youth association |  |  |  |  |  |  |
| Others            |  |  |  |  |  |  |

## 7. Women empowerment

7.1. How do you rate your input in production decision of the following? 1= no input at all; 2= have very little input; 3 = have reasonable input; 4= high input; 5 = always have input

| No |                                           | 1 | 2 | 3 | 4 | 5 |
|----|-------------------------------------------|---|---|---|---|---|
| 1  | In production of food crop                |   |   |   |   |   |
| 2  | In production of cash crop                |   |   |   |   |   |
| 3  | In rearing milking cows                   |   |   |   |   |   |
| 4  | In fattening of ox                        |   |   |   |   |   |
| 5  | In rearing of small ruminant such as goat |   |   |   |   |   |
| 6  | In rearing chicken                        |   |   |   |   |   |

7.2. How do you rate your autonomy in production decision of the following? 1= not autonomous at all; 2= have very little autonomy; 3= have reasonable autonomy; 4= high autonomy; 5= always have autonomous

| No |                                           | 1 | 2 | 3 | 4 | 5 |
|----|-------------------------------------------|---|---|---|---|---|
| 1  | In production of food crop                |   |   |   |   |   |
| 2  | In production of cash crop                |   |   |   |   |   |
| 3  | In rearing milking cows                   |   |   |   |   |   |
| 4  | In fattening of ox                        |   |   |   |   |   |
| 5  | In rearing of small ruminant such as goat |   |   |   |   |   |
| 6  | In rearing chicken                        |   |   |   |   |   |

7.3. How do you rate your ownership of resources? 1= not autonomous at all; 2= have very little autonomy; 3 = have reasonable autonomy; 4= high autonomy; 5 = always have autonomous

| No |                                      | 1 | 2 | 3 | 4 | 5 |
|----|--------------------------------------|---|---|---|---|---|
| 1  | Ownership of asset                   |   |   |   |   |   |
| 2  | Purchase, sale and transfer of asset |   |   |   |   |   |
| 3  | Access to and decision on credit     |   |   |   |   |   |

7.4. How do you rate your control over income? 1= no control at all; 2= have very little control; 3 = have reasonable control; 4= high control; 5 = very high control

| No |                                                                             | 1 | 2 | 3 | 4 | 5 |
|----|-----------------------------------------------------------------------------|---|---|---|---|---|
| 1  | Control on overall household income                                         |   |   |   |   |   |
| 2  | Control on income from self generated such as petty trading, milk sale, egg |   |   |   |   |   |

7.5. How do you rate your leadership role in the community? 1. none 2. rarely 3. medium 4. high 5. very high

| No |                                                        | 1 | 2 | 3 | 4 | 5 |
|----|--------------------------------------------------------|---|---|---|---|---|
| 1  | Membership to group such as women army group, ekub     |   |   |   |   |   |
| 2  | Speaking in public such as meeting in kebele or afosha |   |   |   |   |   |

7.6. How would you rate your workload and leisure 1= always overloaded/no leisure at all; 2= overloaded/little leisure time; 3= fair load/ fair leisure time; 4= not loaded/somewhat enough time for leisure; 5= not loaded at all/have enough time for leisure whenever needed

| No |           | 1 | 2 | 3 | 4 | 5 |
|----|-----------|---|---|---|---|---|
| 1  | Work load |   |   |   |   |   |
| 2  | Leisure   |   |   |   |   |   |

#### IV. Questions to Third objective of the Study

➤ To identify climate change adaptation options by women in Haramaya district

1. Do your farming activities depend on rain? Yes ☐ No ☐

2. What measures do you take when enough rain is not available for your farm?

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3. What kind of measures do you take when the grazing land in your area cannot provide enough to feed your livestock?

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4. According to your view, are those measures effective enough to save crops or livestock?

Yes ☐ / No ☐ If “No”, what are what happens \_\_\_\_\_

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5. Have you heard about the information any one of climate change adaptation options?

Yes ☐ No ☐

6. If the answer to Q.5 is yes how did you know about climate change adaptation? Through: Extension agent ☐ , local leader ☐ ,  
Radio ☐ , Woreda Expert ☐ , Neighbors ☐ Contact farmer ☐ Others specify \_\_\_\_\_

7. Do you practice any climate change adaptation? Yes ☐ No ☐

8. If the answer to Q.7 is yes, which type?

Terracing ☐ , Mulching ☐ , Aforestation ☐ , Short season varieties ☐ Underground water ☐ , Water harvesting ☐  
 , Intercropping ☐

Mixing farming ☐ , No strategy ☐ Other specify ☐ \_\_\_\_\_

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9. From where did you get information about different adaptation options to climate change?  
agent's

From neighbor's ☐ , From extension ☐

From market place ☐ , From research center ☐

10. Can you mention the major challenges in confronting the climate change effects?

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- 
11. Does the local government provide any support in facing challenges related to climate change? Yes ☐ No ☐
12. Have you ever observed when other farmers were using climate change adaptation practices? Yes ☐
13. If yes to Q.12 who are the source of information?  
Farmers ☐ , NGO ☐ Extension agent ☐ , others specify, \_\_\_\_\_
14. Are you interested in using adaptation practices? Yes ☐ No ☐
15. If the answer to Q.14 is yes why? \_\_\_\_\_
- 
16. Do you have planned to use adaptation practice in the future? Yes ☐ No ☐
17. If the answer to Q.16 is no, why? \_\_\_\_\_
-

**Key Informant Interview questions: Agriculture and Rural Development Officials, Meteorological Services Officials and NGOs,**

1. Name.....Position/profession..... Organization.....

2. Is there any form of climate change in your region or district? Yes/No ( )

3. If the answer to Q3 is yes, please would you like to explain the extent of climate  
Change and variability effects on crop and livestock of your region/district/kebele?

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4. What are the effects of climate change on livelihood in your area?

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5. Who is more vulnerable to the effect? (Rich or Poor) (Children, aged groups/elderly, women, Men)

Why? \_\_\_\_\_

6. What are the local coping mechanisms used to reduce the effects?

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7. How do you communicate the climate change related information in your region/district?

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8. What are the main challenges and how do you think they can be improved?

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**Checklist for Group Discussion: Points to be covered during group discussions****GENERAL QUESTIONS**

1. The major activities undertaken in the area
2. The major sources of income to support life in the district
3. How is the supply of basic service like the electricity, telecommunication, water and health in the district
4. The major crops cultivated in the area
5. The challenges faced in crop production
6. The trend of crop production in recent years
7. The place that located to crop production as compared to livestock production
8. Fire woods and water fetching
9. Perception of Climate change by the community
10. Climatic change related shocks in the area
11. Frequency of climatic shocks
12. Adaptation strategies and/or coping mechanisms to climate change
13. Determinants of adaptation strategies
14. Early warning mechanisms in the area
15. Vulnerability to climatic shocks
16. Source of climate change related information