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Willingness to pay for Rainfall based Insurance by Smallholder Farmers in Central Rift Valley of Ethiopia: The Case of Dugda and Mieso Woredas

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ABSTRACT

Current climate variability is already imposing significant challenge to Ethiopia. Therefore, farmers have faced income variability in almost every production season. Problems associated with dependence on rain fed agriculture are common in Ethiopia. Smallholder farmers' vulnerability from such income variability is also common. Over the years, a range of risk management strategies have been used to reduce, or to assist farmers to absorb, some of these risks. Since insurance is potentially an important instrument to transfer part of the risk, this study try to describe the nature of weather related risks faced by smallholder farmers, assess small holder farmers willingness to pay for the rainfall risk insurance and examine factors that affect the maximum farmers are willing to pay for the rainfall risk insurance. The data was collected from 161 sample households from the two woredas of the study area using closed ended value elicitation format followed by open ended follow up questions. The study uses Logit model to estimate the mean willingness to pay in the close ended format in addition with Tobit model to examine factors that affecting small holder farmer willingness to pay as well as intensity of payment. The mean willingness to pay values are found to be 129.98 and 183.41 birr per hectare for the open and close ended formats respectively. The total willingness to pay for the study area was found to be birr 5,740,244 per year. The tobit model shows six potential explanatory variables affect the willingness to pay value. Income of household and ownership of radio have positive and significant effect on the value of willingness to pay, whereas off-farm income, age of household head, number of livestock owning and availability of public and private gifts have negative and significant effect on willingness to pay value. If the rainfall risk insurance premium is affordable and households have enough information about the service they are willing to pay for the service. Eventually policy makers need to be aware that socio-economic and institutional characteristics of households influence the willingness to pay for rainfall risk insurance services.

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INTRODUCTION

Background

Agricultural producers around the world are exposed to a variety of income uncertainties, both market related, such as price variations, as well as non-market related, such as unstable weather patterns. It is well known that such uncertainties induce substantial income risks, and these can be particularly detrimental to small and/or poor producers in developing countries (Sarris, 2002).

A number of countries in Africa already face various challenges due to climate variability and recognize that adaptation is not an option but a necessity (Thornton et al., 2006). It is also well known that farmers have developed several ways for dealing with the various risks they face. Because climate change is expected to adversely affect agricultural production which remains to be the main source of income for most countries (Bryan et al., 2009).

A large array of adaptation practice is available to improve the resilience of smallholder agricultural system to uncertain future impact of climate change. Over the years, a range of risk management strategies have been used to reduce, or to assist farmers to absorb, some of these risks. These strategies include on-farm measures such as diversification or selecting less risky production methods, as well as strategies for sharing risk with others. Risk management strategies in which risks are shared with others include, among others, farm financing, share-cropping, price pooling arrangements, forward contracting of farm products, and hedging on future markets. Also insurance is potentially an important instrument to transfer part of the risks (Anderson, 2001).

Insurance markets are growing rapidly in the developing world, as part of this growth; innovative new products allow individual smallholder farmers to hedge against agricultural risks, such as drought, disease and commodity price fluctuations (World Bank, 2005). These financial innovations hold significant promise for rural households. Shocks to agricultural income, such as a drought-induced harvest failure, generate movements in consumption for households who are not perfectly insured, and at the extreme, may lead to famine or death.

Interest in developing catastrophic weather insurance products for rural dwellers in developing countries has grown radically in recent years. This interest has been fueled by the successful introduction of new products for the management of systematic risks to international financial markets in the recent years. Rainfall-based index insurance products for agriculture represent an attractive alternative for managing weather risk (Hellmuth *et al*., 2009). These products include catastrophic bonds and area yield crop insurance options, and their success suggests that it may be possible to package catastrophic weather and natural event risks facing developing countries and reallocate them to international markets in a cost efficient manner, bringing affordable risk management services to rural dwellers in agriculture dependent countries (Skees, 2001).

The demand for such insurance particularly in developing countries has been increasing over time, as a result of unpredictable weather conditions. In case of Ethiopia the impact that climate variability has on predominantly rain-fed agrarian economies is clearly demonstrated. Current climate variability is already imposing significant challenge to Ethiopia by affecting food security, water and energy supply, poverty reduction and sustainable development efforts, as well as by causing natural resource degradation and natural disasters. In response, the national adaptation program of action (NAPA) for Ethiopia has been prepared and the basic approach to NAPA preparation was along with the sustainable development goals and objective of the country where it has recognized

necessity of addressing environmental issues and natural resource management with the participation of stakeholders (MoWR, 2007).
Agriculture, as in many other developing countries, is the mainstay of Ethiopian economy. Nearly 85% of the population earns its livelihoods and contributing over 43% of the GDP (Gross Domestic Product), about 90% of the foreign exchange earnings, a further 10% earn their living from livestock (CSA 2004) which is almost entirely small-scale and rain-fed. Both farmers and pastoralists are highly dependent on the climate for their livelihoods (World Bank, 2000). Ethiopia has recognized climate change as an important issue and attempts are being made to incorporate potential response measures for reducing impact of climate change in to over all development planning process. One important constraint that emerged as a result of stakeholder consultative meetings is the extreme need for agricultural rainfall risk insurance. It is believed that agricultural rainfall based insurance is seen as one of the strategies to minimize risk and capitalize on opportunities associated with the variable climatic conditions.
The high covariance of climatic risks, coupled with the lack of property to be attached as collateral, makes it difficult for cooperatives, microfinance organizations, or banks to provide financial services to smallholder farmers unless they have insurance/reinsurance against weather risk. These conditions in turn keep farming at a subsistence level. According to Stern (2007), adaptation to climate change and variability will be crucial in reducing vulnerability and is the only way to cope with the impacts that are inevitable over the next few decades. This research is therefore an attempt to look in to the possibility of rainfall based insurance existence in Ethiopia.

Statement of the Problem
The farming community on the globe in general and that of the least developed countries in particular is considered to have a risk aversion attitude (Anderson *et al*., 1977; Dillon and Hardaker, 1993). Hardaker *et al*., (1997) and Binswanger, (1980) have also argued that most smallholder farmers avers to risk-by and large, they are too poor to be otherwise.
Better decisions in risky world can always be made if information about more productive technology option, marketing opportunities and marketing trends are available. But almost all small scale farmers in the globe avers to risk because they are poor (Hardaker *et al*., 1997), which holds true for the farming community in Ethiopian central rift valley. This is because of the erratic rainfall in the area. Furthermore, weather related agricultural production shocks also conspire to keep smallholders within the poverty trap, preventing the country from reaching its productive potential in the agricultural field (Hess and Syroka, 2005). Agriculture is often carried out in open air, and always entails the management of inherently variable living plants and animals which are especially exposed to risk. Production risk comes from the unpredictable nature of the weather (Hardaker *et al*., 1997). And it is probably fair to claim that farmers in developing countries are exposed to most types of risk, and the low-income farmers, especially in semi-arid areas are the most exposed (Hazell 1992).
Ethiopia is among famine-prone countries in Africa and has a long history of famine and food shortage that can be traced back to 250 BC (Assefa and Ramakrishna, 2002). More than half of the food insecure African population lives in Ethiopia, Chad, Zaire, Uganda, Zambia and Somalia and the food insecure population in Ethiopia is estimated to be around 40-50 percent of the total population (Assefa and Ramakrishna, 2002). .
Therefore, farmers have faced income variability in almost every production season. Problems associated with dependence on rain fed agriculture are common in Ethiopia;

repeated famine, crop failure, human and livestock loss are among the indicators (Assefa and Ramakrishna, 2002). Smallholder farmers' vulnerability from such income variability is also common in Ethiopian central rift valley and the two woredas of the study area, Dugda and Mieso. One major constraint to initialize the opportunity to operational risk-covering mechanisms like rainfall crop/input insurance in Ethiopia is absence of public and/or private institutions. In order to exploit the advantage associated with good rainfall seasons, risk financing institutions need to be encouraged to develop operational risk insurance schemes in the marginal rainfall areas.
This study tries to identify willingness to pay for rainfall based insurance by smallholder farmers in central rift valley of Ethiopia. The main issues and problems that need to be researched and analyzed in this study are: to investigate whether smallholder farmers are willing to pay for rainfall based insurance and identify factors that determine their maximum willingness to pay for the rainfall based insurance as well as explore the existing risk insuring mechanisms commonly used by small holder farmers. This study was, therefore, initiated to fill the current information gap and awareness on the subject.

Objectives of the Study
The objectives of the study are;
- To describe the nature of risks faced by small holder farmers in the study area;
- To assess the willingness to pay for rainfall based insurance by small holder farmers in the study area;
- To examine factors that affect the maximum farmers are willing to pay for rainfall based insurance in the study area.

Significance of the Study
The National development plan of the country is based on a strategy called Agricultural Development Led-Industrialization (ADLI), and aims at changing the country's subsistence or traditional agricultural to commercial or market oriented one, which in turn will increase the demand for goods and services and further lead to industrial development. The Government strategy is aimed at reducing country's dependency on food aid. To achieve the intended goals within a short period of time, understanding smallholder farmers' participation as well as their willingness to pay for rainfall based insurance will be vital. Reducing the vulnerability of rainfall dependent communities to climate change requires building of local institutions to support better adaptation practices where vulnerability is usually more clearly expressed.
This research looks also in to the willingness to pay for rainfall-index based insurance contracts that can promote more efficient program of actions in reducing problems of imperfect information in mitigating farmers' risks in Ethiopia. Therefore, identifying smallholder farmer's willingness to pay for rainfall based insurance is expected to be useful for policy makers in providing good information, for decision makers to make informed choices on where and how to intervene and funding agencies, involved in the development and promotion of weather based insurance. Even though the study was conducted in the Central rift valley of Ethiopia, the result can be applicable to other parts of the country which have almost similar climate condition. The outcome of this study is also expected to be useful for governmental and non governmental institutions who are involved in the weather based insurance service.

Scope and Limitation of the Study

The scope of this study covers assessing willingness to pay for rainfall based insurance and examining socio-economic and institutional factors that significantly affect the amount of money farmers are willing to pay for rainfall based insurance. The proposed research is confined only to two woredas of the central rift valley, which can somehow represent other woredas of the Central rift valley of Ethiopia this is because of resource constraint to undertake the study at broader level. In addition, the data collected for 2010 are a onetime data this might not be enough to generate adequate information because there are many variables which could be potentially changed from one survey time to the other survey time. As the research uses contingent valuation method (CVM) the study is subject to all limitations associations with the method however, efforts have been made to minimize the limitations of the methodology.

Organization of the Study

The study is organized in five chapters. Chapter one deals with background, problem statement, objectives, scope and significance of the study. And the remaining chapter, two and three deal with review of theoretical and empirical literature related to weather related insurance (rainfall) and the research methodologies, respectively. Chapter four presents results and discussion of the study. Finally chapter five summarizes the finding of the study and gives policy implication and recommendation.

REVIEW OF LITERATURE

Definitions and Concepts

One common distinction between risk and uncertainty is to suggest that risk is imperfect knowledge where the probabilities of the possible outcomes are known, and uncertainty exists when these probabilities are not known but the distinction of what risk and uncertainty for the farmers is theoretically and practically not clearly defined (Hardaker *et al.,* 1997). Risk is everywhere and is substantially unavoidable. It is often said that, in business, profit is the reward for the risk bearing, no risk, no gain

According to (Hazall *et al.,* 2010), Risks can be characterized according to a number of elements, including: **Covariance;** the degree to which they are correlated across households within a community or region, ranging from independent (affecting one person) to highly covariate (affecting everyone at the same time); **Frequency;** How often they occur; **Types and severity of losses incurred**; Shortfalls in seasonal production and income, damage to assets and loss of life.

Risks in Agriculture

Agricultural production is a risky business. Farmers have faced a variety of price, yield and resource risks that make their incomes unstable and unpredictable from year to year.

The friction due to risk may also contribute to a lag in agricultural incomes relative to those in other sectors of the economy. The people who need to concern themselves with risk in agriculture include farmers, farm advisors, and commercial firms selling to or buying from farmers, agricultural research workers, policy makers and planers. According to (Holden *et al.,* 1991) the greatest risks to family welfare in agriculture are centered in rural areas, which specialize in annual food crops but which are marginal to the production of those commodities, it is poverty and even worse alternatives which bring about such production emphasis. Such strategies are doubly risky because they are often unsustainable environmentally. In such area, fluctuation in weather and production are around the critical margin of profitability which in the case of poor countries and people means at the margin of existence.

Rainfall Based Insurance

The concept of index-based insurance is not new. Proposals for this type of insurance were first articulated by Halcrow (1948) and Dandekar (1977). The Australian Government commissioned a feasibility study of rainfall insurance in the mid-1980s, but decided not to pursue it (IAC, 1986). Index-based insurance is a financial product linked to an index highly correlated to local yields. Contracts are written against specific perils or events (e.g. area yield loss, drought, hurricane, flood) that are defined and recorded at regional levels (e.g. at a local weather station). Indemnifications are triggered by pre-specified patterns of the index, as opposed to actual yields (Hazell *et al.,* 2010).

Research carried out through the International Crops Research Institutes for the Semi-arid Tropics - Village Level Studies (ICRISAT VLS) suggested that rainfall lotteries are better than the crop insurance schemes to diminish rural household income variability in a cost-effective manner in rain fed areas of India (Walker and Ryan, 1990). There would be a fair betting system and would be open to all households in the village. For instance, if landless labor households felt the demand for their labor was markedly reduced in low rainfall years, they could hedge their future labor income by purchasing tickets on the lowest or what they perceive to be the most adverse rainfall event.

Identifying weather risk for an agricultural producer involves defining the time period during which risk is prevalent, and identifying a measurable weather index that is strongly correlated to farmers losses on a particular crop. This is the most critical process in designing a weather risk management strategy. A weather index can be constructed using any combination of measurable weather variables, over any period of time and any number of weather stations (Walker and Ryan, 1990).

Problems with fixing insurance premium: three type of problems related to insurance premium are; adverse selection, covariate risk and moral hazard.

adverse selection: This occurs when potential borrowers or insures have hidden information about their risk exposure that is not available to the lender or insurer, which then becomes more likely to erroneously assess the risk of the borrower or insure.

Covariate risk: Risk that can affect large numbers of people at one time (e.g. widespread drought, flooding, earthquake).

Moral hazard: This occurs when individuals engage in hidden activities that increase their exposure to risk as a result of borrowing or purchasing insurance. These hidden activities can leave the lender or insurer exposed to higher levels of risk than had been anticipated when interest or premium rates were established.

The Rural Poor and Risk Coping Strategies

Siegel and Alwang (1999) developed taxonomy of risk-coping strategies for rural households facing risk. However, many strategies are unavailable or prove ineffective for the poor, especially when the risks are covariate. Households living on very low incomes and limited wealth become highly risk averse. Since even a small disruption in income flows can have devastating effects, such risk aversion retards the development process by limiting household incentives to adopt productivity-enhancing technologies and to specialize in activities where comparative advantages exist. Such risks also affect the credit-worthiness of rural households and constrain credit markets. Farmers, who are more risk averse with respect to losses, would be more likely to participate in crop and rainfall insurance programs and would be willing to pay higher premiums and individuals would include insurance in their risk management strategies if the insurance premium were less than the cost of other risk responses having the same effect (Patrick, 1988).

Demand for Weather Based Insurance in Developing Countries

Weather index-based insurance was being discussed in academic papers as an alternative solution for developing agricultural economies in developing countries. In 2002, donors began to finance the piloting of these ideas. In particular, the World Bank's Commodity Risk Management Group (CRMG) allocated trust funds from the Swiss and the Dutch governments to pilot weather insurance for farmers to complement its price risk management work in commodity markets.

Commodity Risk Management Group (CRMG) has been involved in many weather risk management technical assistance projects to commercial entities in the developing world.

CRMG was involved in its first index-based weather risk management transaction in India in June 2003, the first-ever weather insurance project in the country. Since 2003 there have been several other pilots around the world, including completed pilots in Ukraine, Ethiopia, and Malawi, and upcoming pilots in Kenya, Tanzania, Thailand and Central America. Successes like the market growth in India have had significant demonstration effects and have proven that weather risk management for farmers in the developing world is possible through insurance -type instruments (World Bank, 2007).

Traditional Crop Insurance versus Weather Index Insurance

Traditional multiple-peril crop insurance that indemnifies losses on individual farm basis is subject to high administrative costs in order to overcome the problems of adverse selection and moral hazard. It also requires significant investment in monitoring farm yields to prevent both higher losses than the initial rating and serious actuarial problems. Furthermore, multiple-peril crop insurance has large correlated risks, so it requires the extra cost of providing reinsurance. These extra costs can be quite high in an emerging economy with little or no experience in providing insurance of this type. These conditions mean that traditional multiple-peril crop insurance is not a workable solution for most of agriculture in developing countries (Hess and Syroka, 2005). One form of agricultural insurance that mitigates these added costs is weather insurance. Payout is determined by an objective parameter such as millimeters of rain, soil moisture, etc. Weather index insurance was found to be well suited to the agricultural production in regions in Ukraine where there are wide spread crop losses due to drought and frost (Hess and Syroka, 2005). The monitoring costs of weather insurance are less as there is no need to perform farm-level loss adjustments and the balance of information about the weather is equally shared by the insured and the insurer (unlike with traditional farm-level insurance where the farmer will always know more about the yield than the insurer). Thus, weather insurance could be a preferred alternative to crop insurance, as it avoids moral hazard problems and high administrative costs. Furthermore, the reinsurer is more likely to provide better terms when the insurance is based upon weather events and not farm-level losses.

Standard Approach to Develop a Weather Insurance Pilot

The World Bank (2007) has drawn some lessons from its work and begun to develop a standardized approach to pilot implementation as well as contract design. While this approach is still evolving, there are seven basic components of pilot program implementation that need to be undertaken in order to develop a product that is not only technically sound but is demanded and can be afforded by clients:

- Identify potential pilot areas and carry out a basic risk assessment,
- Identify delivery channels for reaching the end users,
- Design contracts,
- Determine the marketability of the products,
- Finalize contracts and insurance,
- Market the product, and
- Monitoring the pilot.

Methods of Valuation

The farmer's decision to purchase rainfall insurance and the maximum premium he/she is willing to pay can be considered in the framework of maximizing net benefits from non-market goods and services. The principles that non-market goods and services are not efficiently allocated by the market suggests the possibility of improvement in measurements of benefit and costs.

According to Freeman (2003), the widely used methods of valuation of some non-market goods and services are revealed and stated preference methods. Revealed preference methods are based on the actual behavior reflecting utility maximization subject to constraint.

Revealed preference method

Revealed preference methods are based on the actual behavior reflecting utility maximization subject to constraint. One type of the revealed preference method is based on the observed choices in a referendum way. If an individual is offering a fixed quantity of a good price on a take it or leave it or yes or no basis, observation of the choice reveals only whether the value of the offered to the individual was greater than or less than the offered price. The other methods for valuation of non-market goods under revealed preference techniques are the Hedonic Price Method (HPM) or Property Value Method, where the change in the environmental amenity is reflected in the value attached to the amenity and Travel Cost Approach (TCA) where it mostly used to capture the recreation value of sites, such as national parks and sanctuaries. The travel cost approach is applied to determine the influence of various socioeconomic characteristics and the nature of demand for recreation site (Marothia, 2001). However, revealed preference models can not measure existence value or option value. So, firstly they cannot measure total economic value (TEV) and secondly while RP models measure the household's WTP, one cannot be sure that the price captures all the effects.

Stated preference method

Stated Preference Method uses a direct approach to elicit willingness to pay, this method involved asking people directly about the values they place on non-market services by creating in effect, a hypothetical market (Freeman, 2003). Among the frequently used methods of stated preference, the Choice Modeling and Contingent Valuation Method (CVM) are the commonly used ones Choice Modeling do not ask questions directly; instead they ask people to rank alternatives, whereas, CVM is used when market do not exist for environmental resources by asking questions directly (Mitchle and Carson, 1989; Hausman, 1993).

The valuation is done based on hypothetical or non-existing market. The valuation task is therefore, to determine how much better or worse off individuals will be as a result of change in non-market goods. Among the commonly used methods of the stated preference contingent valuation method is widely used.

Contingent valuation method

Contingent valuation method as one of the stated preference methods, is basically uses a survey based approach. The decision to use willingness to pay (WTP) or willingness to accept (WTA) depends on, among other things, individuals' perception as to who has the property right over their source in question (Carson *et al*., 2001). This is computed by asking how much people are willing to pay for a non-market goods (WTP) or how much they are willing to give up having a specified non-market goods quality improvement happen (Freeman, 2003). When market data are unavailable or unreliable, economists can use alternative estimation methods that rely on hypothetical market conditions. Such methods typically use surveys to inquire about individuals' willingness to pay (WTP) for some environmental policy initiative. This survey approach to benefit estimation is known as the contingent valuation method (CVM) because the results are dependent up on the hypothetical market devised. In general, CVM helps researchers to capture the total value of the good both use and non-use values and its flexibility facilitate valuation of a wide range of non-marketed goods. As a result, this method is becoming the most preferred valuation method at present. The major problems with this approach have largely to do with the specification of the "scenario" or the "benchmark" against which the agent is supposed to compare the current situation, and express a monetary value for what it is worth to him/her to move to the new situation, or avoid a bad one

There are number of different elicitation methods used in CVM. Dichotomous and open ended are among the methods used for obtaining the WTP. The open ended question asks the respondent how much he or she is willing to pay for given change in the status quo. This means individuals are asked for their maximum willingness to pay with no value being suggested to them. The other method is dichotomous choice question whereby a respondent is asked if he or she is willing to pay a specific amount of money for a pre specified change (Bateman *et al.,* 2000)

The use of specified format has got the advantage over the open-ended format question in eliciting WTP because of the simplicity for respondents and reduced incentives for strategic responses (Bateman *et al.,* 2000). In the dichotomous method, if the first bid given to the respondent is accepted, a second somewhat higher offer price is made. If the first bid is refused, the second bid price offers is somewhat lower, the bid levels offered in the follow up question will be greater than that offered in the initial payment if the answer to the initial payment question is "yes" and vice v ersa. Finally the dichotomous choice question is followed by an open-ended follow up question (Alberini and Cooper, 2000).

Biases in CVM: criticism on CVM is, since individuals are being given a hypothetical market their responses could be far from reality. Thus there will be biases, which can systematically understate or overstate true values. There are a number of types of biases indicated, some of them are:

Strategic Bias: This occurs when the respondent tries to understate or overstate the bid value so as to influence the outcome. For instance, if the CVM requires payment of a tax the respondent may strategically understate the bid value to influence the outcome. Using the take-it-or-leave it method, Mitchell and Carson (1989) suggests that, deleting protest bids and remove all outliers are the ways to tackle this bias.

Hypothetical Bias: This arises due to the hypothetical nature of the market in CVM surveys which can render respondents' answers meaningless if their declared intentions cannot be taken as accurate guides of their actual behavior. Experimental trials suggest that this problem is less when one uses WTP format instead of WTA format.

Information Bias: The quality of information given in a hypothetical market scenario almost certainly affects the responses in a CVM Survey. Inadequate or improper presentation of information on the good or service to be valued can bias the quality of the CVM study. Besides by making respondents feel that the hypothetical market is realistic, and avoiding WTA format can remove information bias.

Starting Point Bias: The suggestion of an initial starting point in a bidding game can significantly influence the final bid. For example choosing a low (high) starting point leads to a low (high) mean WTP.

Interviewer and Respondent Bias: The interviewer's conduct and interviews can influence responses. Though this kind of bias can be minimized by using mail or telephone surveys, this will result in less information forthcoming and also give rise to hypothetical bias. Respondents may not give correct answers or give the questions proper consideration. Therefore, to minimize this problem, professional interviewers should be used or well trained interviewers to reduce this type of bias.

Willingness to pay (WTP) and willingness to accept (WTA)

Willingness to pay and willingness to accept are two methods for elicitation of values. WTP is the amount that must be taken away from the person's income while keeping his utility constant in the same manner, WTA for a good is defined as the amount of money that must be given to an individual experiencing deterioration in environmental quality to keep his utility constant. The decision to use willingness to pay (WTP) or willingness to accept (WTA) depends on, among other things, individuals' perception as to who has the property right over their source in question (Carson *et al.*, 2001). This is computed by asking how much people are willing to pay for a non-market goods (WTP) or how much they are willing to give up having a specified non-market goods quality improvement happen (Freeman, 2003).

In theory, when WTP is a small fraction of income, WTP and WTA for a given commodity should be approximately equal. However, a number of CV studies have found that WTA is often much larger than WTP for the same commodity. One explanation is that the difference between WTP and WTA depends on the elasticity of substitution between the commodity to be valued (a public good) and private substitutes. The lower the elasticity, the fewer will be the available substitutes and the greater the difference between WTP and WTA (Hanemann, 1991).

Another explanation - the theory of prospects - is that individuals value losses more heavily than gains. It is also possible that individuals react to their perception of who has the property rights over the commodity in question. If the proposed policy contradicts their perception of the existing property rights, individuals might express their rejection of the scenario through high WTA values. Carson (1991), suggests that WTP should be used whenever the individual might incur benefits from the proposed policy, and Mitchell and Carson (1989), offer ways to frame the payment question to elicit WTP.

However, even when the individual might incur benefits from the proposed policy, there are some scenarios under which the respondent may not overstate WTA values (Cooper and Osborn, 1998). Moreover problem with direct WTP studies involves the fact that reported values are likely to be influenced by recent experiences. For instance, farmers are more likely to express high demand for drought insurance if weather in recent periods has been adverse. There are also several technical issues concerning the method of deriving the WTP from either direct expression of values, or contingent rankings of alternative choices, but these seem to have been largely resolved (Hanemann and Kanninen, 1998).

Empirical Studies on Demand for Agricultural Insurance

The review presented in this section shows the logical reasons forwarded by different researchers about the demand for agricultural insurance by farm households, factors including socio-cultural, economical and institutional. There are very few studies relevant to agricultural insurance that use the CV approach. Patrick (1988), analyzed producers' demand for a multiple peril crop insurance (MPCI) program with indemnities based on actual yields, and a rainfall insurance program with indemnities based on area rainfall. Tobit regression analysis was used to estimate responses utilizing information from the participants and non-participants in the hypothetical programs. He found that expected wheat yield had a negative effect on the premium, and suggesting that an area crop insurance program might encounter difficulties of adverse selection. Area in wheat had positive relation to premium paid for crop insurance whereas age has negative relation to premium paid for crop insurance. Farmers who are legume producers and those who are averse to risk would be willing to pay higher crop insurance premium.

The finding of this study is showed that the participation in the crop and area rainfall insurance programs would be limited. One quarter of the producers would participate in the crop insurance program and over one half would not participate in the rainfall insurance program. Twenty percent or less of the producers would be willing to pay the estimated full costs of the insurance programs and the author suggests very limited potential for commercial establishment for programs under current circumstances of drought assistance. In developing country context, the study by McCarthy (2003) found considerable demand for weather-based wheat insurance in Morocco farmers. The indirect methods of estimating WTP involve first the specification of a model of the random income or other variable of direct relevance to the farmer's welfare (e.g. consumption), the information from formal sources e.g. radio, television in fact has a negative impact on demand, indicating that those who keep better informed of rainfall at the station are less likely to prefer any insurance counteract. The result showed that explanatory variables had ambiguous impacts differed both quantitative and qualitative across and within the region. The author concluded that demand for insurance, however, appears to be quite distinct across the different areas, which indicates the need for larger data sets to satisfactorily estimate the determinants of the willingness to pay. The author also expresses the WTP as the amount of money that would equate the expected utilities of the relevant variable with and without the insurance. This amount of money (the premium) is then estimated for objectively estimated values of the risks with and without the insurance, and for a range of relevant utilities, or relevant parameters (such as degrees of risk aversion) from a given class of utilities.

The study by Gautam *et al.* (1994), where the farm household's behavior is assumed to be described by the maximization of the expected value of inter temporal utility function. The production, saving, labor allocation, diversification, borrowing, and insurance decisions are assumed to be endogenous. The equilibrium conditions of the optimization problem are manipulated to infer the production and diversification decisions of the household as functions of both standard variables as well as a variable that measures the relative preference of the household for risky versus non-risky income.

The same approach is essentially followed by Sakurai and Reardon (1997), who utilized panel data for Burkina Faso. The additional feature of this study is that the researchers regress their estimates of farm level demands for drought insurance on a set of variables, so as to identify variables that increase or decrease such demand. They found as expected, that the demand for drought insurance depends on the perceived probabilities of droughts, and is higher for regions with higher such probabilities. They also found that variables such as the size of cultivated area, and the age of household head significantly affect positively the demand for insurance, while the amount of off-farm income, the availability of public aid and private gifts, and the size of household significantly affect negatively the demand for insurance.

Experience of Ethiopia

In recent years Nyala insurance has provided two types of crop insurance: multiple-peril crop insurance (MPCI) and index-based weather insurance, each designed to meet the needs of different farmers. Nyala's MPCI is a double-trigger scheme that insures farmers against a number of different shocks both natural and human caused that affect crop yields, including shortages of rainfall, excess rainfall, fire, and transit risks. Because MPCI insures against a number of perils, it is better suited to farmers who face a number of sources of risk to crop yields than it is to farmers whose predominant source of risk is rainfall variability. Since 2009, Nyala Insurance Corporation introduces and sells weather index insurance through farmer cooperatives, taking advantage of low-cost automatic weather stations owned by the National Meteorological Agency (Hazell 2010) this is specifically to protect smallholder farmers against weather risk. This product was provided in cooperation with Oxfam-America, mainly using satellite data and a weather index product was designed in collaboration with the World Food Program around the rainfall requirements of different crops. Currently, Nyala insurance has found that farmers' unions serve as effective delivery channels for the weather insurance products.

RESEARCH METHODOLOGY

Description of the Study Area

This study is under taken Dugda and Mieso *woredas.* These *woredas* are among the central rift valley *woredas* of Ethiopia. Dugda *woreda* is located in eastern Shoa zone of Oromia region. Dugda *woreda*, the capital is Meki, is located about 175km south of Addis Ababa. It has a total population of 144,849 (CSA, 2008). The altitude ranges from 1610-2020 m. a. s .l. Because of its location in semi-arid type of ago-ecology, the *woreda* has a bimodal and erratic type of rainfall with high variation between and within years. The *woreda* has a total of 36 Peasant Associations (PAs).

Crop-livestock mixed farming system characterizes agriculture in the *woreda*. Cattle, goats, sheep and chickens are important livestock species reared by farmers. Maize, *teff*, wheat and haricot bean are major crops grown by farmers. Besides cereals and pulses farmers in the *woreda* produce significant amount of horticultural crops particularly vegetables. Onion, tomato, pepper and cabbage are the most widely grown vegetable crops

Meiso *Woreda* is located 300km east of Addis Ababa, and at about 200 km east of Adama town. It is located west and is one of Somalia region *woredas* in Oromia where agro pastoral farming system is practiced. The *woreda* has a total number of 37 rural *kebeles* and four town dwellers' associations. The total human population of the *woreda* is estimated at 145,775, and is composed of 22,012 agricultural rural households and 6785 urban households. The total rural population is 115,568, out of which 58,612 (51%) are males. Of the total rural households, 17,495 (80%) are male-headed households.

The *woreda* has a total area of 2573.44 km^2 (about 257,344 ha) and is situated between $40^0 9''30'$ E and $40\ ^0 56''44'$ E; and: $8\ ^0 48''12'$ N and $9\ ^0 19''52'$ N. the *woreda's* attitude ranges between 900-1600 masl. The mean annual temperature varies between 24^0C-28^0C. The mean annual rainfall ranges from 400 to 900 mm, with an average of about 790 mm (IPMS 2006). Agro-ecologically, the *woreda* is classified as lowland (*Kolla*). The area receives a bimodal rainfall where the small rains are between March and April while the main rains are between July and September. During the small rains, are unpredictable and erratic, and as a result, crops fail in most years due to lack of even distribution of rainfall.

Recurrent drought is a major problem, and is making relief aid a regular source of livelihood for many rural families. A total land area of 22,487 ha (about 12% of the *woreda*) is considered suitable for crop production.

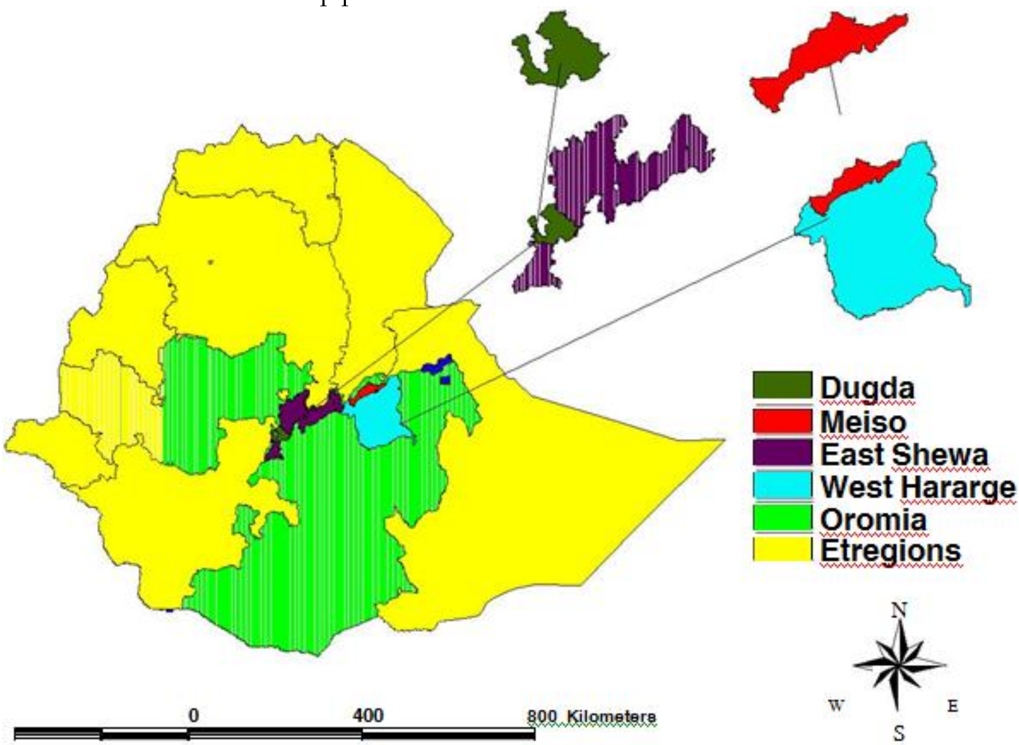

Figure 1. Location of the study area

Sampling Techniques and Method of data Collection

Sampling techniques

A multi stage sampling technique was used to select 161 sample households. In the first step of the sampling, out of the *woredas* in the central rift valley that have almost similar climate condition, Mieso and Dugda *woredas* were purposively selected because these areas are most drought prone areas. In the second stage, out of the 36 PAs in Dugda *woreda* 4 PAs were selected randomly and of 36 PAs in Mieso *woreda* 3 PAs were selected. In the third stage the total numbers of households in each PAs were listed and finally a total numbers of 161 sample households were selected and interviewed based on the proportional to sample households.

Table 1. Number of household and sample sizes

Woreda	No of PAs	Farming system	Name of PAs	No of HH in PAs	Sample HH
Dugda	4	Mixed	B/Gusaa	344	18
		Mixed	Jawe Bofo	332	16
		Mixed	Odd Bokota	496	24
		Mixed	S/Wakalee	474	23
Mieso	3	Agropastoral	Buri Mulu	584	29
		Agropastoral	Chobi	500	24
		Crop-livestock	Husemandhera	551	27
Total	**7**			**3281**	**161**

Method of data collection

Data were gathered from primary and secondary sources. The primary data were collected from sample households through a structured questionnaire using face to face interview as well as CVM was employed to collect willingness to pay data. The secondary data were collected from the existing government line departments and offices, records of non-governmental organizations. In addition a structured questionnaire focus group desiccation was done with a group of farmers in each *woredas* PAs to know major sources of risk and management strategies practiced. Six enumerators who speak the local language were recruited from the study area and trained on interviewing techniques and how to manage CV questions.

Method of WTP data collection

Willingness to pay is defined as the amount that must be taken away from household's income. The willingness data is collected through CV method, this method is also suited to solicit consumers' willingness to pay for a product that is not yet on the market. CVM is now increasingly used in developing countries (Alberini and Cooper, 2000). In this method, the researcher creates a hypothetical market in a non-market or new good. The values which are generated through this hypothetical market are treated as estimates of the value of new good. After designing the draft questionnaire pre test was conducted with 26 randomly selected sample households. An open ended question was used for the elicitation of the respondents' maximum amount they are willing to pay for the insurance service per hectare. This is due to make some modifications in the designed questionnaire of the survey and to obtain starting bid values. Based on this elicitation some values were selected as the starting bid values for the survey questionnaire. The bid values were distributed randomly through 161 sample households and the respondents were asked are you willing to pay this amount if the respondent says yes or no, finally the single bounded dichotomous choice question is followed up by an open-ended follow up question.

Method of Data Analysis

The data that had been collected through contingent valuation method has been analyzed using both descriptive statistics and econometric model. Descriptive statistics such as mean, percentage, standard deviation and frequency of appearance was used, whereas on the econometric approach adopted the Tobit model.

The Tobit model

A very common problem in microeconomic data may stem from conditions in which the researcher had information only on the regressors but not on the regress and (amount of the respondent is willing to pay for rainfall insurance) for some observations. A sample in which information on the regress and is available only for some observations is known as a censored sample. When data are censored, the distribution that applies to the sample

data is a mixture of discrete and conditional distribution and the most appropriate model to analyze such distribution is the Tobit model.
This model is also commonly known as censored normal regression model (Greene, 2003). It assumes that many variables have a lower or upper limit that is known as threshold value and take on this limiting value for a substantial number of respondents. For the remaining sample respondents the variable takes on a wide range of values above the limit. The explanatory variables in the model may influence both the probability of limit responses and the size of non-limit. The two parts correspond to the classical regression for the non limit (continuous) observations and the relevant probabilities for the limit (zero) observations, respectively. Based on the above behavior of the model, Tobit analysis is appropriate for this study and the formula for the Tobit model is given as follows:
Following Long (1997), the structural equation of tobit model censored from below can be expressed as:

$$Y_i^* = x_i\beta_i + \varepsilon_i \text{...} (1)$$

$$Y_i = Y_i^* \; if \; Y_i^* > 0$$

$$= 0 \; if \; Y_i^* \leq 0$$

Where,
Y_i = the observed dependent variable, in this case the maximum willingness to pay the respondent is willing to pay in Birr.
Y_i^*= the latent variable which is not observable.
X_i = vector of factor affecting willingness to pay.
β_i = vector of unknown parameters to be estimated .
ε_i = residuals that are independently and normally distributed with mean zero and constant variance δ^2.
The model parameters can be estimated by maximizing the tobit likelihood function of the following form (Maddala, 1997);

$$L = \prod_{Y_i^*>0} \frac{1}{\sigma} f\left(\frac{Y_i - \beta_i X_i}{\sigma}\right) \prod_{Y_i^* \leq 0} F\left(\frac{-\beta_i X_i}{\sigma}\right) \text{..} (2)$$

Where f and F are respectively, the density functions and cumulative distribution function of y_i^* $\Pi y_i^* > 0$ means the product over those i for which $y_i^* > 0$, and $\Pi y_i^* < 0$ means the product over those i for which $y_i^* < 0$.
Maddala (1997) proposed the following techniques to decompose the effects of explanatory variables into the decision to pay and intensity effects. Thus, a change in X (explanatory variables) has two effects. It affects the conditional mean of Y_i^* in the positive part of the distribution, and it affects the probability that the observation will fall in that part of the distribution. Similar approach will be used in this study.

- The marginal effect of an explanatory variable on the expected value of the dependent variable is:

  $$\partial E(Y_i)/\partial X_i = F_{(z)}\beta_i \text{...} (3)$$

  Where, $\beta_i X_i/\delta$ is denoted by z, and F is cumulative distribution.

- The change in the probability of willingness to pay as independent variable X_i changes is:

  $$\partial F(Z)/\partial X_i = f(z)\beta'/\delta \text{..} (4)$$

- The changes in the amount of money respondent are WTP with respect to a unit change in an explanatory variable among those who are willingness to pay are:

$$\frac{\partial E\left(\frac{Y_i}{Y_i^*}>0\right)}{\partial X_i} = \beta_i\left[1 - Z\frac{f(z)}{F(z)} - \left(\frac{f(z)}{F(z)}\right)^2\right] \ldots\ldots\ldots\ldots \quad (5)$$

Where;
F (z) = is the cumulative normal distribution of z,
f (z) = is the value of the derivative of the normal curve at a given point (unit normal density),
z = is the z score for the area under normal curve,
 = is a vector of Tobit Maximum Likelihood estimates and
σ = is the standard error of the error term.

The logit model

In the logit model of single bounded dichotomous format, households are given initial bid value in which they may accept or reject. In the logit model the dependent variable is dummy variable yes/no. The purpose of the Logit model is to estimate the mean WTP. Following Gujarati, (1999) the Logit model is expressed as follows:

$$\text{Logit } (P(x)) = \beta_o + \beta x_i + \varepsilon_i \ldots\ldots\ldots\ldots \quad (6)$$

Where:

$p(x)$= probability that a given household is willingness to pay

β_o = Constant term

β_i = regression coefficient to be estimated or Logit parameter

x_i = initial bid value

ε_i = error term of the Logit regression

One of the main objectives of estimating an empirical WTP model based on the CV survey responses is to drive a central value or mean of the WTP distribution Hanemann et al (1991). According to Gujrati (1999) both probit and logit models provide similar results thus, for comparative computational simplicity logit model was used for the estimation. And the mean willingness is formulated as:

$$E\ (WTP) = \frac{\ln(1+\exp(\beta_o))}{\beta_1} \ldots\ldots\ldots\ldots \quad (7)$$

Where:

β_1= bid coefficient

β_0= constant term

Variable Definitions and Hypothesis

Dependent variable

The amount of money the respondent is willing to pay for rainfall based insurance service per hectare was taken as the dependent variable.

The independent variables

It is very important to identify the potential explanatory variables and describe their measurements in a model. Therefore, based on review of theoretical and empirical works, Socio-economic characteristics of the households and institutional factors were considered as in the model.

Age of household (AGE): Age is continuous variable defined as the age of the head of farm household at the time of interview measured in years. According to the study by Patrick (1988) the age of the household has negative effect on the demand for insurance. The other study which has almost similar result with Patrick is Gine *et al.* (2007), who found that young farmers are more likely to purchase insurance than elders. Therefore, in this study it is hypothesized that young farmers are more likely to purchase insurance than elders.

Sex of household (SEHH): This is measured as a dummy variable taking the value of 1 for male headed household and 0 otherwise. The sex of the household head was included to differentiate between male and female household heads in their participation of making a decision on income distribution. In this study it is hypothesized that male head households are likely to purchase the insurance service than female head households. Therefore, it is expected to affect willingness to pay for rainfall based insurance positively.

Marital status of household (MRST): Marriage is social engagement to support each other both socially and economically. Married households put aside some of resources for unforeseen circumstances to smoothen their life, pool their resources and reduce cost that would have been spent separately. In this study marriage and willingness to pay for rainfall based insurance premium are hypothesized to be related positively.

Location of the study area (NAWO): This is dummy variable taking 1, if the study area is located in Dugda and take 0, if the area is located in Mieso woreda.

Income from crop (FINC): It is a continuous variable expressed in Birr and shows the amount of income that the household head earned from crop production activities. The increase in demand for insurance associated with income and it appears that an increase in an income may create pressure on the household to purchase additional insurance. This is based on economic theory, which states that individual's demand for most commodities or services depend on income (Mbata, 2006). Vince and Joyce (1994) have found that income of the household has positive impact on the demand for rainfall based insurance. That is financial security for households with greater income may warrant additional protection. In this study income from crop is expected to have positive influence on farmers' willingness to pay for rainfall based insurance.

Off-farm income (OFINC): It is income from other non farming activities like basketry, roping *etc*. It is a continuous variable measured in Birr. A study conducted by Sukurai and Readon (1997) showed that respondents who received high amount of income from other non-farm activities are not interested in participating in drought insurance. Therefore households who have less amount of off-farm income are expected to be more willing to pay for rainfall based insurance.

Family Size (FSIZE): It is a continuous variable measured in number of people living under one roof. Higher family size is accompanied with larger household expenditure, which consequently depletes household cash resources. Sukurai and Readon (1997) have shown that as size of household increase, demand for insurance decrease. In this study size of household is expected to have negative effect on the willingness to pay for the rainfall risk insurance.

Dependency ratio (DEPR): This is a continuous variable measured in ratio. It refers to an increase in working-ratio that reduces the ability to meet subsistence need and also increase the personal rate of time preference. It also tells us the proportion of household members who are dependent on the economically active members of the family. The more dependency ratio in the household, the less active labor force the family would have. Paulos (2002), has found that it is negatively related to willingness on decision of the farmers to participate in soil and conservation practices. Therefore in this study it is expected to affect the expected willingness to pay for rainfall based insurance service negatively.

Education of household head (EDUC): It is dummy variable taking 1 if the respondent is literate and 0 if the respondent is illiterate. Education may increase farmers' ability to use information as well as practice. Education has been shown to be positively related to farmers' willingness to pay for willingness decision of the farmers to participate in soil and conservation practices (paulos 2002). Therefore, it is hypothesized to have a positive influence on farmers' willingness to pay for rainfall based insurance.

Availability of public and private aid (PAPA): Gifts may be in kind or in cash from governmental and other nongovernmental organizations. This is a dummy variable takes the value 1, if households have gift from different sources 0, otherwise. The result from the study by Sukurai and Readon (1997) showed that as the availability of public and private aid is high, participation and willingness to pay for insurance is low. Therefore in this study availability of such aid expected to have a negative influence on the willingness to pay for rainfall based insurance.

Credit constraint (CREDIT): It is dummy variable which takes the value 1, if the household has high credit constrained and 0, if less constrained. A study conducted by Gine *et al.* (2007) indicates that insurance participation is higher when households are less credit constrained. In this study credit constraint is expected to have a negative effect on the demand for insurance and willingness to pay for it.

Extension service access (EXTENTION): It is a dummy variable which takes a value of 1, if the farmer has access to extension service and 0 otherwise. Access to extension service indicates to the availability and existence of technical advices to stallholder farmers in the study area. Extension service widens the farmer knowledge with regard to use of improved seed and agricultural technologies. And has positive impact on household farm and decision for willingness to pay for rainfall based insurance. (Paulos, 2002) have found Extension access to farmers influenced the application of soil conservation technologies positively. In this study it is hypothesized that expected to affect willingness to pay positively.

Initial bid value (BID): This is continuous variable measured in Birr and included in the regression analysis to check weather starting bid bias exist or not. If this variable is significant and positive there is a bias on the starting bid value otherwise not.

Livestock holding (TLU): It is a continuous variable which represent livestock holding of the respondent in tropical livestock unit. It is expected to influence the willingness to pay of the household head either positively or negatively. This is because of the fact that the income from sale of livestock as well as production of livestock have positive influence on income and in turn income has positive influence for willingness to pay. Therefore, On the other hand, it may have negative impact on willingness to pay if the farmers believe that, as the willing to pay amount increases they might have to shift their attention from crop production to livestock production activity. In this study, it is expected to have negative influence on the willingness to pay for rainfall based insurance.

Ownership of radio of the household (RADIO): This variable is a dummy variable, which takes the value of 1 if household has radio and 0 otherwise. Radio is a source of information and can enhance the ability of farmers' access to different sources of information such as extension service, credit service, use of new technologies, improved seed varieties, input price, output price, crop protection, post harvest handling techniques than those farmers don't possess radio. Thus, farmers who have radio might be able to understand those information's earlier than those who do not have. Therefore, in this study it is hypothesized that owner of radio will be positively related to willingness to pay for rainfall based insurance service.

House type of the households (HOUSE): It is a dummy variable that takes the value 1 if the household has iron roofed house and takes the value 0, if they have grass roofed house. Since type of house is a proxy for wealth status it may have positive influence on the farmers' willingness to pay for rainfall based insurance. In this study, it is expected to have positive influence on the WTP.

Table 2.Variables and their measurement included in the mode

Variable	Code	Type of variable	Definition and Measurement
Age of the household	AGE	Continuous	Age of household head in years
Sex of the household	SEHH	Dummy	Sex of household head 1, if male 0, otherwise
Marital status	MRST	Discrete	Marital status 1, married 2, single 3, divorced
Location of the study area	NAWO	Dummy	Location of the study area 1, if in Dugda 0, in mieso
Family size	FSIZE	Continuous	Number of family members
Income from crop	FINC	Continuous	Total annual income of the households from crops in Birr
Education of the household	EDUC	Dummy	Education status of HHH, 1 if literate 0, otherwise
Off-farm income	OFINC	Continuous	Total off-farm income measured in Birr
Initial Bid value	BID	Discrete	Initial bid value offered in Birr per hectare
Maximum willingness to pay	MWTP	Continuous	Maximum WTP in Birr per hectare
Credit constraint	CREDIT	Dummy	1 if the household is highly credit constrained 0, otherwise
Extension service	EXTENTION	Dummy	1 service user 0, otherwise
Livestock holding	TLU	Continuous	measured in tropical unit
Dependency ratio	DEPR	Continuous	measured in Birr
House type	HOUSE	Dummy	1 if iron roofed 0, otherwise
Owning radio	RADIO	Dummy	1 if owning radio 0, otherwise
Availability of public and private aids	PAPA	Dummy	1 if household head has aid 0, otherwise

RESULTS AND DISCUSSION

The number of sample households included in this study was 161. Both descriptive and econometric analyses were used in analyzing the data obtained from the survey.

Descriptive Statistics Results

Descriptive statistics such as mean, minimum and maximum values, range and standard deviations were used to describe the major factors explaining farmers' willingness to pay for rainfall risk insurance. In addition, mean difference for continuous variables and frequency of discrete variables were tested using t-test and chi-square test respectively.

Household characteristics

From the total surveyed respondents 144 (89.4%) were willing to pay for rain fall based insurance where as the rest 17 (10.6%) were not-willing to pay for the service. Based on the survey result, of the interviewed households 155 (96.3%) were male respondents while the remaining 6 (3.7%) were female respondents. Out of willing respondents, 141 (97.9%) were male respondents and 3 (2.1%) were female respondents, while out of non-willing respondents 14 (82.4%) were males and 3 (17.6%) were female respondents. The result of chi-square test shows that there is statistically significant difference in sex of household heads between willing and non-willing groups ($p<0.01$).

Of the total respondents, 147 (91.3%) were married, 7 (4.3%) were single, 5 (3.1%) were divorced and 2 (1.2%) were widowed. Out of the willing respondents, 133 (92.4%), 7 (4.9%), 3 (2.1%), and 1 (0.7%) were married, single, divorced and widowed, respectively. While out of the non-willing respondents 14 (82.4%) were married, 2 (11.8%) were divorced and 1 (5.9%) were widowed. There is statistical significant difference in marital status between willing and non-willing groups ($p<0.05$).

Of the total household surveyed 42.2% have iron roofed house and the rest 57.8% have grass roofed house. There is statistically significant difference between willing and non-willing households in terms of their housing type. The education level of the sample respondents was categorized in to those who can read and write as literate and those who cannot read and write as illiterate. Based on this, illiterate respondents constituted 73 (45.3%) of the total respondents and the literate groups constituted 88 (54.7%). Out of the willing respondents 62 (43.1%) were illiterate and 82 (56.9%) were literate and the chi-square test depicted that there was statistically ($p<0.1$) significant difference in education of the household head. Sample respondents who have their own radio were 132(82%) of the total respondents. Out of this 128(88.9%) are from willing to pay group, and 4(23.5%) are from non-willing group. There is also statistically significant difference between the two groups ($p< 0.01$). The summery of the result is shown below in Table 3.

Table 3. Characteristics of sample household heads by willing and not-willing groups for (dummy variables)

Variable		Willing to pay		Not-willing to pay		Total		
		N	%	N	%	N	%	χ^2
SEHH	Male	141	97.9	14	82.4	155	96.3	10.266***
	Female	3	2.1	3	17.6	6	3.7	
MRST	Married	133	92.4	14	82.4	147	91.3	8.876**
	Single	7	4.9	-	-	7	4.3	
	Divorced	3	2.1	2	11.8	5	3.1	
	Widowed	1	0.7	1	5.9	2	1.2	
HOUSE	Iron roof	65	45.1	3	17.6	68	42.2	4.710**
	Grass roof	79	54.9	14	82.4	93	57.8	
EDUC	Literate	82	56.9	6	35.3	88	54.7	2.876*
	Illiterate	62	43.1	11	64.7	73	45.3	
RADIO	Yes	128	88.9	4	23.5	132	82	43.983***
	No	16	11.1	13	76.5	29	18	

Source: own survey, 2010

***,**,* Statistically significant at 1%, 5% and 10% probability levels respectively.

Regarding the continuous variables mean age of the respondent was found to be 39.84 with the minimum 20 and maximum of 71 years. The mean age for willing respondents was found to be 40.03 with 20 minimum and maximum of 71 years while that of the non-willing was 38.29 with minimum of 22 and maximum of 70 years respectively. There is no statistically significant difference between willing and non-willing respondents. The average family size was found to be 5.86 with a minimum of 1 and a maximum of 11 family members. The average family sizes of the willing respondents and non-willing respondents were 6.05 and 4.24, respectively. The result indicates that there is statistically significant difference at 1% significance level between willing and non-willing respondents in their family sizes ($p<0.01$).

Table 4. Characteristics of sample household heads by willing and not-willing groups for (continuous variables).

Variables	Willing to pay Mean	Std.	Non-willing to pay Mean	Std.	Total Mean	Std.	t-value
AGE	40.03	11.94	38.29	14.79	39.84	12.2	0.552
FSIZE	6.05	2.306	4.24	1.2	5.86	2.28	5.198***

Source: own survey, 2010
*** Statistically significant at 1% probability level

Resource Ownership
The survey result showed that income from farm is the main source of subsistence for the majority of the surveyed households. The mean income of the respondents was 7035.40 birr/year with minimum 700 birr/year and maximum of 19,000 birr/year. The mean income of willing and not-willing respondents was 7237.50 birr/year and 5323.53 birr/year, respectively. The result shows that there is statistically significant mean difference between the two groups of the respondents. On the other hand, the mean annual off-farm income of the respondents from different activities was 773.29 birr/year. The corresponding figure for willing respondents was 570.14 birr/year and the mean of non-willing respondents was 2494.12 birr/year. There is statistically significant difference between two groups ($p<0.01$).

Table 5. Economic Characteristics of sample household by willing and not-willing groups for (continuous variables)

Variable	Willing to Pay Mean	Std.	Not-willing to pay Mean	Std.	Total Mean	Std.	t-value
FINC	7237.5	4679.1	5323.5	4534.4	7035.	5468.7	1.600
OFINC	570.14	1376.1	2494.1	2237.6	773.1	1595.3	-3.469***
TLU	7.3141	4.4872	1.0906	3.4249	7.693	4.5161	-3.19***

Source: own survey, 2010
***, Statistically significant at 1% level respectively

Institutional characteristics
Households' institutional characteristics have important effect on the households preferred status with respect to willingness to pay for rainfall risk insurance. The important institutional factors included in the study are: agricultural extension, credit facility, and availability of public and private gifts.

Of the total households surveyed only 88.8 % had contact with extension agents (Table 6). There was statistically significant difference between the willing and non-willing households in their access to extension services (p<0.1). On the other hand, 28%, the respondents reported to have obtained different public and private aids and the rest 72% did not have this opportunity. There was also statistically significant difference between willing and non- willing households (p<0.01). About 59% of the household were reported that they were credit constrained. The result from chi-square test shows there is statistically significant difference between willing and non-willing households in their credit access (p<0.05).

Table 6. Institutional characteristics of sample households by willing and not-willing groups for (dummy variables)

Variable	Willingness to pay Yes (%)	Not-willing to pay Yes (%)	Total Yes (%)	χ^2
PAPA	22.9	70.6	28	17.159***
CREDIT	43.8	17.6	41	4.283**
EXTENTION	90.3	76.5	88.8	2.919*

Source: own survey
***,**,*Statistically significantly at 1%, 5% and 10% level respectively.

An attempt has also been made to compare respondents grouped based on the two survey woredas Dugda and Mieso among dummy and continuous variables. Table 7 presents the summary of the descriptive statistics.

Table 7. Summary of descriptive statistics of sample households' characteristics by *woreda* for (continuous variables).

Variables	Dugda mean	Dugda Std.	Misso mean	Misso Std.	t - value
AGE	41	13.1	38	10.5	1.639**
FINC	6764	4643	7480	4763.9	-0.940
OFINC	721	1475.8	859	1783.5	-0.531
FSIZE	6.25	2.5	5.21	1.704	3.125***
TLU	7.76	4.52	7.58	4.545	0.243

Source: survey result (2010)
***,** Statistical significant at 1% and 5% probability level.

The purpose of these comparisons using descriptive statistics by woreda was to examine whether there is significant difference between the two woredas in terms of household characteristics, institutional factors and resource ownership. The above Table (Table 7) presents the mean comparison of continuous variables between two woredas. Age of the household head and family size were found to be statistically significant at 5% and 1% significant levels respectively. On the other hand no statistically significance difference was observed between the two *woredas* in terms of total income from crop, total off-farm income and total livestock holding.
Summary of descriptive statistics for dummy variables presented in Table 8 also depicts that there is statistically significant difference at less than 1% significant level in two

woredas of the study area includes: sex of the household head, marital status of the household head, education of the household head, housing type, access to extension services, owning radio and credit constraint. But there is no statistically significant difference in availability of public and private aid in between two *woredas*.

Table 8. Summary of descriptive statistics of sample household characteristics by *woredas* for (dummy variables).

Variable		Dugda N	Mieso N	χ^2
SEHH	Male	100	55	10.217***
	Female	-	6	
MART	Married	94	53	13.343***
	Single	6	1	
	Divorced	-	5	
	Widowed	-	2	
EDUC	Literate	68	20	18.957***
	Illiterate	32	41	
HOUSE	Iron roofed	55	14	17.625***
	Grass roofed	45	48	
EXTENTION	Yes	95	48	10.152***
	No	5	13	
PAPA	Yes	29	16	0.144
	No	79	45	
RADIO	Yes	89	43	8.788***
	No	11	18	
CREDIT	Yes	58	8	31.557***
	No	42	53	

Source: survey result (2010)
*** Statistically Significant at 1% Probability level.

Sources of Risk and Management Strategies Practiced

Farmers were highly affected by many sources of risk, but they were trying to cope and live with these risks. Households in the study areas were also practicing different mechanisms in order to make their living. Among many sources of risk, the following were identified as the major ones by respondents. Households were asked to list the most important, second most important and the third most important sources of risk that they faced. Responses were classified into the categories listed below.

Table 9. Major sources of risk as perceived by sample respondents and their rank given by sample households

	Rank (=161)		
Sources of risk	1st	2nd	3rd
Drought/erratic rainfall	156	10	18
Crop disease	1	128	66
Loss of livestock	1	6	2
Loss of fertility of the soil	2	8	71
Price variability	1	7	2
Low market demand	-	1	2
Fire	-	-	-
Flood	-	1	-

Source: own survey, 2010

Table 9 shows, clearly that the most important source of risk identified by the respondents was drought or erratic rainfall. The second was crop failure due to crop diseases and the third reason was loss of fertility of the soil. Therefore, Drought was the major source of risk in the study area.

Risk management strategies

In order to cope with sources of risks below in table 10, rural households have developed through time various risk management strategies which only differ from place to place, and among the farmers. Farmers in the study area practice sale of livestock as a major risk coping strategy. Diversification, use of improved technology, delay in sale of crop and intercropping were also strategies used by farmers. There is statistically significant difference in coping strategies between willing and non-willing respondents in terms of diversification, off-farm employment and use of improved technologies. But there is no statistically significant difference in terms of intercropping, go for credit, delay in sale of crop and sale of livestock.

Table 10. Risk management strategies practiced by sample households

Management strategies	Willingness to pay Yes (%)	Not-willing to pay Yes (%)	χ^2
Intercropping	66.7	76.5	0.668
Diversification	81.9	64.7	2.837***
Off-farm income	11.8	70.6	35.58***
Go for credit	75.5	58.8	0.279
Delay sale of crop	2.1	-	2.244
Contract sale	80.6	52.9	0.3461
Use of improved technology	85.4	88.2	6.679***
Sale of livestock	85.4	29.4	0.099

Source: own survey, 2010

***, significant at 1%

Risk perception of sample households

Households in the study area perceive that they are exposed to different types of substantial risks from different sources. Therefore, based on the results obtained from formal survey questionnaire, households define risk in three ways: year when rainfall delays, year when rainfall is inadequate, year when rainfall is high. The summary of the result are presented and discussed below in Table 11.

Table 11. Definition of risk by sample households

Description	Willing		Not-willing	
	N	%	N	%
Year when rainfall delays	27	18.7	-	-
Year when rainfall is low	116	80.6	17	100
Year when rainfall is high	1	0.7	-	-
Total	**144**	**100**	**17**	**100**

Source: survey data, 2010

Out of the total households surveyed 80.6 % define risk as a situation where the expected rainfall is low. The others 18.7% and 0.7% percent of the sample households define it as the situation when the rainfall delays and the expected rainfall is high, respectively. Similarly, when the households were asked which was the most risky year in the ten years preceding survey, 105 (65.2%) of the sample households reported the year 2001 the others 47 (29.2%), 3(1.9%), 2(1.2%) identified the years 1995, 2000 and 1994, respectively.

Out of the willing respondents 131 (91%) showed their interest to pay the premium in cash and the remaining 13 (9%) in kind. The respondents also discussed about the time of insurance premium payment. Of the willing respondents, 129 (89.6%) reported that the preferred to pay after the time of harvesting. Their main reason stated for this preference was the prospects of earning money after harvest by selling what they produced. Ninety four (65.28%) of the respondent choose the indemnity to be paid in cash, because they need the money to buy better improved varieties, water pump (hand pump), implement and engaged in fattening activities etc. The other fifty (34.72%) stated that they would opposite for the payment in kind because they are afraid of losing the money without any activity, so that they prefer only the lost product or grain.

Willingness to Pay Analysis

Before implementing the final survey, the pilot survey was conducted using open-ended elicitation format to set up starting bid. The bid values were 50, 100, 150 and 200 based on the pilot survey. The follow-up question was open-ended; if the respondent answered "no" to the randomly aligned initial bid, he/she was then asked how much he/she would pay for the service. If the respondent answered "yes" to th e randomly aligned initial bid, he/she was then asked what was the most he/she would pay for the service.

The total sample households were randomly distributed to the four initial bid value groups and each contains 41, 47, 36 and 37 respectively. Out of the total sample respondents 17(27.2%) responded "no" to the initial bid value. The main reason they have stated includes mainly they couldn't afford it, and they didn't trust the service. But the rest 144(72.8%) show their interest to contribute and gave the "yes" or "no" response to the initial bid value then follow up values.

Table 12. Maximum WTP and percentage distribution of the sample household

Maximum WTP Birr/hectare	Number of respondents	Percentage of the Respondents
0-50	39	24.3
51-100	54	33.6
101-150	11	6.8
151-200	37	23
201-250	7	4.3
251-300	7	4.3
301-350	5	3.1
351-400	1	0.6
Total	161	100

Source: own survey, 2010

Estimation of the mean WTP value

The initial bid value was regressed with the dependent dummy variable, the result of the coefficients were presented in Table 13, and mean willingness to pay for the single bounded dichotomous format is as follows.

Table 13. The Logit model to calculate the mean WTP

Variables	Coefficient	St. d	t-value	p-value
CONST	3.993626	0.6619955	6.03	0.0000
BID	-0.021873	0.0042091	-5.20	0.0000

$$E(WTP) = \frac{\ln(1+\exp(\beta_0))}{\beta_1}$$

Where:

$\beta_1 = 0.021873$

$\beta_0 = 3.993626$

$$= \frac{\ln(1+\exp(3.993626))}{0.021873} = 183.41$$

Thus the mean willingness to pay calculated from the single bounded dichotomous format is 183.41 birr per hectare. However, the mean WTP is 129.93 birr per hectare from responses to the open-ended CV survey questions, which is lower than the mean value obtained from the closed-ended Logit model estimates. Thus the result showed that the respondents were willingness to pay between the ranges of 129.93–183.41 Birr per hectare for the proposed rainfall based insurance service.

Estimating total willingness to pay and total revenue

In this section the total willingness to pay and total revenue at different prices that households in the seven PAs of the two woredas (Dugda and Mieso) were willing to pay as computed. The sampled seven PAs namely, (B/Gusaa, Odd Bokota, Jawe Bofo, S/wakalee, Huse mandhera, Chobi, Burimulu) have a total of 3281 households with a total population of 49,966 households with a total population of 275,307 and an average family size of 5.86. Based on this information and the distribution of WTP amount by the respondents, it would be possible to estimate the expected total willingness to pay and total revenue for the study area. Table 14 provides the procedure and results from this analysis.

Table 14. Total willingness to pay and total revenue in (Birr)

Class bound. For WTP amount	Class mark for WTP amount	Sample District of HHs		Total no of HHs	Total WTP in Birr	Sample HHs WTP at least that amount		Total HHs WTP at least that amount	Total Revenue
		N	%			N	%		
0-50	25	39	24.223	12,103.3	302,582	161	100	49,966	1,249,150
51-100	76	54	33.54	16,759.6	1,273,729	122	75.78	37,864	2,877,664
101-150	126	11	6.832	3,414.18	430,186	68	42.24	21,105	2,659,230
151-200	176	37	22.981	11482.7	2,020,953	57	35.40	17,688	3,113,088
201-250	226	7	4.347	2,172.02	490,877	13	8.07	4032	911,232
251-300	276	7	4.347	2,172.02	599,478	11	6.83	3413	941,988
301-350	326	5	3.105	1551.44	505,771	6	3.73	1864	607,664
351-400	376	1	0.621	310.29	116,669	1	0.62	310	116,560
Total		161	100	49,966	5,740,244				

Source: Own survey, 2010

The first column shows the maximum willingness to pay interval, and the second is class mark for willingness to pay (the mid willingness to pay amount) of the first column. The third and the fourth columns show the number and the percentage of sample households whose willingness to pay amount falls within the given interval.

The total number of households in two woredas of the study area has been multiplied by the proportion of sample households falling in each category to obtain the total number of households whose willingness to pay amount lies in each boundary (column fifth). And total willingness to pay (column sixth) has been obtained by multiplying the mid willingness to pay amount by total number of households willingness to pay that amount. The total household of 49,966 in two woredas of the study area were expected to pay birr 5,740,244 per year, if every household insures one hectare of his land.

Therefore, the result of the survey indicates that the average insurance premium payment of household was birr 114.88 per hectare per household if the proposed insurance service is implemented. This result is almost similar with the average willingness to pay of 129.93 birr per household per hectare. A column seven and eight indicates the number and the percentage of sample household willingness to pay at least the amount in each interval. Similarly, column nine shows total number of households willing to pay at least the amount in each interval and it falls as the mid willingness to pay amount rises (column ten). Total revenue has been obtained by multiplying the mid willingness to pay amount (column two) by the corresponding total number of households' willingness to pay at least that amount, (column nine).

Derivation of aggregate demand

The aggregate demand for this study has been derived from the above willingness to pay scenario (Table 14). The aggregate demand curve is derived using the mid willingness to pay amount along the vertical axis and the number of households' willingness to pay at least that mid value per hectare along the horizontal axis, (Figure 2). The figure shows the aggregate demand curve for the rainfall based insurance using the observations in the study. Any point on the curve shows all the households that prefer the insurance service but do not bid more than the corresponding value on the mid willingness axis.

As shown in Figure 2, the demand curve is negatively sloped, indicating the fall of the demand for the insurance service as the premium increases, like most other non-market goods other things remaining constant. The area under demand curve represents the gross value of consumers' surplus if the service is available for free or zero.

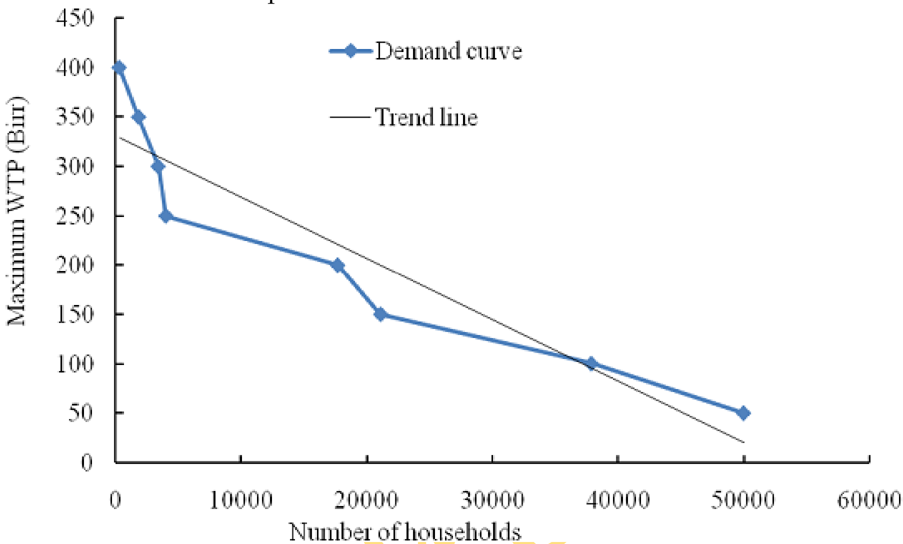

Figure 2. Estimated demand curve for rainfall based insurance service

Econometric Model Result

Econometric software called Limited dependant (Limdep 7) was employed to estimate the Tobit model. In the tobit model the main objective is to identify factors affecting the willingness to pay for rainfall risk insurance and its intensity in relation to socio-economic and demographic variables.

Econometric test and results

Before taking explanatory variables in to the analysis, it was necessary to check the existence of multicolinarity among the continuous and dummy variables. Variance inflation factor (VIF) was used to detect mulitcollinarity among continuous variables and contingency coefficient (C) was used to detect the degree of association among dummy variables. According to Maddala (1992), VIF can be defined as:

$$\text{VIF}\,(x_i) = \frac{1}{1-R^2}$$

Where, R^2 is the squared multiple correlation coefficient between xi and other explanatory variables. A statistical package known as SPSS 16 was used to compute the VIF values. As a rule of thumb, when the VIF exceeds 10, there is muliticollinarity problem. VIF values shown in the Appendix Table 1 indicate that there was no serious muliticolinarity problem. Similarly, contingency coefficients were used to check the existence of muliticolinarity. Contingency coefficient is computed as follows:

$$C = \sqrt{\frac{\chi^2}{N+\chi^2}}$$

Where:

C = is coefficients of contingency

χ^2= chi-square random variable

N= total sample size

The rule of thumb for Contingency coefficient is that when its value approach as 1 and greater than 0.75 there is muliticolinarity problem between dummy explanatory variables. But the result shown in the Appendix Table 2 revealed that all values were less than 0.75 and there was no serious muliticolinarity problem among dummy variables.

The assumption in regression analysis is that the errors terms, Ui has a constant variance δ^2. If the error term doesn't have a constant variance, there is problem of hetroscedastics (Maddala 1992). In the general linear model, OLS estimates are consistence but not efficient when the disturbance terms are hetroscedastic. In the case of limited dependent variable models (such as Tobit), the estimates of the corresponding regression coefficient is upward biased in the presence of hetroscedasticity. But nothing can be said about the direction of bias. It is more practicable to make some reasonable assumption about the nature of hetetroscedasticity and estimate the model to say that the maximum likelihood estimates are inconsistent if hetroscedasticity is ignored (Maddal 1992). The test for the presence of heteroscedasticity problem in the model was also done by using Breusch-Pagen test and the result was ρ= 1.250, this shows that there is no heteroscedasticity problem in the model.

Interpretation of the results

The estimates of the parameters of the variables that were expected to affect the households' willingness to pay for rainfall based insurance are shown in Table 15. The dependent variable was a continuous variable that household response as maximum willingness measured in birr. Out of the 16 hypothesized explanatory variables, six were found to be statistically significant, four of them were continuous and the rest two were dummy variables. The variables were age of the household head (AGE), total income from farm (FINC), total off-farm income (OFINC), livestock holding (TLU), owning radio (RADIO), and availability of public and private aid (PAPA). Moreover, the sign of the estimated coefficients were consistent with the expected signs.

The result has shown that age of household (AGE) is an important factor that influences the respondent's willingness to pay negatively and it is statistically significant ($p<0.05$). Earlier studies by Patrick (1988) and Gine *et al.* (2007) have found similar results. As the age of household head increases, the willingness to pay amount decreases significantly. Therefore, younger household heads are more likely to be willing to pay for rainfall based insurance compared to older household heads. This may be explained by the fact that younger household heads have less long life experience on predicting weather conditions and they are also sensitive to the new technologies than elders. The result shows that for each additional year in age of the respondent, the probability of the willingness to pay for rainfall based insurance decreases by 0.548%. The marginal effect result also shows that as the age of a respondent increase by one year, the amount of cash s/he is willing to pay for rainfall based insurance decreases by 1.5159 Birr.

Household income from crop (FINC): This variable is found to have a positive impact on the probability of willingness to pay as hypothesized and the effect is statistically significant at 1% probability level. Those household heads that generate high income from crop production would be more willing to pay for rainfall based insurance. When the income of the household increases by one birr, the probability of the household to be willingness to pay for rainfall based insurance increases by 0.002%. The marginal effect result shows that when the income level of the household increase by one Birr, the amount of cash the household could pay for rainfall based insurance increases by 0.0055 Birr, other factors held constant at their mean values.

Ownership of radio by the household (RADIO) is another important factor which is positively and significantly ($p<0.05$) related to farmers' willingness to pay for rainfall based insurance and its amount. Information from radio enhances the ability of farmers' access to improved technologies and risk management strategies. Farmers that own radio may get different information on extension service, credit service, improved seed variety, input prices and output prices than those farmers who do not have radio. This variable also shows that farmers that own radio have 15.218% more probability of paying for rainfall based insurance than those farmers who do not possess. Also, the marginal effect of this variable shows farmers that own radio, would pay Birr 42.0637 more than those farmers that do not have radio.

As expected the availability of off-farm income (OFINC) is negatively and significantly related to willingness to pay ($p<0.05$). Households engaged in off-farm activities reduce the probability of willingness to pay for rainfall based insurance by 0.003%. Households who are engaged in off-farm activity are expected to have less attention to farm activity. Sukurai and Reandon (1997) have found similar result. The marginal effect of this variable also shows when off-farm income increases by one Birr the amount of cash households would be willing to pay for rainfall based insurance decreases by 0.0098 Birr, other factors held constant.

Public and private gift (PAPA): This is another important factor which affects the dependent variable negatively and significantly ($p<0.01$). Availability of public and private aid decreases the willingness to pay by 16.233%. Sukurai and Reandon (1997) have found a negative effect on the dependent variable when farmers have aid from governmental or other non-governmental organizations, either in kind or in cash, and this may be explained by the fact that as households become more dependent and less active, and their willingness to pay tends to be less. The marginal effect of the variable shows that those household who have some kind of public and private gifts decrease willingness to pay amount by 44.8686 Birr than those who don't have the gift, other variables held constant.

Livestock Holding (TLU): Number of livestock owned by households is found to have negative and significant ($p<0.01$) effect on willingness to pay. Each additional unit of livestock (TLU) decreases the willingness to pay by 1.618%. This implies that income from livestock may encourage farmers to depend more on livestock than farming and results in less attention being give to the crop production. The marginal effect shows that for each additional TLU that the household possess the willingness to pay amount decreases by 4.4728 Birr, other variables held constant.

Table 15. Maximum Likelihood estimates of the Tobit model

Variables	Estimated coefficient	Standard error	t-ratio
Constant	3.70112	103.639	0.0357
NAWO	-2.77379	18.8725	-0.14697
SEHH	105.47	62.4742	1.68821
AGE	-1.72656	0.71336	-2.42032**
EDUC	7.89432	15.9354	0.49539
MRST	22.2316	22.1423	1.00403
FINC	0.00556	0.00155	3.59743***
OFINC	-0.01032	0.00487	-2.12119**
DEPR	-0.66475	8.84637	-0.07514
FSIZE	5.18168	3.7561	1.37954
TLU	-5.01802	1.64755	-3.04575***
CREDIT	-9.49309	15.8865	-0.59756
EXTENTION	24.4899	22.8428	1.0721
PAPA	-49.3245	16.0296	-3.0771***
BID	0.05866	0.12318	0.47623
RADIO	33.4783	20.6775	1.61906**
HOUSE	0.68939	14.8145	0.04653

Number of observation = 161
Log likelihood = -854.3120
Threshold value for the model: Lower = 0.0000
Upper = + infinity
δ = 83.4523
Z= 1.48 ϕ (z) = 0.2859 Φ(z) = 0.9307
***, **, * indicate significance at 1%, 5%, and 10% levels, respectively Source: model result, 2010

Table 16. Marginal effects of the explanatory variable on the dependent variable

Variables	Change in probability $\frac{\partial F(z)}{\partial Xi}$	Change among willing $\frac{\Delta E(\frac{y_i}{y_i}>0)}{\partial x_i}$	Total change $\frac{\partial E(y_i)}{\partial Xi}$
NAWO	-1.66800	-2.63030	-2.58250
SEHH	63.4230	100.0140	98.1955
AGE	-0.00548	-1.51590	-1.4900
EDUC	0.04564	12.6173	12.4022
MRST	13.3687	21.0861	20.6982
FINC	0.00002	0.0055	0.0054
OFINC	-0.00003	-0.0098	-0.0096
DEPR	0.01727	-4.7743	-4.6929
FSIZE	0.01691	4.6763	4.5966
TLU	-0.01618	-4.4728	-4.3966
CREDIT	0.02439	-6.7416	-6.6269
EXTENTION	0.09502	26.2641	25.8164
PAPG	-0.16233	-44.8686	-46.723
BID	0.00085	0.0235	0.0231
RADIO	0.15218	42.0637	41.4367
HOUSE	0.01919	5.3063	5.2159

Source: based on model out put

SUMMARY AND POLICY RECOMMENDATIONS

Summary and Conclusion

The main objective of this study was to identify factors affecting smallholder farmers' willingness to pay for rainfall based insurance in Central rift valley of Ethiopia. The study was designed to identify the variables, which determine farmers' willingness to pay for rainfall based insurance. This study tried to look in to socio economic, institutional and physical and other related factors which can affect farmers' willingness to pa y for rainfall based insurance. Data were collected from 161 farm households drawn randomly from Dugda and Mieso Woredas. The primary data were collected using semi structural questionnaire and the secondary data were obtained from woredas agricultural office and other non-governmental organizations around the woredas. Both descriptive statistics and econometric model were employed to analyze the data. Contingent Valuation Method (CVM) was employed to elicit farmers WTP for rainfall based insurance. The responses from the survey were analyzed by using economic software Limdep version 7.

Descriptive statistics were also used to describe risks faced by smallholders' farmers and management strategies practiced by the respondents. It also shows that there were significant differences between willing and non-willing households with respect to some variables of interest which include: sex, marital status, house type, education, owning radio, off-farm income, income, family size, credit constraint, availability of public and private aid and access to extension service at different significant levels.

The result from descriptive statistics also revealed that households suffered from drought or erratic rainfall, crop disease and loss of fertility of soil respectively. Therefore, they have practiced different types of coping strategies which included: intercropping, diversification, off-farm employment, go for credit and delay in sale of crop. The study used CVM technique to elicit farmers' willingness to pay for the proposed rainfall based insurance service. The sampled households were asked questions, related to their socio economic, demographic, institutional characteristics and some general questions. They were also asked dichotomous question and this were followed by open ended question to elicit households' willingness to pay for the proposed rainfall based insurance service. Of the total sample households 144 (89.4%) were willing to participate and the rest 17 (10.6%) were not willing to participate. The following bid values 50, 100, 150 and 200 were found from the first open-ended questions. The total willingness to pay amount for the total of 49,966 households is estimated to be birr 5, 740,244 per hectare per year. Sixteen potential explanatory variables were hypothesized to explain farmers' willingness to pay for rainfall risk insurance, and they were measured based on the model output. The result of Tobit model revealed that only six potential explanatory variables were used to identify willingness to pay among selected sample households at different significant levels. Among the six potential explanatory variables, three were significant at 1% probability level and the other three were found to be significant at 5% probability level to willingness to pay. Age of the household was found to have a negative and significant impact on farmers' willingness to pay for rainfall risk insurance at ($p< 0.05$) level it implying that aged farmers' have confident by their own weather condition prediction trend from their long life experience and they may not trust the insurance service. But younger farmers could easily decide to take part willingly in proposed insurance service.

Income from crop production was another important, highly significant and positively related variable that affect willingness to pay for the proposed insurance service at 1% probability level. Households with more income from their crop production could be willing to contribute more of their income for the proposed rainfall based insurance service. This means that income is an important variable affecting the willingness to pay. Households' off-farm income is also another significant and important variable which is found to be negatively related to the willingness to pay for the rainfall based insurance 5% probability level. The result revealed that households with radio have more information access on different aspects of both agricultural and non-agricultural sectors. This variable was positively related to willingness to pay at 5% probability level. This means willingness to pay for the rainfall risk insurance is more related to both information access and awareness. Availability of public and private aid was found to be highly significant at 1% probability level and it was negatively related to the willingness to pay. Households who are more dependent on governmental and non-governmental organizations aids are not willing to pay for the proposed rainfall based insurance service payment. The last important variable is households' livestock holding it was found to be negatively related to willingness to pay at 1% probability level. This is also because of households with more livestock number depending more on the livestock production as their primary activity and may have less time to care the crop production activity.

Policy Implication of the Study

The overall understanding of factors affecting smallholder farmers' willingness to pay for rainfall based insurance would help policy makers and development workers to design and implement the rainfall based insurance service in sustainable and in effective manner. Based on the findings of the study, the following points are suggested to be considered as an important element in order to implement the service and enhance farmers' rainfall based insurance utilization and effectiveness in the country.

The strong negative relation between availability of public and private aid and willingness to pay for the proposed rainfall based insurance revealed that in order to increase the willingness of household, development policies focused on sustainable development rather than giving some aid at the time when disaster is occurred. This can be through organizing farmers in to saving and credit cooperatives so that they can increase their income and can be self sufficient.

Household income from crop and willingness to pay for rainfall based insurance were positively related, development policies should target at increasing income of households that address specially the low income members of the smallholder farmers. This can also be through facilitating and forming small business groups, educating and giving awareness to involve in credit and saving cooperatives.

Household off-farm income and willingness to pay for rainfall based insurance were negatively related. Household willingness to pay for rainfall based insurance were relatively less if they have off-farm income from other non-farm related activities this is because of off-farm income is another option for households' livelihood.

Households who have radio have an access to information as well as they have awareness on different agricultural activities such as market price, post harvest management strategies, and information on weather conditions. Development policies focused on the different Medias to create awareness and understanding among farmers.

REFERENCES

Addis Ababa University, 2001. Introductory geography of Ethiopia Geo,101. Teaching text, Department of Geography.

Alberini, A., and Cooper, J., 2000. Application of contingent valuation method in developing countries. Economic and social development paper. No. 146, FAO, Rome.

Anderson, D.R., 2001. All Risks Rating Within a Catastrophe Insurance System. *Journal of Risk and Insurance*. 43: 629-651.

Anderson, J. R., Dillon,J. L., and Hardaker, J.R., 1977. Agricultural decision analysis: Lowa State University press.

Assefa Demeke and G. Ramakrishna, 2002. An empirical analysis of food security in Ethiopia, the case of North Wollo. *African Development Journal.* 27 (1&2):127-144.

Bateman, I. J. H. Langford, A. P. Junes, G. B. Kerr and R. Scarpa, 2000. Bound and path effects in double and triple bounded dichotomous choice contingent valuation. A paper presented at the tenth annual conference of the European Association of Environmental Resources Economists (EAERE), Great Britain.

Binswanger, H.P., 1980. Attitudes towards risk. Experimental measurement in rural India. *American Journal of Agricultural Economics*. (62): 395-407.

Bryan, E., T. Deressa, G. Gbetibouo and C. Ringler (2009). Adaptation to climate change in Ethiopia and South Africa: options and constraints. *Environmental Science and Policy,* 12: 413-426.

Carson, R.T., 1991. Constructed Markets. In: J.Barden and C.Kolstad (eds). Measuring the Demand for Environmental Commodities. Amsterdam, North Holland.

Carson, R.T., N.E. Flores and N.F. Meade, 2001. Contingent Valuation: Controversies and Evidence. *Environmental and Resource Economics,* 19(2): 173-210.

Cooper, J. and T. Osborn, 1998. The Effect of Rental Rates on the Extension of Conservation Reserve Program Contracts. *American Journal of Agricultural Economics* 80, 184-194.

CSA (Central Statistics Authority), 2004. Agricultural sample survey report Federal Democratic Republic of Ethiopia, Addis Ababa, Ethiopia.

Dandekar, V.M. 1977. *Crop insurance for developing countries.* Teaching and Research Forum Paper No. 10. New York: Agricultural Development Council.

Dennis Holden, Peter Hazell, Anthony Pritchard, 1991. Risk in Agriculture. *Proceedings of the Tenth Agriculture Sector Symposium.* World Bank Washington, D.C. USA.

Dillon J.L and J.B. Hardaker, 1993. Farm management research for small farmers development. FAO Farm Management Series. FAO, Roma Italy. (6):302

Freeman, A.M., 2003. The Measurement of Environmental and Resource Values: Theory and Methods. Washington, D.C.

Gautam, M., Hazell, P., and H. Alderman, 1994. Rural demand for drought insurance, world bank Policy Research Working Paper No. 1383.

Gine Xavier, Robert Towensend and James Vickery, 2007. Patterns of rainfall insurance participation in rural India, Policy research working paper. 4408.

Greene, W. H., 2003. Econometric Analysis. Fourth Edition, Prentice Hall International, Inc. USA.

Gujarti, D., 1999. Essential of Econometrics. Second edition, Mc-Graw hill companies.

Halcrow, H.G. 1948. *The theory of crop insurance*. Ph.D. diss. Chicago: University of Chicago.

Hanemann, W.M., 1991. Willingness to accept and willingness to pay and how much can they differ? *American Economic Review*, 81(3): 635-647.

Hanemman, W.M & Kanninen. B., 1998. The statistical analysis of discrete response data. Department of Agricultural, Resource Economics and Policy, Working paper No, 798 University of California, Berkeley.

Hardaker, J. Banri., Ruud B.M. Hurnie and Jock R.Anderson, 1997. Coping with risk in agriculture. CAB International London.1-10p.

Hauseman, J., 1993. Contingent Valuation: A critical Assessment, North Holland Publishing Co., Amsterdam.

Hazell, P, J. Anderson, N.Balzer, A.Hustarp Celmmensen, U.Hess and F.Rispoli. 2010.

Hazell, P.B.R., 1992. The appropriate role of agricultural insurance in developing countries. *Journal of International Development. (*4):567-581.

Hellmuth M.E., Osgood D.E., Hess U., Moorhead A. and Bhojwani H (eds), 2009. Index insurance and climate risk: Prospects for development and disaster management. Climate and Society No. 2. International Research Institute for Climate and Society (IRI), Colombia University, New York, USA.

IAC. 1986. *Crop and rainfall insurance.* Report No. 393. Canberra: published for the Industries Assistance Commission by the Australian Government Publishing Service.

IPMS (Improving Productivity and Market Success), 2006. Pilot searing site of Mieso woreda. IPMS, Adiss Ababa, Ethiopia. http//www. IPMS-Ethiopia.org.

Long, S., 1997. Regression Models for Categorical and Limited Dependent Variables. Saga Publications.

Maddala, G.S., 1992. Introduction on Econometric. Second edition . Macmillan Publishing Company, New York.
Maddala, G.S., 1997. Limited Dependent and Qualitative Variables in Econometrics. Cambridge University Press, Cambridge.
Marothia, D.K., 2001. Valuation of Day Use Recreation site: Application of Alternative Estimation Techniques. Indian journal of Agricultural Economics. University of Gulbarga. 56(3) 313-324.
Mbata, J., 2006. Estimating Household Willingness for Water Service in Rural Economy: the case of Kenya, Southern Botswana. *Development of Southern Africa*, 23 (1):29-43.
McCarthy, 2003. Demand for rainfall-index based insurance: A case study from Morocco International Food Policy Research Institute, U.S.A.
Mithcele, R.C. and T.R. Carson, 1989. Using survey to value public Goods: The contingent valuation method. Resources for the future, Washington, D.C.; The Johns HopkinsUniversity Press, Baltimore, U.S.A.
MoWR (Ministry of Water Resource of the Federal Democratic Republic of Ethiopia) 2007. Climate Change Adaptation Program of Action (NAPA) of Ethiopia. Addis Ababa, Ethiopia.
Patrick G. F., 1988. Mallee Wheat farmer's demand for crop and rainfall insurance, *Australia Journal of Agricultural Economics*, 32 (1): 37-49.
Paulos, A., 2002. Determinants for Farmers' willingness to participate in soil conservation practices in the highlands of Bale: The case of Dinsho Farming System Area. M.Sc. Thesis Presented to the School of Graduate Studies of Alemaya Universty.
Potential for scale and sustainability in weather index insurance for agricultural and rural livelihood. International Fund for Agriculture Development and World Food Program, Roma.
Rahman MA. 2013. Comparative Study on the Efficiency of Bangladeshi Conventional and Islamic Life Insurance Industry: A Non-Parametric Approach Asian Business Review, 3, 88-99.
Sakurai, T and T. Reardon., 1997. Potential demand for drought insurance in Burkinafaso and its determinants. *American Journal of Agricultural Economics*. 79 (4):1193-1207.
Sarris, A. 2002. The demand for commodity insurance by developing country agricultural producers: Theory and an application to cocoa in Ghana. Working Paper, DECRG and RDV. Washington, D.C.
Siegel, P.B. and J. Alwang., 1999. An asset based approach to social risk management: A conceptual approach, Social Protection Discussion Paper 9926, World Bank, Washington DC.
Skees, Jerry R. 2001, The Bad Harvest, Regulation, the CATO Review of Business and Government, 24: 16-21.
Stern, N.H., 2007. *The economics of climate change*: the. Cambridge University Press.
Storck, H., Bezabih Emana, Berhanu Adnew , Borowiecki, A.A and Shimelis w/ Hawariat, 1991. Farming systems and Farm Management Practices of Small-holders in the Hararghe Highlands. Farming System and Resource Economics in the Tropics.11: Wissenschafts Varlag Vauk Kiel KG, Germany
Thornton, P.K., P.G. Jones, T.M. Owiyo, R.L. Kruska, M. Herero, P. Kristijanson, A. Notenbaert, N. Bekele, 2006. Mapping Climate Vulnerablity and Poverty in Africa. Report to the Department for International Development, ILRI, Nairobi.
Ulrich Hess and Joanna Syroka, 2005. Weather based insurance in Southern Africa, Malawi. Agricultural and rural development discussion paper 13.
Vince E. Showers, and Joyce. Shotick, 1994. The effect of household characteristics on demand for insurance; a tobit analysis. *The Journal of Risk and insurance,* Vol 61, (3): 492-502.
Walker, T.S and James G.Ryan, 1990. Village and household economies in India's semi-arid tropics. Baltimore, Maryland, USA: The Johns Hopkins University Press.
World Bank, 2000. Mexico Rural Finance, Saving Mobilization Potential and Deposit Instruments in Marginal areas, Washington DC.
World Bank, 2005. Managing agricultural production risk innovation in developing countries. Report No. 32727-GLB. The International Bank for Reconstruction and Development. Washington , D.C.
World Bank, 2007. UN Department of Economic and social affairs division for sustainable development innovation briefs. Developing Index-based Insurance for Agriculture in Developing Countries, New York.

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