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# The effect of drought risk perception on local people coping decisions in the Central Rift Valley of Ethiopia

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**In an attempt to address the objectives of examining factors influencing smallholders' drought risk perception and coping to climate variability and change, this study utilized household level data collected from 384 households and employed Heckman selection model for its analysis. The study revealed that perceiving climate variability and change does not always guarantee coping and adaptation responses, particularly among the rural people who face more binding constraints that deter adaptation decisions. While educated farmers and those with strong social network are more likely to perceive climate variability and change, it is farmers with better access to weather forecast and extension services who are more likely to respond to the perceived change. Strategies targeted at enhancing smallholder adaptive capacity to the impacts of current and predicted climate change need to focus not only on creating awareness but also on improving enabling conditions through provision of tailored weather forecast and extension services as well as strengthening social network and rural infrastructure.**

**Key words:** Adaptation, climate, coping, Heckman, perception, smallholder, variability.

## INTRODUCTION

Climate variability and change causes negative impacts upon agriculture (Below et al., 2010). Because of the size and sensitivity of the agricultural sector, the impact is relatively high in developing countries (IPCC, 2014). Climate change is a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties that persists for an extended period, typically decades or longer (IPCC, 2007). Climate variability means deviations in the mean state of climate and inconsistencies (e.g. in occurrence of drought and

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flood), on temporal and spatial scales, including short term fluctuations that happen from year to year (Ziervogel et al., 2006a). Variability in this case is an integral part of climate change, in which, a change in mean climatic condition is experienced through changes in the nature and frequency of particular yearly conditions including extremes (Smit et al., 2000). In the present report, we use both terms regularly.

Like in many sub-Saharan Africa (SSA) countries, smallholder agriculture underpins most rural livelihoods and the national economy in Ethiopia. About 93% of the resource-poor rural communities are predominantly engaged in subsistence agriculture (ERSS, 2013). The nature of Ethiopia's agriculture is primarily rain-fed, and hence, the production is sensitive to fluctuations in rainfall (Conway and Schipper, 2011), and other climatic stresses (Yesuf et al., 2008). Recent studies on long-term climate trends indicate that large areas of Ethiopia experience high seasonal rainfall variability (Conway and Schipper, 2011) and a number of regions in the country are found to be prone to drought recurrently (Funk et al., 2012; NMSA, 2001). Besides the past trends, various climate projections (IPCC, 2007; Conway and Schipper, 2011; Funk et al., 2012) reveal a drying trend in all agricultural production seasons across the country. Drought is a recurrent phenomenon and is perhaps the most important climatic challenge in Ethiopia resulting in a sharp reduction of agricultural output (Benson and Clay, 1998; Buckland et al., 2000; FDRE, 2011) and thereby low economic performance. However, drought is not a new phenomenon in Ethiopia as it was recorded as long ago as 250BC (Degefu, 1987; Webb and von Braun, 1994). What is new is its increase in scale and frequency of recurrence during recent decades (Lautze et al., 2003; NMS, 2007). The fact that climate has changed in the past and will continue to change in the future underlines the need for developing a well thought early warning and adaptation interventions. Developing effective adaptation policy on the other hand requires better understanding of the process of adaptation (Below et al., 2012).

Historically, farming community in Ethiopia remained isolated and poorly supported. However, they have a history of responding to the impacts of change in exogenous factors including climate variability and extremes. For instance, farmers claim to have shifted to more drought-resistant crops due to declining rainfall during the last couple of generations (Meze-Hausken, 2004). However, such local level coping and adaptation responses as well as the role of perception in shaping smallholders decision are not well documented. Smallholder farmers often engage in autonomous type of adaptation practices, that is, based on experience and prevailing conditions (Smithers and Smit, 2009). Their adaptive capacity is therefore influenced by the knowledge and perception they have about climate change (Adger, 2003) and decisions are hardly made based on extensive numerical datasets or cost-benefit analysis (Maule and Hodgkinson, 2002). Moreover, as agricultural systems evolve not to average conditions but in response to unpredictable and extreme conditions (Smit et al.,1996), the role of perception is rather critical in shaping farmers' adaptation decision in cases where the stress goes beyond their previous experiences (Tucker et al., 2010). Earlier studies on smallholder farmers' perception in the Sahel (Mertz et al., 2009), Nile basin of Ethiopia (Deressa et al., 2011), Zambia (Nyanga et al., 2011), and semi-arid central Tanzania (Slegers, 2008) indicate that the majority of the farmers are aware of climate variability and extremes. However, numerous recent studies caution that having perception or knowledge about climate change may not necessarily lead to adaptive responses (Kahan et al., 2012; Lemos et al., 2012; Weber, 2010). Some consider adaptation to climate change as a two-step process (Deressa et al., 2011; Gbetibouo, 2009; Maddison, 2006) which initially requires the perception that climate is changing, and then responding to the changes through adaptation. In such situations, the adoption process often starts with the perception of the adopter about the problem as well as the type of technology proposed (Adesina and Zinnah, 1993). On the other hand, the level of awareness and perception of climate change is found to be influenced by different socioeconomic and environmental factors including culture, education, gender, age, resource endowments, and institutional factors (Hamilton, 2011; Milfont, 2012; Posthumus et al., 2010). Therefore, understanding the perception of farmers is important precondition to guide policymakers regarding adaptation investments.

Despite the fact that there is consensus that local level responses are part of the solution to effective adaptation (Mertz et al., 2009; Tschakert, 2007), there are limited studies that have elaborated on factors affecting smallholder perception and coping to climate variability. Various recommendations have been proposed to enhance the adaptive capacity of smallholders. Although it is hardly put in practice, mainstreaming adaptation into national development process is one such recommendation (Boko et al., 2007). Moreover, ensuring enhanced adaptive capacity among smallholder farmers requires policies and programs to build on the already existing measures being implemented by farmers (Mertz et al., 2009) and also to reflect the divers environmental and socioeconomic conditions in which people live (Ziervogel et al., 2006b). In most cases, lack of mainstreaming leaves the smallholders' adaptive role in agriculture overlooked (Tschakert, 2007; Adger et al., 2006). Coping mechanisms consists of household practices used as a reactive responses when confronted with immediate and unexpected threats such as drought (Thomas et al., 2007), whereas adaptive strategies refer to proactive and anticipatory measures in response to actual and/or expected climatic stimuli and their impacts (IPCC, 2012).

By providing local level evidence on determinants of perception and coping decisions of smallholders, this study will build on authors who have analyzed the role of perception in long-term climate change adaptation. We ask whether smallholders' perceive climate variability, who and how are they coping with the perceived change. We then provide empirical evidence on the factors that facilitate or hamper smallholder's perception and coping decisions. In order to answer these questions, we analysed primary data collected from the CRV of Ethiopia, where serious ecological and socio-economic changes have already been reported (Biazin and Sterk, 2013; Garedew et al., 2009).

## MATERIALS AND METHODS

### Study setting and data collection

The study was conducted in the Ethiopian Central Rift Valley (CRV) region which is part of the East African Rift System. The area is located between 7°10' - 40' N and 38°25'- 50'E. The mean annual rainfall in the CRV area is 929.45 mm and the mean annual minimum and maximum temperatures are 13.5 and 27.7°C, respectively. More than 85% of farmers in the study area mostly practice crop-livestock mixed farming, which is predominantly rain-fed while part of the lowland areas practice agro-pastoral activities.

The study followed a multistage-stage stratified random sampling procedure to select the final sample units. Initially CRV area was selected purposively based on severity of climate variability and extremes. The area is then stratified into three agroecological zones based on elevation, rainfall and temperature criteria. In the second stage, 3 from lowland, 2 each from midland and highland, a total of 7 kebeles (the smallest administrative unit) were randomly selected. In the third stage, the survey randomly drew a total of 384 farm households (146 from lowland, 123 from midland, and 115 from highland) based on proportional to size sampling technique.

### Empirical approach and model specification

The main objective here is to explain why some farmers take measures to adapt to climate change while others do not. In theory, decision on adaptation to climate change involves perception of climate change and its seriousness. Conditional on perception, a given farmer is expected to decide on whether or not to respond to the perceived change. As such, adaptation to climate change entails a two-stage process (Maddison, 2006). The assumption is that only those who perceive the risk will respond to the perceived risk provided that the perceived benefit of adaptation outweighs its costs. In this regard, a Heckman's sample selection model is applied to explain farmers' decision to adapt to climate change.

Heckman's sample selection model assumes that there exists an underlying relationship which consists of the latent equation given by:

$$Y_j^* = X_j\beta + U_{1j} \quad (1)$$

where $Y_j$* is the latent variable (the propensity to cope to perceived climate change), $X$ is a k-vector of explanatory variables expected to have influenced farmers' decision to adapt to climate change, β is a vector of parameter estimates and $U_{1j}$ is an error term. The latent variable ($Y_j^*$ ) is related to the observed binary dependent variable $(Y_j)$ as follows:

$$Y_j^{probit} = \left(Y_j^* > 0\right) \quad (2)$$

The dependent variable is observed only if the observation $j$ is observed in the selection equation:

$$Y_j select = \left(Z_j\gamma + U_{2j} > 0\right) \quad (3)$$

$$U_1 \sim N(0,1)$$

$$U_2 \sim N(0,1)$$

$$Corr(U_1, U_2) = \rho$$

Where $Y_j select$ is whether a farmer has perceived climate change, $Z$ is an **m** vector of explanatory variables, which include different factors hypothesized to affect perception; $\gamma$ is the parameter estimate, $U_{2j}$ is an error term and $U_1$ and $U_2$ are error terms, which are normally distributed with mean zero and variance one. When the error terms from the selection model and the outcome equations are correlated or when $\rho \neq 0$, applying standard probit techniques to the Equation (1) yield biased results. In such conditions, Heckman probit provides consistent, asymptotically efficient estimates for all the parameters (Van de Ven and Van Pragg, 1981).

It is hypothesized that age, gender, and education of the head of the household, access to information on climate, access to extension services, participation in local institutions, social network, quality of farm land, household income, prior experience of climate induced shocks, dependence on aid, year round access to food, distance to nearest town, and agro-ecological settings influences farmers' perception of climate variability and extremes (Deressa et al., 2011; Gbetibouo, 2009; Maddison, 2006; Diggs, 1991; Ishaya and Abaje, 2008; Semenza et al., 2008). Correspondingly, the explanatory variables selected for the outcome equation include age, gender, and education of the head of the household, number of wives, farm size, quality of the farm land, number of economically active member of the household, non-farm income, number of oxen, access to information on climate, access to extension services, participation in local institutions, social network, land tenure arrangement, distance to nearest town, year round access to food, and agro-ecological settings (Deressa et al., 2011; Maddison, 2006; Bryan et al., 2009; Gebremedhin and Swinton, 2003; Kassie et al., 2009; Nhemachena and Hassan, 2007; Seo and Mendelsohn, 2008; Teklewold et al., 2013).

The suitability of Heckman probit model over the standard probit model (that is, without accounting for selection) was tested and the result indicated the occurrence of sample selection problem (that is, dependence of the error terms from the outcome and selection models) justifying the use of Heckman probit model with *rho* significantly different from zero (Wald $\chi 2$=3.71, with P=0·054).

**Table 1.** Description of variables and summary statistics of the variables used in the perception and coping equations for the Heckman probit selection model**.**

| Variable | Description | Mean | SD |
|---|---|---|---|
| AGE | Age of the head of the household (years) | 41.53 | 14.36 |
| SEX | 1= Male-headed; 0 otherwise | 0.84 | 0.37 |
| WIFE | Number of wives per household | 1.09 | 0.79 |
| EDUCHEAD | Years of education of the household head | 0.69 | 0.46 |
| LAND | Size of the farm land (hectare) | 1.89 | 1.68 |
| LABOR | Economically active members in the house | 2.52 | 1.86 |
| OXEN | Number of oxen owned | 1.41 | 1.33 |
| | *Farmers perception of fertility level of their farm land:* | | |
| HIGHLYFERTILE | 1= Highly fertile; 0 otherwise | 0.27 | 0.45 |
| MODERATEFERT | 1= fertile; 0 otherwise | 0.57 | 0.50 |
| LESSFERTILE | 1= less fertile; 0 otherwise | 0.15 | 0.36 |
| DISTOWN | Distance of the household from nearest town (Walking hours) | 3.70 | 2.70 |
| TENURE | 1= registered and certified land; 0 otherwise | 0.58 | 0.49 |
| FARMINCOME | Gross annual income (log) | 13386.04 | 11369.27 |
| NONFARINC | Annual income from nonfarm activities (Br) | 1834.57 | 3882.14 |
| | *Local agroecological setting:* | | |
| HIGHLAND (Dega) | 1= Dega; 0 otherwise | 0.30 | 0.46 |
| MIDLAND (Weynadega) | 1= Weynadega; 0 otherwise | 0.32 | 0.48 |
| LOWLAND (Kola) | 1= Kola; 0 otherwise | 0.38 | 0.49 |
| FDACCESS | 1=Year round access to food; 0 otherwise | 0.78 | 0.41 |
| EXTENSION | 1= received extension advise; 0 otherwise | 0.81 | 0.39 |
| FORECAST | 1= access to weather forecast; 0 otherwise | 0.85 | 0.36 |
| SOCIALNETWORK | 1= have family ties in different agroecology; 0 otherwise | 0.75 | 0.43 |
| LOCALINST | 1= participated local institutions ; 0 otherwise | 0.38 | 0.49 |
| AIDSAFNET | 1= received food aid/ safety net ; 0 otherwise | 0.63 | 0.48 |
| SHOCK | 1= experienced climate induced shock; 0 otherwise | 0.84 | 0.36 |

Moreover, the likelihood function of the Heckman probit model was significant (Wald $\chi2=49\cdot74$, with $p<0\cdot001$), showing its strong explanatory power. Furthermore, results show that most of the explanatory variables and their marginal values are statistically significant at $p<0\cdot05$ and generally in the directions that were expected.

## RESULTS AND DISCUSSION

### Descriptive statistics and model variables

Sampled households are heterogeneous in various attributes. Of the sample households 84% have a male head. In the study area, the land size per household ranges from 0.13 to 13 ha with the average land holding of about 1.89 ha. Table 1 presents the descriptions of model variables and summary statistics for the Heckman probit selection model.

### Climate related shocks and coping measures

With the assumption that climate change may alter the frequency of extreme events such as drought and flood, the survey sought information on the types of climate shocks households experienced over the last 5 years and the types of coping strategies employed by households in response to these climate shocks. Accordingly, the surveyed households reported to have encountered many environmental shocks mainly droughts, floods, dry spells, pests and disease epidemics. Over the previous five years period, the households reported that about 63% of the shocks were droughts, 39% were flood and 35% were animal disease. The relatively high frequency of drought-affected households is consistent in Ethiopia as it is a drought prone country and particularly so in drought prone areas like CRV. According to respondents, the effect of drought shock is highly pronounced in

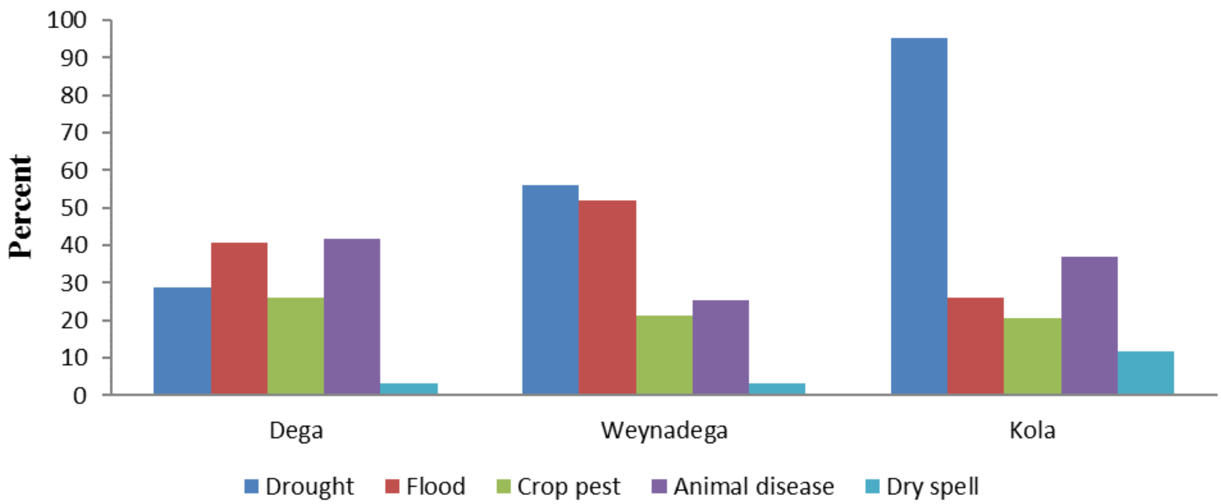


**Figure 1.** Major shocks encountered by surveyed farmers by agroecological zone.

**Table 2.** Effects of climate shocks on surveyed farmers.

| | Respondents (%) | | | |
|---|---|---|---|---|
| | **Highland** | **Midland** | **Lowland** | **Total** |
| Loss of assets | 41.74 | 33.33 | 45.21 | 40.36 |
| Loss of income | 55.65 | 65.85 | 77.40 | 67.19 |
| Decline of crop yield | 80.87 | 74.80 | 73.97 | 76.30 |
| Death of livestock | 44.35 | 30.89 | 65.75 | 48.18 |
| Decline in consumption | 39.13 | 28.46 | 41.10 | 36.46 |
| Food shortage | 60.87 | 55.28 | 40.41 | 51.30 |

lowland/kola agro-ecosystem while occurrence of flood is prevalent in the midland and highland agro-ecosystems (Figure 1).

These shocks resulted in a variety of reported losses, primarily consisting of crop yield declines, loss of asset/income and food insecurity (Table 2).

Those farmers who perceived variability and change were subsequently asked if they had taken measures to cope with the impact of these changes notably drought. Tables 3 and 4 illustrate the main coping responses to climate shocks by agroecological zone and income tercile, respectively. Due to the fact that the main effect of climate shocks was a decline in crop yield and food shortage, the major coping response involved reliance on food aid and safety net and consuming less amount food in stress periods. With respect to agroecological setting, the majority of the farmers in the lowland relied on food-aid and safety-net and also collects fuelwood, charcoal and other woodland based forest products to prevail over drought shock. Selling livestock was also important strategy for households coping with climate shocks. However, livestock selling is a less viable strategy among agro-pastorals in the lowland areas as they are reluctant to sell their livestock even in periods of drought preferring to take the risk that many will survive. A large percentage of households in the lowland have low adaptive capacity and were reliant on external support particularly through food-aid and safety-net programs. The low probability of adaptation in the lowland areas may be partly due to the fact that they have already adjusted to more difficult production conditions such as drought-tolerant crop varieties and also to low consumption level and hence have limited additional options at their disposal.

In terms of income level of the household, majority of the income poor households relied on food-aid and safety-net programs. Livestock selling and reducing consumption level are preferred by relatively better-off families. This is probably due to the fact that poor households already are at low consumption level and will face difficulty in acquiring back livestock resources. Use

**Table 3.** Major drought coping measures across agroecological zones.

| Agroecology/ coping strategies | Percentage respondents | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| Highland | 18.89 | 1.22 | 5.55 | 22.32 | 28.87 | 14.62 | 8.52 | 24.38 |
| Midland | 19.77 | 16.76 | 12.04 | 19.01 | 12.03 | 7.48 | 12.89 | 32.31 |
| Lowland | 20.53 | 36.73 | 10.03 | 10.03 | 3.51 | 17.29 | 1.89 | 43.31 |
| CRV | 19.88 | 21.62 | 9.59 | 15.93 | 12.45 | 13.47 | 7.06 | 100.00 |

**Table 4.** Major drought coping measures across income groups.

| Income tercile/ coping strategies | Percentage respondents | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Total |
| Poor | 26.96 | 35.82 | 8.39 | 3.51 | 3.47 | 19.43 | 2.42 | 34.01 |
| Medium | 24.56 | 21.87 | 8.25 | 16.27 | 6.96 | 16.78 | 5.32 | 32.01 |
| Better-off | 7.32 | 6.01 | 5.90 | 27.84 | 25.83 | 14.38 | 12.72 | 33.98 |
| CRV | 19.52 | 21.23 | 7.50 | 15.86 | 12.18 | 16.86 | 6.85 | 100.00 |

1 **=** Did nothing; 2 = Received aid and safety net; 3 = Sought off farm opportunities; 4 = Sold livestock; 5= Reduced consumption; 6= Relied on woodland resources; 7= Borrowing.

of woodland and forest based products such as collection of fuelwood and charcoal to generate income is an important coping strategy during stress period regardless of household's income level and geographical location. This is maybe related to the fact that most income generating activities in the CRV is related with the fuelwood and other woodland forest based products. Additional coping strategies employed by the households include seeking off-farm opportunities mainly seasonal migration and labor supply, borrowing from relatives and rural microfinance institutions.

Farmers who perceived variability and change in climate but failed to cope and adapt gave various reasons as hurdles to coping including shortage of land (47%), poor potential for irrigation (45%), lack of money/credit (40%), large family size (16%), lack of market access (17%), and lack of information (3%).

## Factors affecting farmers' drought risk perception and coping decisions

Results of the selection model show that factors that positively affect farmers' perception of climate variability and extremes are the age of the head of the household, his/her education status, farm income, social network, participation in local institutions, farming in the lowland, and prior experience of climate induced shocks. However, farming in the highland, year round access to food, land quality, and access to aid and safety-net programs negatively affected perception (Table 5). The outcome model helped identify variables that positively influenced coping with drought. These are the number of economically active labour in the household, nonfarm income, access to extension advice, access to weather forecast, distance to nearest town, and whether the head of the household was male. Farming in the highland, and having more than one wife negatively affected households coping decisions.

The fact that no significant variation in climate perception due to gender of the household head implies that, women in the study area have comparable perception with that of men. However, the gender of the household head had a positive effect on coping with drought which implies that, even though female-headed households perceive a change in climate, they cope less easily than male-headed households. This reflects the limited access women in the study area have to assets and productive capital which will potentially limit their capacity to respond to weather shocks. For instance, due to societal construction of gender roles and differential household responsibilities of women in rural Ethiopia, they attend school less often than men which may limit their capacity to diversify their livelihood and cope with drought as also indicated in Knight et al. (2003). Other studies, e.g. Demeke and Zeller (2011) and Viatte et al. (2009) indicated female-headed households are vulnerable, less food secure and have low technology adoption rates. However, such variation might also happen due to the fact that women have different coping

**Table 5.** Results of the Heckman probit selection model.

| | Outcome model | | | | Selection model | | | |
|---|---|---|---|---|---|---|---|---|
| | Regression | | Marginal effect | | Regression | | Marginal effect | |
| | Coef. | P-level | Coef. | P-level | Coef. | P-level | Coef. | P-level |
| AGE | -0.003 | 0.695 | -0.001 | 0.692 | 0.025*** | 0.000 | 0.008*** | 0.000 |
| SEX | 0.647** | 0.041 | 0.162** | 0.023 | 0.100 | 0.644 | 0.033 | 0.650 |
| WIFE | -0.241** | 0.028 | -0.73** | 0.036 | | | | |
| EDUCHEAD | -0.159 | 0.528 | -0.047 | 0.510 | 0.525*** | 0.007 | 0.176*** | 0.009 |
| LAND | 0.068 | 0.270 | 0.0205 | 0.270 | | | | |
| LABOR | 0.171*** | 0.009 | 0.0515** | 0.017 | | | | |
| OXEN | 0.065 | 0.408 | 0.020 | 0.410 | | | | |
| HIGHLYFERTILE | -0.076 | 0.759 | 0.231 | 0.764 | -0.417** | 0.037 | 0.139** | 0.047 |
| LESS FERTILE | -0.402* | 0.083 | 0.132 | 0.104 | 0.760** | 0.017 | 0.177*** | 0.007 |
| DISTOWN | 0.004 | 0.001 | 0.001*** | 0.002 | -0.001 | 0.280 | -0.0005 | 0.285 |
| TENURE | 0.051 | 0.869 | 0.154 | 0.869 | | | | |
| FARMINCOME | 0.009 | 0.818 | 0.0027 | 0.819 | 0.057** | 0.031 | 0.018** | 0.032 |
| NONFARMINCOME | 0.00006* | 0.088 | 0.00002* | 0.095 | -0.00003 | 0.209 | 0.0000005 | 0.207 |
| HIGHLAND ( *Dega)* | -0.661* | 0.076 | 0.216 | 0.121 | -0.827*** | 0.004 | -0.283*** | 0.005 |
| LOWLAND (*Kola)* | -0.722 | 0.109 | -0.228 | 0.101 | 2.333*** | 0.000 | 0.566*** | 0.000 |
| FDACCESS | 0.319 | 0.241 | 0.089 | 0.200 | -0.485** | 0.022 | -0.166** | 0.031 |
| EXTENSION | 0.741*** | 0.001 | 0.224*** | 0.002 | -0.300 | 0.127 | -0.093 | 0.111 |
| FORECAST | 1.361*** | 0.000 | 0.488*** | 0.000 | 0.063 | 0.816 | 0.020 | 0.818 |
| SOCIALNETWORK | -0.511 | 0.225 | -0.176 | 0.268 | 1.125*** | 0.003 | 0.228*** | 0.000 |
| LOCALINST | -0.046 | 0.850 | -0.014 | 0.850 | 0.644*** | 0.008 | 0.178*** | 0.001 |
| AIDSAFTYNET | | | | | -0.575*** | 0.002 | -0.194*** | 0.001 |
| SHOCK | | | | | 0.661*** | 0.001 | 0.189*** | 0.000 |
| Constant | -1.6229 | 0.048 | | | -1.090** | 0.044 | | |
| Total observation | 383 | | | | | | | |
| Censored | 142 | | | | | | | |
| Uncensored | 241 | | | | | | | |
| $\rho$ | -0.662** | 0.013 | | | | | | |
| Wald $\chi 2$ (zero slopes) | 49.7 | 0.001 | | | | | | |
| Wald $\chi 2$ (indepen. Equations) | 3.71 | 0.054 | | | | | | |

***, **, * implies significance at 1, 5 and 10% probability level, respectively.

strategies than men (Fothergill, 1996), which were not exhaustively investigated within this study. Other social factors including lack of mobility, lack of power and legal protection and social position (UNIFEM, 2010; Mutton and Haque, 2004) might also undermine women capacity to cope.

The age of the household head, used as a proxy for farming experience, positively affected the propensity of detecting changes in climate variability and extremes. Previous works, e.g. Maddison (2006) and Ishaya and Abaje (2008) also arrived at a similar conclusion. Conversely, results also showed that elderly people do not have better ability to convert their perception into taking coping action suggesting that risk awareness alone is not sufficient for making coping decisions. Given the risk adverse behaviour of aged farmers, older age may mean less coping. In a study conducted in the highlands of Ethiopia Yesuf et al. (2009) found that the older the age of the household heads, the less likely they were to adopt soil conservation technologies.

Compared to illiterates, households headed by an educated farmer have 18% higher probability of perceiving a change in climate. However, education did not significantly influence farmers' coping decisions. A similar result was reported by Clay et al. (1998). On the other hand, adaptation studies in Ethiopia (Deressa et al., (2009) and in many other countries (Maddison, 2006) concluded that the probability of adapting to climate risk increases with education level of the household head. The fact that education contributes to improved perception of risk but not on coping decision indicate that farmers may construct different meaning out of the perceived risk as also indicated in IPCC (2012)..

Consistent with previous studies (Deressa et al., 2011; Semenza et al., 2008; Bryan et al., 2009; Demeke and Zeller, 2012), higher income level increased the probability of drought perception. However, this is in contrast with Legesse and Drake (2007) who reported that in the eastern highland of Ethiopia, farmers with increased wealth and asset were less perceptive of drought risk. The fact that economically active members in the household increases the likelihood of coping is probably because higher labour endowment would enable a household to engage in various agricultural and non- agricultural tasks especially during stress periods. The probable reason for the effect of proximity to town on farmers coping decision could be due to the fact that households close to towns may look for alternative income earning opportunities in towns than making input-demanding coping decisions.

In terms of agro-ecological settings, farming in the highland agro-ecosystem was negatively related with drought perception thus suggesting that the issue of drought is not a primary concern to the highland farmers whereas farming in the lowland was strongly associated with drought risk perception. Our findings concurs with Diggs (1991) who in his drought perception study revealed that farmers living in drier areas with frequent droughts are more likely to perceive the change than those living in a relatively wetter areas with less frequent droughts. Lowland areas of Ethiopia are drier with higher drought frequency than other areas (Belay et al., 2005). Hence, compared to the midlands, farming in the highlands negatively and significantly affects perception towards drought risk while farming in the lowlands had a positive and significant effect on drought risk perception. Despite high level of perception, however, lowland farmers were found to be less likely to employ coping measures in response to the perceived drought risk, which concurs with Admassie and Adnew (2008). The likely reason for this could be lack of means and other binding limitations that deter coping decisions among lowland farmers which is also confirmed by our qualitative investigation within this study that lowland farmers mentioned the various resource and livelihood constraints that they face in order to respond to the perceived change in climate. Farmers drought perception is also influenced by land quality, that is, households with more fertile land were less worried about drought than those with poor land quality as good quality land produces more even under bad weather. Thus, receiving adequate and timely rainfall is more critical for farmers with less fertile farm plots. Poor quality of the farm plot was also found to discourage coping decisions as it may require a relatively large investment to improve the quality of the plot.

Access to climate-related information positively and significantly affected drought coping. This is consistent with Bryan et al. (2009) and Ziervogel and Calder (2003). This may suggest that farmers in the study area rely more on traditional knowledge, social networks, and locally existing institutions for weather-related information. Contrary to our expectation, access to extension advice did not reveal strong association with probability of perception but positively and significantly influenced coping decision of farmers. The fact that access to extension services enhance the probability of adaptation but failed to influence farmers' perception of climate change raises questions about the message and approach of the rural extension. This finding suggests that it is not the extension contact that matters but the relevance of the message discussed for farmers' actual production decisions (Gebremedhin and Swinton, 2003; Zinnah et al., 1993). Furthermore, the extension message in Ethiopia may lack adequate focus on climate change indicating the need to revisit the content and communication approach.

Results also uncover the importance of aid and safety net in influencing farmers' perception of climate risk. Households that rely on aid and safety net were less likely to perceive drought risk. This could be linked both from the problem of dependency syndrome from the recipients' side and targeting problem on part of the government strategy. Previous studies, e.g. Grosh et al. (2008), Harvey and Lind (2005), Lind and Jaleta (2005) claim that recipients developed dependency syndrome and did not make the maximum effort required to improve their livelihoods, others, e.g. Bakewell (2000) and Harrell-Bond (1986) argue that part of the problem lies at the heart of the government's strategy itself as it focuses more on provision of aid rather than solving the problem of production failure from its root.

Households with strong social network were positively and significantly related with high level of risk perception. Social network can serve as a means to access and exchange of various information, protect against unforeseen events, and reduce information asymmetries (Barrett, 2005; Fafchamps and Minten, 2002) and hence are increasingly promoted as a long-term adaptation strategy among adaptation scholars and policymakers (Adger, 2003; IPCC, 2012; Pelling and High, 2005).

During our qualitative assessment, farming communities in the CRV also largely cited social networks as an imperative medium of climate information exchange, which concurs with Melka et al. (2013). Overall, the present result indicates that households with strong social network and participation in local institutions were in a better condition to access required information for enhanced climate risk awareness.

Polygamy negatively affected farmers' coping decisions. A household with more than one wife was found to be less likely to cope with climate variability and extremes as compared to a monogamous household. This could be linked with large number of children and high dependency ratio, which may limit available resources to be used for coping in drought periods. The likelihood of perceiving drought risk has increased with prior experience of climate induced migration. In particular, households with prior experience of seasonal or long-term migration were 19% more likely to be alert and notice variability and change in drought compared to those with no such experience. This result is in agreement with Bryan et al. (2009) who reported that adaptation response of South African and Ethiopian farmers is enhanced by their risk awareness triggered by extreme climate events. Contrary to the argument on lack of clear relationship between migration and climate change (IPCC, 2014; Black, 2001), migration remains to be an important strategy for reducing vulnerability and to diversify livelihoods (Banerjee et al., 2013) especially when all other coping measures are exceeded (Meze-Hausken, 2000).

## CONCLUSIONS AND RECOMMENDATIONS

The study analyses local people's perception of climate variability and change as well as the role of such perception on influencing coping and adaptation decisions. Evidence from this study highlights that perceiving the change would not always lead to adaptation decision especially among the rural farming community who face more binding constraints such as poverty, lack of appropriate incentives as well as other social, economic, institutional, and cultural limitations that deter adaptation decisions. Therefore, one should consider perception as a necessary but not sufficient condition for influencing adaptation decisions. Nevertheless, more than half of those who felt that the climate has changed had employed at least one coping measure in light of the changes they perceive. The fact that they are making adjustments to their agricultural practices, however, does not necessarily mean that those autonomous adaptations measures are appropriate and effective. In terms of policy implications, it appears that improved education and reinforced social network would enhance the perception of local communities whereas improved access to weather forecast and extension services encourage farmers' adaptation decision making processes. The fact that education has contributed towards enhancing climate risk perception but failed to enable farmers engage in adaptation intervention raises intriguing question. Early warning and access to reliable weather forecast, particularly rainfall distribution is vital for making informed decisions in agricultural activities. In this regard, the spatial variability of rainfall and lack of meteorological stations with reliable long-term records are limitations that need to be addressed. Likewise, more engagement towards capacity building in downscaling and communicating the information to farmers as well as increasing the network of automatic weather record¬ing stations is one of the areas to be intervened. The study also highlights the need for improving the rural agricultural extension program particularly through improving the approach, enriching the message as well as the orientation of the extension workers towards climate resilience. The other important policy issue is food aid and safety net program which is acknowledged for its contribution towards reducing the negative consequences of drought. However, as it is one of the central approach and policy instruments for the Ethiopian government in drought affected and food insecure areas like CRV, the study findings highlight the need for revisiting the program in terms of approach and targeting so as to avoid creation of dependency syndrome. In general, while some coping and adaptation takes place autonomously, the role of the government intervention in promoting the adaptation process particularly through provision of tailored weather forecast, infrastructure development, creating enabling policy environment is required.

### Conflict of interest

The authors have not declared any conflict of interest.

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