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Climatic Hazards, its Effect and Coping Mechanisms of Farmers of Ada'a Berga District of West Shewa Zone, Oromia, Ethiopia

Daniel AT*

Department of Disaster Risk Management and Sustainable Development, Institute of Cooperatives and Development Studies, Ambo University, Ethiopia

Abstract

The effect of both natural and human activities has overtime caused significant shift in the climate state, creating climate change and thereby impacting the human being through its shocks. This study therefore investigated climatic shocks experienced and its devastating effect in the area. The study examined the local coping mechanisms practiced by farmers with aim of survival from the two agro-ecologies of Ada'a Berga district. Primary data were collected and analyzed from a total of 512 farm households that considered from eight kebeles'. Descriptive statistics and multinomial logit model were used to analyze the collected data. The statistical analysis of the climatic shocks in the eight kebeles' revealed that drought (ranked as #1), crop disease (ranked as #2), animal disease (ranked as #3), landslide (ranked as #4) and flood (ranked as #5) in the six sampled kebeles' of lowland agro-ecology, and crop disease (ranked as #1), flood (ranked as #2), landslide (ranked as #3), drought (ranked as #4) and animal disease (ranked as #5) in the two identified kebeles' of midland agro-ecology. The rank ranged from 1 to 5 indicates its seriousness of climatic shocks on the living of the study community. In the response farmers used various means of coping mechanisms with the aim of surviving disastrous effect posed by climatic shocks. However, the empirical result of MNL model explains that Age (0.008), Education (0.017), Family size (0.000), Wealth status (0.030) and Early warning system (0.007) were potential factors that significantly determined the coping ability of farmers in the study area. Finally, based on the result, the study recommends that any policy that designed to address negative effects of climate change induced hazards should focus on diversifying the means of coping and reduces the determinants that challenge their adaptive capacity.

Keywords: Climate change; Effects; Factors; Coping; Shocks

Introduction

Climate related shocks and its adverse impact is one of the common stressors that put the farming community under serious vulnerability. Such as heat waves, droughts, floods, cyclones, and wildfires that led to significant vulnerability and exposure of some ecosystems and many human systems are common climate related shocks in the current time from which the world people are suffering from [1]. But shocks like extremely high temperature and changing patterns of rainfall and its manifestations in the forms of extreme events i.e., drought and flood are the major challenging factors to farm households in particular [2]. This is not only due to its direct effect but the frequency and magnitude of epidemics from water-borne diseases such as typhoid and cholera, as well as the incidence of vector-borne diseases is another exacerbating factor that caused by frequent occurrence of drought and flood.

Even though the subsequent impact of such climate related shocks is severing for peoples' who depend on farming activity but even more for community who rely on rain-fed agriculture. Accordingly, communities in SSA are already experiencing the impacts of rising temperatures, more erratic rainfall and increasing frequency of droughts and floods, have critical consequences for livelihoods, particularly for the poorest households in rural areas [3]. In Africa, being two-thirds of population depends on rain-fed agriculture the consequence of such climate related shocks will be sever through amplified with increase in average temperature and believed to lead farmers in to serious vulnerability in the region [4]. Besides, the continent's low ability to cope [5] overdependence on rain-fed agriculture with having marginal climate and existence of many other stressors is another interconnected problem challenging the farmers [6].

Similarly, Ethiopia is also just as any African countries suffering from recurrently occurring climatic extremes, particularly by drought and flood. Accordingly, the frequency of drought has increased over the past few decades [7] and this is also suggested as the most common causes of disaster and food crisis in terms of frequency, area coverage and number of people affected [8]. The last three decades in general (1970-1996), 25 drought events associated with food shortage and famine led to the deaths of 1,200,367 and 60,880,064 people affected [9]. In addition, the impact of recent flood of 2006 that led to the death of 614 and 199,000 people were critically affected which was one of the typical examples to mention about the devastated impact of drought and flood in Ethiopia [10]. For these all environmental problem such as; deforestation, loss of biodiversity, soil erosion, land degradation, desertification, and water and air pollution and its consequent effect to the emergence of malaria, livestock disease, and insect pests have been the main reason for the impact faced from shocks and for being sources for vulnerability in the country [11].

Ada'a Berga is the district with similar fate of the country by being among highly vulnerable communities to the negative effects of climate change induced hazards in the area. Among 18 districts in the west Shewa zone of Oromia regional state of Ethiopia Ada'a Berga is also known as one of mixed agricultural area. But the district is recognized as one of extremely vulnerable to different climate induced hazards such as drought, flood, and land slide [12]. The higher the frequency of drought and flood, and other related hazards mean the bigger the threat for the economy and populations' livelihoods because of the many consequences on agricultural production, food security, water availability and human health [13].

***Corresponding author:** Daniel AT, Department of Disaster Risk Management and Sustainable Development, Institute of Cooperatives and Development Studies, Ambo University, Ethiopia, Tel: +251 0913337217; E-mail: frewa2015@gmail.com

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However, there were limitation in conducting research in the areas of climate related hazards, its effects and coping mechanisms employed by farmers in the country in general and study area in particular. accordingly, though Ada'a Berga district was well recognized as highly susceptible to the impacts of hazards which were historical, drought and flood but currently intensified and increased its dimension in terms of frequency, intensity, extent or magnitude, and also in terms of newly emerged type of hazards but there was no scientific research conducted in the district. Besides, the disastrous effect posed by various types and nature of hazards and the coping mechanisms practiced by the farmers of the district were also not investigated yet. Therefore, this present study was sought to answer:

- What were climate induced shocks experienced in the study area?
- What effects of climate related hazards were farmers experienced in the area?
- What type of coping mechanisms were farmers employed in the Ada'a Berga district of west Shewa zone of Oromia regional state?

Materials and Methods

Study setting

The study was conducted in Ada'a Berga district of west Shewa zone Oromia region, Ethiopia. The area is located between 9°12'' to 9°37''N and 38°17'' to 38°36''E and about 107 km north east of zonal town Ambo and 60 km west of Addis Ababa [14]. Its annual average precipitation is 1290 mm and the minimum and maximum annual average temperature lies between 12°C and 25°C. The mean annual rainfall of the district is 1290 mm and the mean annual minimum and maximum temperatures lies between 12°C and 25°C, respectively. More than 85% of farmers in the study area mostly practice crop-livestock mixed farming, which is predominantly rain-fed.

Sampling procedures

The study followed a multistage-stage stratified random sampling procedure to select the final sample units. Initially Ada'a Berga was selected purposively based on severity of climate variability and extremes. The area is then stratified into three agro-ecological zones based on elevation, rainfall and temperature criteria. In the second stage, 6 from lowland, 2 from midland, a total of 8 kebeles (the smallest administrative unit) were purposively selected from two stratums based on the frequent occurrence of extreme events and its consequent impact in the area. In the third stage, the survey randomly drew a total of 512 households (384 from lowland 128 from midland) based on the principle of proportion to the total population of the surveyed communities.

Sources and methods of data collection

Both primary and secondary data sources were used to achieve the objective of this study. Both qualitative and quantitative data used in this study were collected from eight kebeles in Ada'a Berga district (i.e., Gatira, Sambaro Sago, Elu sodolbe, Adada Sodolibe, Debisa Agasa, Dire Medale, Qore Jenu and Odomo Jio). Household survey on the total of 512 farm households using semi-structured questionnaires were conducted after pretest made by including five households prior to the main survey and the final questionnaires were amended based on the feedback. Survey was administered face-to-face with the head of households and focused on demographic and socio-economic characteristics, climate related shocks, institutional factor, barriers to coping mechanism and household characteristics.

A total of 16 households were randomly selected from each community and the household heads were individually interviewed. The 16 key informants' interview were conducted by including two development agents in each kebele, four experts and two experienced farmers from each kebele. The main importance of key informant interview was mainly to get information on farming characteristics, major climate related shocks and its impact events in the area.

In addition, a total of 16 focused group discussions, one from men and the other from women were conducted in all eight kebeles'. With FG discussant detailed discussion was made on how farmers characterize climate related shocks in terms of its direct and indirect cause, major experienced impacts and the drivers of their vulnerability to such shocks in the area. Also, Key informant interview and FGDs were held to double check the household survey data.

Econometric model

Multinomial logistic regression model (MNL) was used to analyze factors that influence farm households' ability to cope to climate related shocks in the study area. Because is an appropriate model for evaluating alternative combinations of coping mechanisms, including individual strategies make it selective than other [15,16].

Since, MNL model specifies the relationship between the probability of choosing a coping mechanism and the set of explanatory variables [17] and its computational simplicity in calculating the choice probabilities that are expressible in analytical form is another advantageous reason to select this model [18].

To describe the MNL model, let y denote a random variable taking one the values {1,2…. j} for choices j, a positive integer, and let x denote a set of conditioning variables. In this case, y representing the coping mechanism chosen by any farm household in the study area. We assume that each farm households faces a set of discrete, mutually exclusive choices of coping mechanisms in order to survive from climatic shocks (that means that a person chooses exactly one of the options, not more and not less) and these mechanisms are assumed to depend on factors of x. Therefore, x represents a number of climate attributes, environmental, socioeconomic characteristics of households and other factors.

The question is how, ceteris paribus, changes in the elements of x affect the response probabilities p(y=j/x), j = 1, 2…. J. Since the probabilities must sum to unity, p (y=j/x) is determined once we know the probabilities for j = 2…j. Let x be a 1x K vector with first element unity. The MNL model has response probabilities:

$$p(y=j/x)=\frac{\exp(x\beta j)}{1+\sum_{k=1}^{j}\exp(x\beta k)\, j=1,\ldots,j} \quad (1)$$

Where: β_j *is k×1, j = 1……, J*

Unbiased and consistent parameter estimates of the MNL model in equation-1 require the assumption of Independence of Irrelevant Alternatives (IIA) to hold. More specifically, the IIA assumption requires that the probability of using a certain coping mechanism by a given household needs to be independent from the probability of choosing another coping mechanism (that is, Pj/Pk is independent of the remaining probabilities). The parameter estimates of the MNL model provide only the direction of the effect of the independent variables on the dependent variables, but estimates do not represent either the actual magnitude of change or probabilities [19]. To interpret

No	Shocks	Lowland (n=384)			Midland (n=128)			Total
		Frequency	Percentage (%)	Rank	Frequency	Percentage (%)	Rank	
1	Drought	368	96	1	79	62	4	--
2	Animal disease	226	59	2	74	58	5	--
3	Crop disease	181	47	3	115	90	1	--
4	Landslide	142	37	4	110	86	3	--
5	Flood	115	30	5	92	72	2	--
Grand total								512

Table 1: Climatic shocks reported by farmers.

Shocks	Reason for shocks	Percentage (%)
Drought	Deforestation	19.7
	Increase in temperature	12.4
	Decrease in rainfall	18.2
	Climate change	22.6
	Total	100
Crop disease	Erratic nature of rainfall	23.4
	Increase in temperature	3.6
	Increase in rainfall	4.4
	Decrease in rainfall	27.7
	Climate change	13.9
	Total	100
Animal disease	Increase in temperature	14.6
	Climate change	22.6
	Frequent occurrence of drought	35.8
	Total	100
Landslide	Deforestation	26.3
	Increase in temperature	3.6
	Increase in rainfall	17.5
	Climate change	25.5
	Total	100
Flood	Increase in rainfall	37.2
	Deforestation	10.2
	Climate change	25.5
	Total	100

Table 2: Relative frequency of reason for climate related shocks.

No	Coping mechanisms	Frequency	Percentage (%)	Total
1	Selling asset (both fixed and variable asset)	445	87	512
2	Reducing the number of meals	424	83	512
3	Consuming seed reserves	404	79	512
4	Collecting hay for animal	379	74	512
5	Borrowing from relatives and families	345	67	512
6	Moving to distant area in search of temporary work	317	62	512
7	Working as wage labor in the community	332	65	512
8	Getting food aid	297	58	512
9	Insurance	271	53	512
10	Prepare and sell charcoal and fire wood	246	48	512

Table 3: Coping mechanisms employed by households.

No	Coping mechanisms	Coefficient	Std. Err	*z*	*P-value*	Odd ration
1	Sex	-0.1019685	0.62528	-0.16	0.870	-1.327495
2	Age	-1.05764***	0.3969614	-2.66	0.008	-1.83567
3	Education	2.102513***	0.8803109	2.39	0.017	0.3771352
4	Family size	0.628227***	0.1630916	3.85	0.000	0.3085734
5	Access to early warning information	4.40248***	1.626296	2.71	0.007	1.214998
6	Wealth status of the household	1.282526**	0.5893976	2.18	0.030	0.1273282
7	Lack of income diversification	-1.528627	0.9028456	-1.69	0.090	-3.298172

Table 4: Coping mechanisms employed by households.

the effects of explanatory variables on the probabilities, marginal effects are hence computed. Differentiating equation-1 partially with respect to the explanatory variables provides marginal effects of the explanatory variables given as:

$$\frac{\partial pj}{\partial xk} = pj\left(\beta jk - \sum_{j=1}^{j-1} pj\beta jk\right) \quad (2)$$

The marginal effects or marginal probabilities are functions of the probability itself and measure the expected change in probability of a particular choice being made with respect to a unit change in an independent variable from the mean.

The qualitative information collected through key informant interview and FGDs was written on flipchart sheets, which were then compiled, transcribed, coded thematically, and analyzed quantitatively in an Excel spreadsheet. The data was analyzed in terms of differences between farmers of different agro-ecological areas midland and lowland and potentially supported the quantitative data.

Results and Discussion

Climatic shocks experienced in the community

Climatic shocks that experienced in the surveyed communities were well reported by the residence farmers of the area. Frequent occurrence of extreme events caused by climate change and prevalence of its consequent impact was the major climatic shocks in the area across the agro-ecologies. For better understanding of the characteristics and experience of shocks, ranking was made based on the occurrence and its impact on the livelihood. Accordingly, of the other, drought was ranked as first and fourth in the lowland and midland agro-ecologies as confirmed by 96% and 62% of respondents, respectively (Table 1).

Climate change caused by increase in temperature (12.4%) and decrease in rainfall (18.2%) was mentioned as the most serious reason for the frequent occurrence of drought across the agro-ecologies (Table 2). Similarly, cutting trees in search of additional land for farming, construction, charcoal and fuel wood that led to deforestation was mentioned as the other major reason for the frequent occurrence of drought and that reported by 19.7% of respondents during the field work.

Regarding to animal disease, it was ranked at the third stage in the lowland and fifth in the midland (Table 1). Here frequent occurrence of drought in the area particularly in the lowland community was considered as the key reason for the prevalence of animal disease and which was reported by around 59% of the farmers of the area. Similarly, about 31% of respondents were considered climate change as among the leading reason which significantly influenced the livestock production in the area thereby challenge the livelihood of farmers. The remaining, 20% of informants confirm that increases in current temperature of the area are the factors that put farmers in stresses by affecting their animal (Table 3).

Poudel and Shaw [20] stated that the current change in precipitation pattern, untimely and heavy rainfall, winter drought, and other phenomena of climate hazards are more frequent than before. Its manifestation was also depicted in different effects like: in the prevalence of disease, pest and the like. Similarly, of the total of 384 interviewed in the midland, 90% were reported crop disease as the primarily ranked shock while 47% of informants in the lowland ranked it as the third shock in the area (Table 1). The result in Table 2 reveals that decrease and erratic nature of rainfall was mentioned as the most disastrous reason for the reduction in crop across the agro-ecology that recognized by 38% and 32% of interviewed, respectively. Because, decrease in the amount of precipitation or increase in temperature is the major reason for fall in net revenue in final yield of seasonal crop [21].

In addition to this; let come, early succession and untimely rainfall particularly during the growing period was among the serious challenge of crop growth and productivity. This was also resulted to fluctuation in sowing or cropping pattern. The problem here is that both planting too early might lead to crop failure and, in turn, planting too late might reduce valuable growing time and crop yield [22]. Similarly, the remaining 15%, 6% and 5% of respondents were noted climate change, increase in rainfall and temperature as among the challenging factors of their production, respectively. Because, both increase in temperature and change in precipitation patterns have ability to negatively affect soil quality which results in loss of soil organic matter [23]. Hence rising of air temperature are likely to speed-up the natural decomposition of organic matter and increase the rates of other soil processes this in turn negatively affects soil fertility and thereby crop production [24].

The results in Table 1 indicates that most farmers, about 37%, were ranked landslide at the fourth stage in the lowland compared to 86% were ranked it at the third stage in the midland. Commonly landslide is known as geological hazard but the cause that led it to be take place can alter its definition. For instance, landslide that occurred due to earthquake may be identified as geological. Similarly, landslide that caused due to soil type and sloppiness of land setting may lead to the same definition. Poudel and Shaw [20] stated heterogeneity in the topographic set-up mostly leads to landslides in the higher altitudes and floods in the lower region. But it is also possible to categorize landslide that resulted due to runoff or damaging flood caused by torrential rainfall from the upstream to climatic hazards. Consequently, climate change, deforestation and increase in rainfall were the three key reasons contributed for damaging landslides in the area and reported by 37%, 36% and 24% of farmers in the residence, respectively (Table 2).

Concerning the manifestation of flood occurrence in the area, it was among the most frequently happened climatic hazards in the community and ranked as fifth by 30% of lowland informants and second in the midland agro-ecology as noted by 72% of surveyed (Table 1). Increase in rainfall in the area was mentioned as the leading reason for frequent occurrence of flood (51%). Besides climate change was also mentioned as the second most devastating cause to the frequent occurrence of flood across the agro-ecology. The reason is that climate change was the root cause for torrential rainfall in the area and that cause damaging flood. Consequently, it can be concluded that climate change is the double burden case for the frequent occurrence of several hazards and that led to serious challenge of human wellbeing in the area. The main reason for this is that climate is a fundamental element of the environment and a change in climate will consequently cause a change in the entire environment and affecting other elements of the environment [25].

Effects of climatic shocks in the community

The negative effect of climatic shocks on the study communities were various in characters. Susceptibility nature of farmers in the face of climate change induced shocks was the most serious challenge for the livelihood and living of peoples in the surveyed communities. This was mainly due to majority, 92% of surveyed farmers were depend mainly on rain fed agriculture which was mainly subsistence in nature. This is because climate change or its variability and the resultant shocks are known to cause severe impacts on livelihoods that are sensitive to climate change like rain-fed agriculture [26-28].

According to the surveyed farmers' its effect ranges from socioeconomic to environmental. In the first stage this ranges from reduction in yield to complete loss of crop. Accordingly, erratic nature of rainfall is among the frequently mentioned effect in the area to have reduction in final yield in crop. As result lack of rain during land preparation period mostly led them from complete rejection of sowing of particular crop. However, if it also come let just after prolonged drought it was not supporting the production since all the activities related with production is very sensitive to a specific period. Consequently, they mentioned as they were rejected different crop type at different period because of variability in local climate. Since, high sensitivity of crop to marginal change in both temperature and precipitation is the main reason for the extreme experiences of farmers [29].

For instance, most of the time because of let come of rain particularly during March or April crop like Maize and sorghum, which farmers of surveyed communities sow during this period, mostly forced to pass from sowing them and this led to shortage of household consumption as the same time to miss off equivalent income that can be drawn from it. The inherent variability of weather, especially intra-seasonal and inter-annual rainfall variability often prevent from planting crop and reduces its yield from reaching its potential in rain fed regions [22].

In addition, rainfall that come after lagging much more time also reported as it resulted in damaging flood. This was mostly resulted in submerging of sowed seed, led to be taken by runoff even the seed as well as already germinated field. Moreover, the impact of this also sometimes led either to reduction in yield or total loss of crop from the field. But the consequence from it mainly depends on the magnitude of potential rainfall appeared during that particular time [17]. Climate-related shocks most often resulted in a crop yield reduction, and in some cases, loss of an entire crop. In addition to this reduction in crop yield in the area was not only due to direct consequence of erratic rainfall but also due to reduction in fertility of the soil. This is mainly because of taken away of top soil by runoff, currently leading to degradation of some of the farm land of the study community. Because frequent and damaging flood and erosion has the ability to remove top soil and result in reduction in soil fertility, destroy roads, affect fresh water resources and threaten lives and properties [25].

On the other hand, crop disease was also among the limiting factors of crop production caused by untimely rain during the flowering or maturity period. This has been considered as one of the pressing challenges of farmers, both as the farmers themselves during survey and FGD period, and district level experts from key informant also recognized. The effects of this were articulated well from two sides: the cost that farmers incur for the treatment through chemical and from its effect on final yield reduction. In addition to erratic nature of rainfall decrease in the amount of rain fall particularly during the growing period was aggressively noted problem. Because its effect also ranges from both in terms of serious reduction in final yield and complete loss of the field. The resultant impact on their livelihood was not easily concluding, because it encompasses many things including increased food shortages, food price increases, and loss of income and assets.

In the regards of animal disease, surveyed communities reported as it was becoming the worst challenge that farmer across the agro-ecology facing from recurrent drought even though its consequence is relatively highest for farmers living in the lowland area. The reason is that climate change has a direct and indirect impact on livestock and other assets. Direct effects occur with regard to reproduction, animal growth and its products while indirect effects associated with availability and quality of animal feeds such as pasture and forage, and prevalence and severity of livestock diseases and parasites. Due to this disease farmer in the surveyed communities was forced to incur additional cost through visiting veterinary center. This was why the effect of climate change on animal disease is indicated as among the second worst side of climate change challenge from which farmers were suffering. Similarly, drought and erratic rainfall were cited as the most serious shocks or risks that threaten the livelihood of households in southern Zambia.

Coping measures employed by farmers (issue of survival)

In the response to shocks farmers in the surveyed communities were employed different mechanisms as a means of survival. The mechanisms also range from selling of asset to moving to distant area in search of temporary work. The measure that respondents take was not the action that they perused to live with already changed climate but to survive that particular emergency period. Because the measure that farmers use with the intention to survive is completely different from adjusting the system to the changed or currently changing local as well as global climate. Because coping strategies are short-term actions to ward immediate risk, rather than to adjust to continuous or permanent threats or changes; strategies usually rely on selling or using up assets and reserves.

According to the analysis result in Table 3, out of 100% (n = 512) of respondent's majority, 87% were experienced selling of their asset (both fixed and variable asset) as a means of coping mechanism in the response to climatic shocks (Table 3). The common climatic shocks that force farmers to take this type of action in their area were if their seasonal field was affected from drought or erratic nature of rainfall. This action was taken mainly by those who are endowed with the assets to sell. This implies that only who have asset were able to direct some of the resources to be sold and try to curb the impact on the households. But those who have no such type of assets used other means of coping mechanisms in order to survive the emergency period in the community.

In this regard, farmers reported as they sell one of their livestock, tree like Eucalyptus and any asset that they have depending on the magnitude of shocks they faced. Reducing the number of meals and consuming seed reserves was also among the mechanisms many of the interviewed, about 83% and 79% of farmers experienced in the response to different types of shocks in the locality, respectively. Similarly, about 74% of informants collect hay for their animal particularly when there is stress from temperature increments and that result in lack of pasture in their locality. Collecting of hay includes reserving the byproduct or crop residual (e.g., byproduct of Teff, Wheat, and Burley) and collecting from grass during the normal period are among the measure they use to survive of serious condition.

Out of 100% of respondents, about 67% of farmers noted as they used to borrow from relatives and families including neighbor as a means of coping during the emergency period. The practice of borrowing was both in the form of cash and kind. This mechanism was used in the area if the magnitude of shock they faced, and its impact was not as such serious and could be bounce back easily. Instead if its impact posed on the living of farmers was serious and if they feel as it is difficult to bounce back easily within a short period, they use other advanced option from the list (Table 3).

In addition to this, around 62% of interviewed were indicated as there was experience of moving to distant area in search of temporary work as a means of coping mechanism in the response to climatic

shocks (Table 3). The common climatic shocks that force farmers to take this action in their area were if their livelihoods, field were affected from drought or erratic nature of rainfall. The farmers decide on this action just after they face complete loss of their field as well as when they feel that the final yield is low. As result Bale and Arsi-Negele are where commonly farmers of the surveyed communities went gone in search of temporary work. They prepare bale because they get their various forms of work like being engaged in land preparation, in sowing, in cultivation and in harvesting of crop. In addition, 65% of interviewed reported as they were work as wage laborer in different cement factors around in their community like Muger, Bedrok, Dangote, Habesha and Capital cement factory, that exists in their area.

Even though there is no insurance system to natural disaster caused by climatic shocks just as for other forms of disaster in our country but one interesting culture in this district is that the district level council allocate budget for this purpose yearly. For the general management of the insurance system there was well established committee both in the district and community level with different responsibility. But, key informants from the experts indicate that currently the district level government designed to collect money in the near future from the farmers using legal money collection tools instead of allocating budget for this purpose. First, this is because, managing this type of disaster by the government shoulder alone is very challenging since it is critically mandated to invest on other socioeconomic developmental activities that may be preventive. Second, involving the community in the insurance activity as a part of solution is among good culture of solving problem in collaboration.

On the other hand, this may also encourage farmers to work more on the preventive action like in afforestation or reforestation, soil and water resource management activities thereby reduce the direct impact of climate change induced shocks. In addition to this activity that district level government doing clearly indicates how much the frequency of shock is increased from time to time and affecting the residents in the surveyed communities.

Besides, 58% of surveyed farmers in the study communities used aid both in the form of food item and materials in order to cope with shock. In this regards aid to farmers provided from different sources, non-government organizations working in the district and from both district and zonal level disaster prevention and preparedness department. Similarly, in the worst-case farmers prepare and sell charcoal and fire wood in the nearby town which was confirmed by 48% of informants. Currently the involvement of residents in these activities was increased and becoming the additional source of their income. However, it was not encouraging activity because it is the act on forest distraction and using these activities as coping strategies in the response to stress may further increase the possibility of communities' vulnerability in the long term.

Of the all above mentioned and discussed coping mechanisms moving to distant area in search of temporary work, work as wage laborer in the nearby town, and prepare and sell charcoal and fire wood was not only practiced during emergence period but also becoming the common experience of farmers in the normal situation as the means of supporting their income particularly by poor farmers. Widening income sources by engaging in diverse off-farm and non-farm activities is essential as farming alone fails to provide an adequate means of survival. Though it was considered as income diversification by farmers who are relatively poor in the area but it also becoming commonly practiced activity among farmers who considered as middle level.

Increase in the dramatic nature of climate related shocks both in terms of frequency and severity coupled with low yield of seasonal production was the major reason for the increasing involvement of meddle level farmers. In addition, reduction in the trend of productivity that was mostly becoming resulting with not enough even to consume and support other parts of socioeconomic needs was mentioned as among serious problem for the increasing search to get other source of income in the communities. As result they do this just after completing the production season including the harvest.

Factors affecting farmer's ability to cope with climate related shocks

The results of MNL model showed how factors of socio-economic characteristics influence farmers' choice of coping action in the study area. Therefore, the choice set in the MNL model included the coping option listed in the above Table 4. Selling asset (both fixed and variable asset); Reducing the number of meals; Consuming seed reserves; Collecting hay for animal; Borrowing from relatives and families; Moving to distant area in search of temporary work; Working as wage labor in the community; Getting food aid; Insurance; and Prepare and sell charcoal and fire wood.

The estimation of MNL model for this study was undertaken by normalizing one category, which is normally referred to as the "base category". In this analysis, the first category (no coping) was the base category. The likelihood ratio statistics from MNL model indicated that $\chi 2$ statistics (75.62) are highly significant ($p<0.004$), suggesting the model has a strong explanatory power. Therefore, (Table 3) presents the marginal effects along with the levels of statistical significance. The variables which only appear statistically significant were discussed.

Age: as the age of household head increases, the chance of using one or a combination of coping mechanism were reduced by 1.83567 times compared to farmers with relatively low age and this is significant at $p<0.01$ level. This implies that aged farmers were less likely to cope with the negative effects of climatic hazards in comparison to young farmers. This may be aged farmers have less capacity to search new way of coping mechanisms to invest during the emergency period. On the other hand, younger farmers may decide to migrate to far villages where climatic hazards are perceived as less likely to occur like drought and landslide noted aged household heads were fragile and unable to explore many coping alternatives [30].

Education: the educational levels of farmers have showed a positive and significant relationship with different coping mechanisms to the negative effects of climate induced hazards in the area. A farm household head that were educated are 0.38 times more likely to cope with the hazards rose due to climate change in contrast to the households who were not educated in the surveyed communities. This is probably because a farm household which is headed with educated farmers is able to easily and wisely manage difficult condition without damaging the resource base. Because mostly actions to cope is well understood for damaging the future resource base of the households in the intention to survive the actual hazards with which the households confronted with. In fact, education is known for giving better knowledge for peoples to see all the situations around and to manage things in a win-win scenario. Several studies conducted in this area reveals that education of the head of household increases the probability of coping to climate change [12,30-32]. This infers that farmers who educated have relatively better to see any opportunities of coping mechanism during the emergency period.

Family size: is positively and significantly associated with one or a combination of coping mechanisms at $p<0.01$ level of significance, respectively. The computed conditional odds ratio of 0.31 indicates that farmers with a greater number of family sizes were more likely to cope with the impacts of currently occurring climate induced hazards in the study area. Contrary to this household with a smaller number of family sizes were less likely to cope with the hazards that caused by climate change. The probable explanation for this is may be households with large family size may divert or lead some of the family group to be involved in various activities out of their community to collect some additional income to the household members and that can be invested to cope with emergency situation. The result found by Fatuase and Ajibefun [33] are in convergence to this study. In his finding he concluded that the large family size which is normally associated with a higher labor endowment and this would enable a household to accomplish various agricultural tasks which helps to earn additional income especially at the peak seasons. Similarly, having a greater number of family size increases the likelihood of using other coping through engaging in different activities like diverting from farming to non-farming, crop to livestock [34].

Wealth status of the households: the computed conditional odds ratio indicates that the variable is positively associated with various coping mechanisms at $p<0.01$ level of significance. Farmers with better wealth status are by 0.13 times likely to cope with climate related hazards i.e., drought, flood, animal disease, pest infestation …etc. in comparison to the base category. This indicates that farmers endowed with resources were relatively had high capacity to early invest in any appropriate coping mechanisms in order to survive the impacts of climatic hazards. For instance, farmers who have numbers of livestock could sell one or two of his animals to cope with the emergency period rose due to much reduced yield or complete damage of seasonal crop caused by erratic rainfall rained during the maturity period of the crop. In comparison to this if a given farm households have no such like resources to sell in the market and to fill the consumption need of his households the households may face serious challenge and not able to cope with the experienced hazards in their community. The present paper is in agreement with the argument of Franzel [35] they indicated farm households with sufficient financial capital is probable able to cope with the impact of climate change and variability through investing in different technologies. Similarly, other finding indicates that income level of the household is the major indicators of household capacity to cope with the hazards through investing in alternative mechanisms of survival [36].

Early warning system: the variable is positively and significantly associated with relative coping mechanisms at 1% probability. The computed odds ratio of 1.21 indicates that farmers who were had access to early warning system particularly at the time of hazards were likely to cope. The early warning system which is well established with both material and trained human resources is currently very demanding. Since if it is well organized in all its important aspect and networked from the institution where it processed to at risk community; it is possible to prevent the hazard before its occurrence or able to reduce or manage early the impact will arises from disastrous hazards. For instance, if there is scientific prediction about the fluctuation of weather conditions of the coming week particularly in terms of rainfall and if the given farmer get about this information early he will have the opportunity to take any action before the occurrence of hazards. This is in line with assumption given by Knowler and Bradshaw [34], they reported as access to climate information like temperature and precipitation increases the probability of using various coping mechanisms before the arrival of hazards.

Conclusions and Policy Implications

From the foregoing, it could be deduced that although the impact of climate change varies between regions, farmers in Ada'a Berga district is likely to be among the worst-hit because the effect is more severe among the tropical regions to which Ethiopia belonged. Drought and flood are the two major historical hazards known in Ethiopia. But today due to climate change these historical hazards to Ethiopia were becoming very sever and frequent in its occurrence. The result reveals that hazards that occurring in the surveyed communities was not only drought and flood but also includes crop pest or disease, animal disease and landslide. Of the mentioned hazards, landslide is commonly known as geological hazards but abnormal rain in the area that come after long period stay was led to it and cause serious effect to the localities. The severities of hazards in the study area were different between two agro-ecologies. Drought ranked as first in the sampled lowland kebeles' while crop disease was ranked as first in the midland kebeles'. The rank ranges from one to five with mentioned five hazards represents the frequency and effect in the kebeles'. Increase in temperature and decrease in the amount of rainfall was the major cause for drought in the lowland and taking firs rank. On the other hand, erratic nature of rainfall was the key reason for crop pest or disease and to take first rank in midland agro-ecology.

All the five hazards

Drought, flood, crop disease, landslide and animal disease have been serous effect on the living of the community. Drought and its followed hazards, animal disease was affected the community by affecting their livestock through affecting pasture and water resource and animal disease particularly in the lowland. Torrential rainfall that arrives after delaying long period caused runoff that mostly led the community to face damaging flood. The damage of flood in the community was led to damage in crop field and finally result in low yield, led to take a way of tope soil by erosion, this also resulted in low productivity of the crop land, led in landslide and that sometimes result in house and property damage in the study area. Crop disease was mainly affected the farmers through reduced yield harvest caused by erratic nature of rain fall particularly the rain that come during flowering period was criticized for damage of crop and let to had low yield.

Though farmers of the surveyed communities strive to survive climatic shocks through employing various coping mechanisms, but they challenged due to frequent occurrence of climatic shocks and with having low resources capacity to divert during the emergency period. Therefore, the government and any non-government agencies working in the area must come together try to reduce the occurrence and effects of climate induced shocks and increase their choices of coping mechanisms.

Government policies and investment strategies must support the factors highlighted above in order to rescue the poor farmers from the danger of climate change. The policy must also be designed in such a way that farmers should have multiple coping mechanisms as well as reduced factors of their coping mechanisms. Future policy could also focus on creating awareness of climate change through well-established early warning systems and facilitating the development and adoption of adaptation strategies. The intensive awareness on climate change induced shocks and the way how to implement beneficial information delivered from early warning center before the occurrence of emergency period will be best achieved in the study area through extension agents, mass media, town/village cry, agricultural show, symposium and the likes [37-39].

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