Science Research
2015; 3(4): 129-136
Published online June 20, 2015 (http://www.sciencepublishinggroup.com/j/sr)
doi: 10.11648/j.sr.20150304.11
ISSN: 2329-0935 (Print); ISSN: 2329-0927 (Online)

Factors Affecting the Choices of Coping Strategies for Climate Extremes: The Case of Yabello District, Borana Zone, Oromia National Regional State, Ethiopia

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To cite this article:
Dirriba Mengistu, Jema Haji. Factors Affecting the Choices of Coping Strategies for Climate Extremes: The Case of Yabello District, Borana Zone, Oromia National Regional State, Ethiopia. *Science Research.* Vol. 3, No. 4, 2015, pp. 129-136. doi: 10.11648/j.sr.20150304.11

Abstract: This study was undertaken in Yabello district of Borana zone to identify factors affecting the choices of coping strategies for climate extremes and the ongoing coping strategies in topical condition. The primary data collected from 123-sample households was analyzed with multinomial logit model. The multinomial logit outcomes were includes coping strategy 1 (Livestock diversification based coping strategies), coping strategy 2 (Integrated crop-livestock based diversification based coping strategies), coping strategy 3 (Livestock diversification, water and rangeland management based coping strategies) and coping strategy 4 (Livestock diversification, income earning opportunities and strategic feeding system based coping strategies). From MNLM result, sex of household head, education status of household head, size of livestock holding, market distance from homestead, access to credit, access to early warning information, access to training and pastoral/agro-pastoral income are the key determinants of the choices of coping strategies for climate extremes. Thus, establishment of formal early warning information centers and sophisticated delivery system, improving access to market, training, credit scheme, improving livestock holding and income of the household would boost the choices of best coping strategies to overcome deleterious impacts of climate extremes.

Keywords: Coping Strategies, Climate Extremes, Climate Change, Pastoralist

1. Introduction

Ethiopian is characterized by a history of climate extremes, such as drought and flood, and increasing temperature and decreasing precipitation trends (NMS, 2007). The history of climate extremes, especially drought, is not a new phenomenon in Ethiopia; moreover, the frequency of drought has increased, especially in the lowlands (Lautzne *et al*., 2003). Additionally, annual minimum temperature has been increasing and average annual rainfall has recently shown a very high level of variability (NMS, 2007). As a result, the livelihood of the households, pastoralists, is suffering now days frequent risks of climate failure. The increase in the risks of climate change is clearly visible. The traditional evidence from Borana pastoralists suggests that drought cycles have shortened from 5-10 years to 3-5 years (Markakis, 2004; Oxfam, 2011).

As a result, the density and reproductive performance of livestock have reduced to the lower level despite the fact that livestock mortality was increasing though a large percentage of the cattle and beef meat exported from Ethiopia originates from Borena pastoral area (Angassa and Oba, 2007; Herrero *et al*., 2010; Gezahegn *et al*., 2014). Furthermore, land degradation and forage shortage became the basic problems in Borana zone. Traditionally, the pastoralists were using rotational grazing; community based restocking (*Buusa-gonofa*), migration, reducing food intake, bleeding, calf slaughtering and more recently destocking, livestock diversification and livelihood diversification because of peripheral inspirations (Riché *et al.*, 2009). However, most of the coping mechanisms become less operable in many ways in today's situations (Morton, 2006; Notenbaert *et al*., 2010).

Principally, expansions of farmland, land degradation, shortage of feed and high population growth undervalue the

use of their conventional coping strategies. Additionally, increase in drought duration, intensity and coverage of drought with erratic, highly intensive and short duration rainfall has delimited the conventional coping strategies (Skinner, 2010). Despite the increase in climate extremes, most of the adopted strategies have come to be short-term considerations and survival needs, which directly or indirectly worsen the environmental degradation, lessen future adaptive capacity and livelihood options (Riché *et al*., 2009). Recently, conventional coping strategies are rapidly weakening to cope with the recent impacts of climatic threat (Coppock,*et al*., 2008).

As a result, today the livelihood in Borana zone and Yabello district in particular are highly suffering from the recurrent impacts of climate extremes; especially drought and flash flooding. Thus, to build the future coping capacity of the pastoralists, it is important to notices factors affecting the decision to choose the ongoing coping strategies. Otherwise, a livelihood suffering from climate extremes will lead to irreversible impact unless right coping strategies are chosen.

2. Conceptual Framework of the Study

Climate change is one of the all-encompassing global environmental changes likely to have deleterious effects on natural and human systems, economies and infrastructure (Seo and Mendelsohn, 2006).The magnitude and rate of climate change, combined with economic, social and environmental factors, are making many conventional coping strategies ineffective. Rather, directly or indirectly diminish their future adaptive capacity. Consequently, the conventional coping strategies are rapidly weakening to cope with topical impacts of climatic hazard, which could worsen the vulnerability of pastoral households' to the adverse impacts of climate extremes. To counteract this vulnerability, it need better understanding of the ongoing coping strategies and factors affecting the choices of these coping strategies. By this premises, this study identified the coping strategies of households in the study area, and factor affecting the choices of these coping strategies to suggest the better ways of building the future coping capacity of pastoralists.

This conceptual framework depicts that climate change worsening the impacts of climate extremes, which have a direct or indirect effects on environmental factors, individual and socio-economic characteristics of the households and institutional factors. These entities in turn affect the choices of households among the available coping strategies, which directly or indirectly deteriorate the coping capacity of the pastoralists.

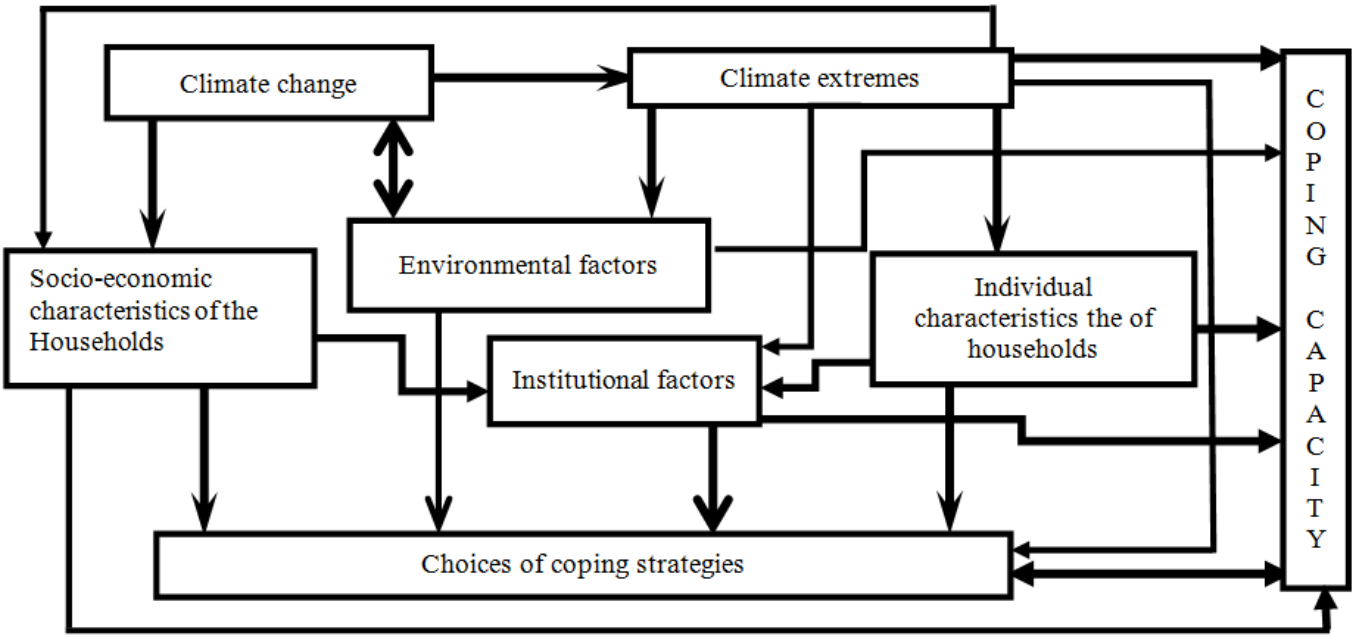

Figure 1. *Conceptual framework of the study*

3. Research Methodology

Sampling is the procedure through which we pick out an item, from a set of units that make up the object of study (the population), a limited number of cases (sample) chosen based on cost of data collection; time required for the collection and processing of data among the major (Corbetta, 2003). In this study, a stratified sampling method followed by simple random sampling was used to select sample households from the population in the district.

Stratified sampling technique is generally applied in order to obtain a representative sample where a population from which a sample is to be drawn does not constitute a homogeneous group (Kothari, 2004). Under stratified sampling the population is divided into several sub-populations that are more homogeneous than the total

population, (the different sub-populations are called 'strata'). Then, the sample households were selected randomly from each stratum finally.

Based on this principle, Yabello district was stratified into two homogeneous group based on its livelihood system; namely pastoral and agro-pastoral. Note that there is no formally recognized farmers during site selection but those destitute households are informally practicing farming as their practical main livelihood activities. However, generally those households' partially (approximately 50/50) dependents on livestock and crops are commonly known as agro-pastoralists. From these livelihood systems, sample *kebeles*are randomly selected from their category. According to information from Yabello District Pastoral Development Office, 16 *Kebeles* (*Ganda*) are categorized under pastoral *kebeles* and only seven *kebeles* are categorized as agro-pastoral community from 23 *kebeles in the district,* i.e. two strata. Generally, for the purposes of this study the sample households were selected randomly from each stratum regardless of its livelihood activities. Accordingly, Cholkasa *kebele* from agro-pastoral *kebeles* and Dikale and Dharito from pastoral *kebeles* are randomly selected. Finally, the sample households were also randomly selected on proportionality basis from each selected *kebeles*.

Accordingly, out of 17,516 households in the district, 2074 households were constituted in the selected *kebeles*. Based on this, 123 households were drawn out at 95% CI with 0.5 degree of variability at 9% precision level (Tora, 1987). Finally, MNLM was used to analysis the generated date through households 'survey.

4. Results and Discussion

In this chapter, both descriptive statistics and econometric results represented. Descriptive statistics includes demographic and socio-economic characteristics of households and agricultural production system in the study area. Then, the multinomial logit model outputs are presented as follows.

The analytical approaches that are commonly used in an adaptation decision involving multiple choices are the multinomial logit (MNL) and multinomial probit (MNP) models (Hassan and Nhemachena, 2008). These approaches are also appropriate for evaluating alternative combinations of adaptation strategies (Hausman and Wise, 1978; Wu and Babcock, 1998).

The multinomial probit model (MNP) specification for discrete choice models does not require the assumption of the IIA (Hausman and Wise, 1978). A test for this assumption can be provided by a test of the 'covariance' probit specification versus the 'independent' probit specification, which is very similar to the logit specification. The main drawback of using the MNP is the requirement that multivariate normal integrals must be evaluated to estimate the unknown parameters. This complexity makes the MNP model an inconvenient specification test as the MNL model (Hausman and McFadden, 1984).

Similarly, unbiased and consistent parameter estimates of the MNL model require the assumption of independence of irrelevant alternatives (IIA) to hold (Negassa *et al*., 2012). The advantages of the MNL is, however, that it permits the analysis of decisions across more than two categories, allowing the determination of choice probabilities for different categories unlike the binary logit models and computationally simple than MNP (Madalla 1983; Tse, 1987; Wooldridge, 2002). Thus, in this study multinomial logit model was selected.

However, it was assumed that the different choices are associated with different levels of utilities for individual households reflecting their preferences for different coping strategies choices. Thus, the household's decision of whether or not to undertake adaptation strategies for climate change was considered under the general framework of utility or profit maximization (Deressa *et al*., 2008). The economic agents such as households are used adaptation options only when the perceived utility or net benefit from using a particular coping strategy was significantly greater than the option in the base category (Aemro *et al*., 2012; Zivanomoyo and Mukarati, 2013). In this context, the utility of the economic agents is not observable, but the actions of the economic agents could be observed through the choices they made. Let U_j and$U_k$represent households utility of coping strategies of option j and k respectively, the linear random utility model could then be specified as follows:

$$U_j = \beta'_j X_i + \varepsilon_j \text{ , for all j; i=1, 2 …N and } U_k = \beta'_k X_i + \varepsilon_k \text{ , for all k; i=1, 2 …N} \quad (1)$$

where U_j and U_k are perceived utilities of coping of options j and k, respectively, X_i is the vector of explanatory variables which influences the perceived desirability of each option; β_j and β_k are the parameters to be estimated, and ε_j and $\varepsilon_k$error terms assumed to be independently and identically distributed (Greene, 2003). For climate extremes coping strategies options, if a households decides to use option j, then it follows that the perceived utility or benefit from option j is greater than the utility from other options (say, k) depicted as:

$$U_{ij}(\beta'_j X_i + \varepsilon_j) > U_k(\beta'_k X_i + \varepsilon_k),\ j \neq k \quad (2)$$

Based on the above relationship, we could define the probability that households will use option j from among a set of climate extremes coping strategies as follows:

$$P(Y_i = j/X) = P(U_{ij} > U_{ik}) \quad (3)$$

Equation (3) can be simplified as:

$$P\left((\beta'_j X_i + \varepsilon_j) - (\beta'_k X_i + \varepsilon_k) > 0/X\right) \quad (4)$$

$$P\left(\beta'_j X_i - \beta'_k X_i + \varepsilon_j - \varepsilon_k) > 0/X\right) \quad (5)$$

$$\mathrm{P}\left(\beta^*{}_j X_i + \varepsilon^* > 0/X = \mathrm{F}(\beta^*{}_k X_i)\right) \quad (6)$$

Where, P is a probability function; $\varepsilon^* = \varepsilon_j - \varepsilon_k$ is a random disturbance term and $\beta^* = \beta^*{}_j - \beta^*{}_k$ is a vector of unknown parameters that can be interpreted as a net influence of the vector of independent variables influencing coping strategies and $\mathrm{F}(\beta^*{}_k X_i)$ is a cumulative distribution function of;ε^* *e*valuated at $\beta^*{}_k X_i$. The exact distribution of F depends on the distribution of the random disturbance term, ε^*.

To describe the MNL model, let *Y* denote a random variable taking on the values {1,2,…,J} for a positive integer *J*, and let *X*denote a set of conditioning variables. In this case, *Y* denotes options or categories of coping strategies, and *X*contains different households, institutional, and environmental attributes. The question is how, ceteris paribus, changes in the elements of *X* affect the response probabilities $\mathrm{Prob}(\mathrm{A} = \mathrm{j/x,}), \mathrm{j} = 0,1, \ldots, \mathrm{J}$. Because the probabilities must sum to unity, $\mathrm{Prob}(\mathrm{A} = \mathrm{j/x,})$ is determined once we know the probabilities for *j* = 2,...,*J*.

$$\mathrm{Prob}(\mathrm{A_i{=}j}) = \frac{e^{\beta_k X_i}}{\sum_{k=1}^{j} e^{\beta_k X_i}}, \mathrm{j} = 0,2 \ldots \mathrm{j}, \beta\mathrm{o} = 0 \quad (7)$$

Where β_j is a vector of coefficients of each of the independent variable X_i, β_k is the vector of coefficient of the base alternative; J denotes the specific one of the $j + 1$ possible unordered choice and A_j is the indicator variable of choices. The equation can be normalized to remove indeterminacy in the model by assuming the $\beta o = 0$ and possibilities can be estimated as:

$$\mathrm{Prob}(\mathrm{Ai} = \mathrm{j}) = \frac{e^{\beta_k X_i}}{\sum_{k=1}^{j} e^{\beta_k X_i}}, \mathrm{j} = 0,2, - - - \mathrm{j}, \beta\mathrm{o} = 0 \quad (8)$$

Where β'_j is$k \times 1$, j=2, …j

Estimating equation (8) yields the j log-odds ratio is given by:

$$ln\left(\frac{\partial P_{ij}}{\partial P_{ik}}\right) = X'_I(\beta_j - \beta_k) = X'_i\beta_j, if\ k = 0 \quad (9)$$

Note that the MNL coefficients are difficult to interpret and associating β_j with the j^{th} outcome is tempting and misleading. To interpret the effects of explanatory variable on probabilities marginal effects are derived (Green, 2003). The marginal effects, or marginal probabilities, are functions of the probability itself. It 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 (Greene 2000). The marginal effect is derived as:

$$\delta_j = \frac{\partial P_j}{\partial X_i} = P_j\left[\beta_j - \sum_{k=0}^{J} P_k\beta_k\right] = P_j(\beta_j - \bar{\beta}) \quad (10)$$

The signs of the marginal effects and respective coefficients may be different, as the former depend on the sign and magnitude of all other coefficients. Therefore, every subsector of β_j enters every marginal effects both through probabilities and through weighted average that appear in δ_j.

Coping strategies for climate extremes are a short term or immediate action taken to reverse the evil outcome of climate extremes. However, most of the coping strategies were became obsolete due to the expansion, coverage and/or increase intensity of drought impacts. In this study, about four coping strategies were suggested.

Finally, MNLM output indicated that pastoral and agro-pastoral income, livestock holding, access to credit, education status of household, sex of household head, market distance from homestead, early warning information and access to training are variables affecting the choices of coping strategies for climate extremes. The other variables including household size, distance of water from homestead and amounts of non-farm-non-pastoral income was not a detrimental factor that affects the decision to choose coping strategies. The multinomial outcomes strategy 1, strategy 2, strategy 3 and strategy 4, which could be defined as follow.

1. Strategy 1: Livestock diversification based coping strategies (heard splitting, changing species composition, destocking, livestock migration and grazing based on rotation between dry and wet season)
2. Strategy 2: Integrated crop-livestock diversification based coping strategies (Livestock diversification, early matured and drought resistant crop farming, hay making, conservation and feeding on crop residue, intercropping, temporal and spatial planting, dry soil seeding)
3. Strategy 3: Livestock diversification, water and rangeland management based coping strategies (Livestock diversification, water harvesting, water resources maintenance, bush clearing, communal grazing land management)
4. Strategy 4: Livestock diversification, income earning opportunities and strategic feeding system adjustment based coping strategies (borrowing money from friends or neibors, social insurance including *buusaa gonofa,* remmitance, depending on asistant from other relatives or aid organization, sending childreen to other realtives, labor work, charcoal and firewood sell and petty trades, reducing food intake, bleeding, feeding on wild fruits and roots)

Sex of household head (X1): In this study, sex has a significant and positive effects on the choices of coping strategies for climate extremes. The marginal effect indicates that the probability of households to choose coping*strategy 1 and* coping *strategy 2 f*or male-headed households is increasing by 0.02 and 0.44 at p<5% and p<10% respectively holding the value of other variables constant. Becasues, due to the physical and natural capability difference in male and female, the male households can choose strategy 1 and strategy 2 relatve to strategy 4 than female households for coping climate extremes. It is the women that were in most case employ startegieslike selling of charcoal and firewood, petty trades and strategic feeding system adujustiment such as feeding on wild fruit and roots, reducing food intake. This finding corraborate with other fiding (Temesgen *et al.*, 2009).

Education status of household head (X3): The result from multinomial logit indicated that access to education has significant and positive influences on the choose of coping strategy 3. As the household access to education, the probability of choosing coping *strategy 3* increass by 0.027 at a p<5% holding the value of other variables constant. This hints that the educated households are more sensitive for manging their environments by harvesting water and/or maintainig water resources to reduces water problems. Similarly, this hints that educated households practices bush clearing and grazing land managements to improve the access for grass and water than illitrate households. On the other hand, educated households chooses permanent establishment by improving its access to resources around their environment than illitrate households. This finding supports other imprical study (Tizale, 2007)

Table 1. *Parameter estimates of the MNLM of coping strategies.*

Variable	Strategy 1			Strategy 2			Strategy 3		
	ME	Coefficient (SE)	P-value	ME	Coefficient (SE)	p-value	ME	Coefficient (SE)	p-value
Sex of household head	0.000	2.72(1.36)**	0.05	0.444	3.37(1.15)***	0.00	-0.007	1.15(1.92)	0.55
Household size size	0.008	-0.05(0.19)	0.78	-0.020	-0.26(0.18)	0.15	0.001	0.22(0.25)	0.37
Education status of household head	0.076	0.70(1.02)	0.49	-0.133	-0.74(0.93)	0.43	0.027	3.18(1.62)**	0.05
Livestock size	0.002	0.18(0.09)**	0.05	0.004	0.13(0.09)	0.14	0.000	0.19(0.11)*	0.08
Market distance	0.001	0.05(0.03)	0.12	0.000	0.03(0.03)	0.35	0.000	0.07(0.04)*	0.07
Access to credit	0.025	2.31(1.09)**	0.03	0.052	1.84(0.99)*	0.06	0.004	3.34(1.51)**	0.03
Access to EWI	0.255	19.43(1.69)	0.99	0.542	5.24(1.32)**	0.00	0.012	18.68(1.12)	0.99
Water distance	-0.001	-0.07(0.05)	0.22	-0.001	-0.05(0.04)	0.23	0.000	-0.15(0.10)	0.12
Access to training	0.019	2.27(1.05)**	0.03	0.088	1.94(0.95)**	0.04	0.000	1.87(1.41)	0.19
Farm income	-0.001	-0.06(0.03)**	0.04	-0.001	-0.04(0.03)	0.15	0.000	-0.07(0.04)*	0.06
NFNP income	0.006	0.29(0.24)	0.23	0.003	0.17(0.23)	0.47	-0.001	-0.36(0.63)	0.57

Notes: SE (standard error) in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ ME: Marginal effect
Base outcome: Strategy 4

Log-Lik Intercept Only: -142.824
D(75): 177.169
McFadden's R2: 0.380
Maximum Likelihood R2: 0.586
Count R2: 0.553
AIC: 2.221
BIC: -183.745

Log-Lik Full Model: -88.585
LR(33): 108.479
Prob > LR: 0.000
McFadden's Adj R2: 0.044
Cragg & Uhler's R2: 0.650
Adj Count R2: 0.052
AIC*n: 273.169
BIC': 50.323

Size of livestock holding (X4): The MNLM result indicates that livestock size has a positive and significant effects on the the choice of coping *strategy 1 and coping strategy 3*. The marginal effect coefficient also indicates that as the livestock size increase by one TLU the probability of choosing *strategy 1 and strategy 3 increases by* 0.002 and 0.0001 at a p<5% and p<10% respectively holding the value of other variables constant. This finding coincides with the reality in Borana pastoralist where the strategies of heard splitting, changing species composition, destocking, livestock migration and season based grazing rotation is higher for the household with larger livestock holding. Additionally, the activities of livestock diversification, water harvesting, water resources maintenances, bush clearing, grazing land management and conservation is the foremost concern of household with larger livestock holding than households with lower livestock in study area. This finding also supports the other findings that higher livestock perceived to encourage livestock destocking (Temesgen*, 2010*).

Distances to Market (X5): From emprical study, the longer distance from the nearest market decrease the probabilities of farm adaptation in africa due to market provides an important platform for farmer to gather and take information (Maddison, 2006). However, the marginal effect result indicates that as market distance increase by one kilometer the probability of choosing *strategy 3* increases by 0.0001 at p<10% holding the value of other variables constant. Because, households at a furthest distance from the market need to improve their herd composition, water harvesting, water resources maintenances, bush clearing, communal grazing land management and conservation due to they could not sell their livestock at the time they need to sell as a coping strategy otherwise they could lose their livestock asset as a whole or partially. As a result, to reduce the impacts of the climate extremes, the households at a furthest distance from the market need to improves their access to water and forage resources in their environment to keep the body condition of their livestock.

Access to credit (X7): Access to credit has a significant and positive effect on the chooses of coping strategy 1, coping strategy 2 and coping strategy 3. The marginal effect coefficient indicates that as the household access to credit, the probability of choosing coping *strategies 1 and strategy 3 increases* by 0.025 and 0.004 at a p<5% respectively than the

households with no access to credit. Similarly, the probability of choosing coping strategy 2 increases by 0.052 as the household access credit at p<10%. Credit provides opportunities to engage in various coping strategies including livestock diversification based coping strategies, integrated crop-livestock diversification based coping strategies, livestock diversification, water and rangeland management based coping strategies; livestock diversification, income earning opportunities and strategic feeding system based coping strategies. It provides opportunities to purchases early matured and drought resistant crop, commercial feed, supplies for water harvesting, water resources maintenances, to finances bush clearing, grazing land management and petty trade. This finding corroborate with the finding of other where access to credit is an important determinant for enhancing the adoption of various strategies to coping with climate extremes (Tizale, 2007). It also supports with more financial and other resources at their disposal, households are able to make use of all the available options to change their management practices in response to changing climatic events (Yesuf *et al*., 2008).

Access to early warning information (X9): Access to early warning information has positive and significant effects on the decision to choose strategy 2. The marginal effect indicates that as households access EWI, the probability of households to choose *strategy 2* increases by 0.542 at a p<1% holding the value of other variables constant. It informs the households to prepare to cop with the climate extremes by livestock diversification, early matured and drought resistant crop farming, hay making, conservation and feeding on crop residue, intercropping, temporal and spatial planting, dry soil seeding. This finding supports the finding of others where people-centered early warning information systems empower communities to prepare for and confront the impacts of climate extreme events (Hassan and Nhemachena, 2008).

Access to training (X12): Access to trainig has a positive and significant effects on the chooses of strategy 1 and strategy 2. From Marginal effect results, as the household access to trainig the the probability of choosing*strategy 1* and *strategy 2 increases 0.019 and 0.088*respectively at a p<5% holding the value of other variables constant. This indicates that the households with access to training are more likely to take different coping strategies because they are informed of different alternatives in their environment to cope with the climate extremes.

Farm/pastoral income (X14): Pastoral/agro-pastoral income is negatively affects the pprobability to choose strategy 1 andpostively affects the probability of choosing strategy 3. From the marginal effect, as the income of household increase by 1000Birr, the probability of household to choose strategy 1 decreases by 0.001 at p<5%. Similarly, as the income of household increase by 1000Birr, the probability of choosing strategy 3 increases by 0.0001 at a p<10% holding the value of other variables constant. Higher income helps the households to invest on water harvesting and forgae improvements to cope with climate extremes since water and livestock feed is the most challenging during climate extremes which coincides with the finding of study in Borana (Dejene, 2014). This result also coincides with other finding where farm income has a positive and significant impact on conserving soil as adaptation strategy to climate change (Temesgen *et al*., 2009).

5. Conclusion and Reccomendation

This study was generally focus to understand the determinants of coping strategies of pastoral households for climate extremes in Yabello district where the district is highly vulnerable to climatic shocks. As a result, the conventional coping strategies were became weakened and ineffective to overcome the impacts of climate change due to environmental factors and socio-economic characteristics of the households. From the model results, sex of household head, education status of household head, size of livestock holding, market distance from homestead, access to credit, access to EWI, access to training and pastoral/agro-pastoral income are the variables that significantly affects the choices of coping strategies for climate extremes. From the coping strategies, the strategy that was associated with crop-livestock integration outweighs the preferences of sample households.

Integrated crop-livestock diversification based coping strategies encompasses the current increasingly practiced coping strategies than the other choices of coping strategies followed by livestock diversification based and livestock diversification, income earning opportunities and strategic feeding system based coping strategies. From the study result, sex of household head, size of livestock holding, access to credit, access to training and pastoral/agro-pastoral income are factors that significantly affects the choices of livestock diversification based coping strategy.

On the other hand, sex of household head, access to credit, access to early warning information, access to training and pastoral/agro-pastoral income significantly determines the choices of households for integrated crop-livestock diversification based coping strategies. Similarly education status of household head, size of livestock holding, market distance from their homestead, access to credit and pastoral/agro-pastoral income are the key determinants that affects the choices of for livestock diversification, water and rangeland management based coping strategies. Based on the result of this study, the following recommendation has rendered to improve the coping capacity of the pastoralists in Yabello district.

Improving access to market: Market is the major means of accessing financial resources and other necessities in Yabello district. However, as a distance increases it reduces the market participation of the households and drives the households to depend on their traditional practices. This could directly/indirectly exposes the households to climatic shock (risks) due to the households at a distances market are tough to access the market services. Thus, improving the access to market could have a significant role in improving the pastoral livelihood and in improving the traditional

livelihood system of the pastoralists within the frameworks of climate change. Otherwise, it would create a dependency syndrome if the impacts of climate changes and its outcome sustained beyond the coping capacity of the pastoral households.

Establishment of formal EWI centers and sophisticated delivery system: Early warning information is the key determinants of the choices of coping strategies where its helps to select the viable coping strategies. In Borana zone, there is no formal early warning information center to provide formally organized early warning information (EWI) persistently in Borana zone. As a result, the inaccurate conventional coping strategies are undervalue the acceptances of formal early warning information. Thus, establishment of pastoral focused EWI center with sophisticated methods of delivery system need further investigation and interventions. Most commonly, this will enable the household to adjust their production system based on the conditions of the coming climate events before the devastating consequence of climate extremes.

Improving access to training: Access to training alerts the consciousness of the households just as EWI but biased to practical path. However, still pastoralists were mostly dependent on their weakening conventional indigenous knowledge and inspiration than formal external mobilizations due to pastoralists commonly value their indigenous knowledge than external information due to its practical background. However, any training provided to the pastoral households need to improve or enhance their indigenous knowledge which will facilitate the adoption of provided training and information. Thus, to build the awareness of the community it needs a further investigation to recognize their indigenous knowledge, households' capacity and their need. Otherwise, the pastoralists' could provide superior attitudes for their endogenous knowledge, which is the major challenge in Yabello district.

Improving access to credit scheme: The formal credit system in Yabello district is not well developed in a ways that could available for the rural households. Mainly, due to the settlements and livelihood structure of the pastoralists, provision of credit for individual households needs a further research and policy investigation. Thus, the research focuses on economical ways of delivering and management of credit systems with appropriate investment opportunities needs further interventions. Thus, prior to practical credit interventions it needs a practical research on the provision and collecting of credit resources.

Improving livestock holding and income of the households: Improving income of the households would help the households to invest in various coping strategies to take over an opportunity to overcome the impacts of climatic challenges. However, it needs a further investigation on how to improve the income of the households followed by practical integrated interventions. Similarly, improving the livestock holding within the framework of carrying capacity of the rangelands need a further investigation of rangeland capacity because linearly increasing of livestock size has also its negative influence beyond the carrying capacity of the environment.

Acknowledgement

This work is possible with the financial grant from Council for the Development of Social Science Research in Africa (CODESRIA).

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