

# Traditional Coping Strategies of Borana Pastoralists for Climate Extremes: A case of Yabello District, Borana Zone, Ethiopia

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**Abstract** – This study was undertaken in Yabello district of Borana zone to identify the ongoing coping strategies of pastoralists in topical condition. The primary data collected from 123-sample households was analyzed using multinomial logit model. The major coping strategies most commonly used in study area were Livestock diversification based coping strategies, integrated crop-livestock based diversification based coping strategies, livestock diversification, water and rangeland management based coping strategies and Livestock diversification, income earning opportunities and strategic feeding system based coping strategies. The multinomial logit model result indicated that 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 determines among coping strategies for climate extremes. Generally, the pastorals' coping strategies for climate extremes inclined to a multi-choice coping strategies. Accordingly, establishment of formal early warning information, improving access to market, improving access to economic credit scheme, improving livestock ownership and income of the household would enhance the pastoral capacity to the employ a multi-choice coping strategies.

**Keywords** – Coping Strategies, Climate Change, Pastoralist.

## I. INTRODUCTION

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 [11]. Additionally, annual minimum temperature has been increasing and average annual rainfall has recently shown a very high level of variability [16]. In southern Ethiopia, it is the greatest threat to livestock production system, which recurrently erodes the livestock asset before full recovery achieved [1]. As a result, Borana pastoralists are much poorer today than they were in decades [2].

Furthermore, the traditional evidence from Borana pastoralists also suggests that drought cycles have shortened from 5-10 years to 3-5 years [14]. As a result, the reproductive performance of livestock have reduced to the lower level despite the fact that livestock mortality was increasing [10]. Though pastoralists were using different conventional coping strategies, today most of the coping mechanisms become less practicable in many ways [17]. 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 [19].

Moreover, most of the adopted strategies have become to be short-term considerations and survival needs, which directly or indirectly worsen the environmental degradation, lessen future adaptive capacity and livelihood options [18]. Recently, a single common conventional coping strategies are rapidly weakening to cope with the recent impacts of climatic threat [3]. Conversely, the magnitude and frequency of climate extremes is sporadically increasing overtime [25].

Thus, it need further attentions to build the coping capacity of the pastoralists to overcome the challenges of climate extremes. Otherwise, the future livelihood of the pastoralists of Borana zone costs beyond the current capacity of exiting interventions.

## II. RESEARCH METHODOLOGY

This study was undertaken in Yabello district is located in Borana zone, Oromia National Regional State to identify current coping strategies of Borana pastoralists for climate extremes and factors determining the choices among the coping strategies. It is located between the altitude of  $4^{\circ}30'55.81''$  and  $5^{\circ}24'36.39''$  N and the longitude of  $37^{\circ}44'14.70''$  and  $38^{\circ}36'05.35''$  E, at the central of Borana rangeland of southern Ethiopia [5].

The primary data were collected from sample households using a semi-structured questionnaire following stratified sampling technique. 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 [23].

$$n = \frac{N}{1+N(e^2)}$$

Where:  $n$  is the required sample size,  $N$  is population size and  $e$  is level of precision. Finally,

$$n = \frac{17516}{1+17516(0.09^2)} = 122.5927 \approx 123$$

In analyzing data, both descriptive statistics and econometric model was used. Multinomial logit model was used where 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 [24].

In the choices of categorical variables, 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 [27]. 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.

To describe the MNL model, let  $Y$  denote a random variable taking on the values  $\{1,2,\dots,J\}$  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  $\text{Prob}(A = j/x)$ ,  $j = 0,1, \dots, J$ . Because the probabilities must sum to unity,  $\text{Prob}(A = j/x)$  is determined once we know the probabilities for  $j = 2 \dots J$ .

$$\text{Prob}(A_i=j) = \frac{e^{\beta_j X_i}}{\sum_{k=1}^J e^{\beta_k X_i}}, \quad j = 0,2 \dots j, \beta_0 = 0 \quad (1)$$

Where  $\beta_j$  is a vector of coefficients of each of the independent variable  $X_i$ ,  $\beta_k$  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.

Estimating equation (1) yields the  $j$  log-odds ratio is given by:

$$\ln \left( \frac{\partial P_{ij}}{\partial P_{ik}} \right) = X'_i (\beta_j - \beta_k) = X'_i \beta_j, \quad \text{if } k = 0 \quad (2)$$

Note that the MNL coefficients are difficult to interpret and associating  $\beta_j$  with the  $j^{\text{th}}$  outcome is tempting and misleading. To interpret the effects of explanatory variable on probabilities marginal effects are derived [8]. The marginal effects, or marginal probabilities, are functions of the probability itself. It measures the expected change in probability of a particular choice being made with respect to a unit change in an independent variable from the mean [7]. The marginal effect is derived as:

$$\delta_j = \frac{\partial P_j}{\partial X_i} = P_j \left[ \beta_j - \sum_{k=0}^J P_k \beta_k \right] = P_j (\beta_j - \bar{\beta}) \quad (3)$$

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  $\beta_j$  enters every marginal effects both through probabilities and through weighted average that appear in  $\delta_j$ .

Table 1. Summary of coping strategies for climate extremes

Lvelhood activities	Strategy 1		Strategy 2		Strategy 3		Strategy 4		Total		$\chi^2$ -value
	N	%	N	%	N	%	N	%	N	%	
Pastoralists	1	7.14	9	64.29	3	21.43	1	7.14	14	11.35	11.22*
Agro-past.	24	25.26	46	48.42	5	5.26	20	21.05	95	77.24	
Farmers	2	21.95	10	71.43	0	00	2	18.70	14	11.35	
Total	27	21.95	65	52.85	8	6.50	23	18.70	123	100	

Source: Own survey

\* Significant at 10%

### III. RESULT AND DISCUSSION

#### A. Pastoral Coping Strategies for Climate Extremes

Borana pastoralists were using different conventional coping strategies traditionally. However, recently the dependency on one line driven coping strategies was challenged. From this study, a more combinations of coping strategies were choosing than a single line coping strategies from the suggested coping strategies (Table 1). To ease the discussion, the major coping strategies employed by Borana pastoralists was grouped in to four major groups.

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**Livestock Diversification only Based Coping Strategies (Strategy 1):** this strategy includes heard splitting, changing species composition, destocking, livestock migration and calf slaughtering. Herd mobility was among the most common conventional coping strategies that dictated by season and the availability of forage, as well as personal relationships, family structure, and immediate demands in search of water and pasture. However, in recent period the Borana now travel significantly greater distances to reach pasture and water. Moreover, traveling greater distances places extreme caloric demands on cattle and exposes them to disease. As a result, the choices related to herd mobility was chosen as a second option with only 22% of respondents (Table 1). Though the market as a mechanism (destocking-restocking) is another option, it is a problematic due to Borana pastoralists selling when they abject to save their livestock. This condition results in flooding of livestock into the nearby market with low market price. Additionally, though well-organized vaccination program as a tool of reducing drought risk was well applied in Borana zone, it cannot escape the pastoralist from drought hazard. Additionally, the livestock classification and grazing rotation to prevent land degradation and maintain family consumption need was common. They feed those livestock unable to move long distance, and those essential for their home family consumption such as shoat, milking cows and sick animals stays around homestead where others are migrated.

**Integrated Crop-livestock Livelihood Diversification Based Coping Strategies (Strategy 2):** This strategy includes livestock diversification, early matured and drought resistant crop farming, hay making, conservation and feeding on crop residue, intercropping, temporal and spatial planting and dry soil seeding. As an alternative and complementary with pastoralism, the households are increasingly participating in farming as compared to the last four decades where almost no households involved in cultivation [4]. This transition was encouraged at least in part by government policy promoting agriculture particularly among pastoralists who had lost. However, expansion of farmland contributes to the disruption of the traditional movement between seasonal grazing areas that rises attributed conflict over land and water resources. From survey result, more than 52% of the respondents were selecting this strategy as a top priority.

**Livestock Diversification, Water and Rangeland Management Based Coping Strategies (Strategy 3):** This strategy includes various strategies including livestock diversification, water harvesting, water resources maintenances, bush clearing, communal grazing land management and conservation, season based grazing rotation). To cope with severe shortage of water during severe droughts, the pastoralists have been digging shallow and deep wells on the dry season along riverbed and on the dry water pans. Even this strategy was not as such effective due to increase in the evapotranspiration which is difficult to manage traditionally.

**Livestock Diversification, other Income Earning Opportunities and Strategic Feeding System Based Coping Strategies (Strategy 4):** This strategy takes strategies like reducing food intake, bleeding, feeding on wild fruits and roots, borrowing money from friends or neighbors, remittance, depending on assistant from other relatives or aid organization, sending children to other relatives, labor work, charcoal and firewood sell and petty trades.

## B. Determinants of Coping Strategies

Coping strategies of pastoralists in Yabello district was enrich with a numbers of options. Though the pastoral community eager to survive its livelihood with all available options, different factors limits the the employment of the option. As a result, prioritizing from the existing option become the viable options. Finally, pastoralists were limited to a certain options of coping strategies which are today relatively better to reduce the effects of climate extremes. Thus, the MNLM was run to see the determinants of different factors that affects the choices among the coping strategies. However, due to the coefficients generated from MNLM guides only to the significant of the effect of the independent variables, the marginal effects was used. The marginal effect measures the expected change in probability of a particular choice being made with respect to a unit change in independent variables. The estimated coefficients were compared with the base category of strategy 4 [12]. The multinomial coefficient shows whether a given explanatory variable is significant and does not show the magnitude and direction of the effect of the independent variables on the wheat variety choices [15].

**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 for 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. Because, due to the physical and natural capability difference in male and female, the male households can choose strategy 1 and strategy 2 relative to strategy 4 than female households for coping climate extremes. It is the women that were in most case employ strategies like selling of charcoal and firewood, petty trades and strategic feeding system adjustment such as feeding on wild fruit and roots, reducing food intake. This finding corroborate with other finding [20].

Table 2. Determinants of pastoral coping strategies for climate extremes

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	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*

<i>Log-Lik Intercept Only:</i>	-142.824	<i>Log-Lik Full Model:</i>	-88.585
<i>D(75):</i>	177.169	<i>LR(33):</i>	108.479
<i>McFadden's R2:</i>	0.380	<i>Prob &gt; LR:</i>	0.000
<i>Maximum Likelihood R2:</i>	0.586	<i>McFadden's Adj R2:</i>	0.044
<i>Count R2:</i>	0.553	<i>Cragg &amp; Uhler's R2:</i>	0.650
<i>AIC:</i>	2.221	<i>Adj Count R2:</i>	0.052
<i>BIC:</i>	-183.745	<i>AIC*n:</i>	273.169
		<i>BIC':</i>	50.323

**Education Status of Household Head (X3):** Access to education has significant and positive influences on the choice of coping strategy 3. As the household access to education, the probability of choosing coping strategy 3 increases by 0.027 at a  $p < 5\%$  holding the value of other variables constant. This hints that the educated households are more sensitive for managing their environments by harvesting water and/or maintaining water resources to reduce water problems. Similarly, this hints that educated households practices bush clearing and grazing land managements to improve the access for grass and water than illiterate households. On the other hand, educated households chooses permanent establishment by improving its access to resources around their environment than illiterate households. This finding supports other empirical study [22]

**Size of Livestock Holding (X4):** Livestock size has a positive and significant effects on the the choice of coping strategy 1 and coping strategy 3. 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 herd splitting, changing species composition, destocking, livestock migration and herd splitting 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. This finding also supports the other findings that higher livestock perceived to encourage livestock destocking [21].

**Distances to Market (X5):** From empirical 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 [13]. However, result from this study indicated 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, specially, Especially, 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 otherwise they could lose their livestock asset as a whole or partially. Most probability, due to the pastoralists were traditionally struggling to save their livestock than early destocking, the

households at a distance market prefer to improve their environment.

**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. 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, involved in income earning opportunities and strategic feeding system based coping strategies. Generally, it provides opportunities to employ all possible coping strategies to overcome the devastating risk of climate impact. This finding corroborate with the finding of others scholars where access to credit is an important determinant for enhancing the adoption of various strategies to coping with climate extremes [22]. It also supports the finding that claims the households with more financial and other resources at their disposal are able to make use of all the available options to change their management practices in response to changing climatic events [26].

**Access to Early Warning Information (EWI) (X9):** Access to early warning information has positive and significant effects on the decision to choose strategy 2. As the households access EWI, the probability to choose strategy 2 increases by 0.542 at a  $p < 1\%$  holding the value of other variables constant. It indicates that the household with access to EWI is expected to prepare for the forthcoming climate risks by diversifying their livelihood as a strategy to diversify risks. This finding supports with the finding of others researchers where people-centred early warning information systems empower the communities to prepare for and confront the impacts of climate extreme events [9].

**Access to training (X12):** Access to training has a positive and significant effects on the chooses of strategy 1 and strategy 2. As the household access to training the the probability of choosing strategy 1 and strategy 2 increases by 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 advantages of 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 probability to choose strategy 1 and positively affects the probability of choosing strategy 3. As the income of household increase by 1000Birr, the probability of household to choose strategy 1 decreases by 0.001 at  $p < 5\%$ . Because, households with more income needs to protects their environment to access an important resources in their environment rather than migrating in search of these resurces. Thus, rather than migrating households with more income invest on their environment. Contrariwise, 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. The higher income helps the households to invest on water harvesting and forage improvements to cope with climate extremes since water and livestock feed is the most challenging during climate extremes. This result, coincides with other finding where farm income has a positive and significant impact on conserving soil as adaptation strategy to climate change [20].

#### IV. RECOMMENDATION

The traditional coping strategies of the pastoralists are currently delimited to sustain the livelihood of pastoralists as earlier epochs. Thus, the more combinations of coping strategies outweighs the attentions of the pastoralists today to safeguard their livelihood. However, 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 variables that significantly affects the choices of coping strategies for climate extremes.

Typically, income of the households determines the choice they will made. Improving the income of the households enables to employ more coping strategies to moderate the impacts of climatic challenges. Especially, building a sustainable livestock assets and management plays a crucial role in improving the income of the pastoralists within the framework of carrying capacity of the rangelands. Essentially, livestock is the major foundation cash, consumption, cultural heritages and social coherences of the pastoral community where it eases the efforts to build the income of households. In pastoral area, the expansion of credit market is very low however livestock is the only collateral for their livelihood risks.

Moreover, developments of formal credit scheme in pastoral area creates a great opportunity to employ numerous coping strategies. However, due to settlements condition of the pastoral community, intervention of the financial institution is very low besides problems of collateral prerequisite of credit delivery. So, provision of credit for individual pastoral households needs a further

research and pastoral policy investigation. Thus, the research focuses on economical ways of delivering and management of credit systems will demands further mediations prior to practical credit supply. Especially, access to credit breaks the financial scarcity problem during risks of climate extremes in pastoral area. Otherwise, the pastoralists are enforced to sell their livestock at the existing market inconsistent price.

The livestock price variability was also a biggest challenge especially during drought. However, pastoralists are culturally desire to save the life of their livestock rather than earlier destocking. Unfortunately, the price of livestock is much deteriorated during drought season which makes the household to sell more numbers of livestock to feed themselves. Thus, improving access to reliable market will helps the pastoralists to improve their income.

Particularly, developments of accessible early warning information will have a great role to reduce the impacts of climate extremes on the decision of coping strategy. However, besides language bars the delivery of early warning information was less developed in pastoral community. Notably, the effective early warning information will help the pastoralists to employ the numbers of coping strategies within their capacity. Especially, it enables the household to adjust their production system based on the conditions of the coming climate events before the devastating consequence of climate extremes.

The terrible thing is that still the pastoralists were mostly dependent on their weakening conventional indigenous knowledge and inspiration due to pastoralists commonly value their indigenous knowledge than external information. Thus, to build the awareness of the community it needs a further investigation to recognize their indigenous knowledge, households' capacity and their need.

Generally, there is no single promising coping strategy to overcome climate extremes in Borana zone. As a result, the more combinations of the coping strategies become the demand of most pastoralists unlike the earlier eras. However, the economic, financial, perception and access to public services and facilities limits the capacity of the pastoral community. Thus, it need a further policy investigation to improve the livelihood of pastoral community in Borana rangelands where drought, rangeland degradation and food insecurity is a challenging.

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