Households' Coping Strategies to Food Insecurity: Insights from a Farming Community in Aguie District of Niger

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Abstract

Niger is affected by recurrent production shocks leading the country into food insecurity situation at varying magnitude across regions. Farm households are the most affected because their livelihood relies on the agriculture sector that has the highest sensitivity to climate change. During a food shock period, households implement a package of strategies to mitigate their vulnerability from food shock. The objective of this study is to analyze households' coping strategies to food shocks. We randomly selected 160 heads of households from two villages in Aguie Department of Maradi Region. Probit model is also used to determine the effect of households' characteristics on the adoption of coping strategies. The study identified that households employed different coping strategies, among the most regularly employed are expenditure reduction (92.6%), smoothing consumption (66.40%), borrowing food or money (55.00%), waged labor (45.00%), and undesirable food consumption. The results reveal that the adoption of specific strategy depends on a household's livelihood strategy and its socio-economic characteristics. Results from probit analysis show that a household's decision to adopt a specific coping strategy is significantly influenced by gender, ethnicity, annual revenue, food production, livestock size, food stock, education, adaptive capacity, and number of meal per day.

Keywords: Adaptation, dry land, food security, livelihood, coping mechanism

1. Introduction

Agriculture is the key economic sector in Niger and a source of food supply to many vulnerable households. It contributes 45.2% of GDP and a source of livelihood to 85% of the population. Therefore, it is tough issue for achieving sustainable development. However, empirical studies revealed that agriculture is very sensitive to climate change impacts (rising temperature, rainfall variability) and these impacts are expected to become severe (McCarthy J.J, Canziani O.F et al. 2001, IPCC 2007, Dasgupta, Morton et al. 2014). As such IPCC (2007) considers climate change a fundamental threat to global food security and a significant hunger-risk multiplier.

FAO (1996) stated that: "food security exists when all people at all times have physical and economic access to sufficient, safe and nutrition food that meets their dietary needs and food preferences for an active and healthy life" (Maxwell 1996, Clay 2002). When the four dimensions (availability, access, utilization and stability) are stable we can say that community is food secure. However, climate change can destabilize all the four dimensions. For example declining crop yields can reduce the availability of food lead to food prices hikes and hence reduce food access. Actually, food availability and accessibility are the main drivers of food insecurity in many developing countries, especially sub-Sahara Africa where one out of four people, or 23.2 percent of the population, is estimated to be undernourished (FAO, IFAD et al. 2015). In Niger, food insecurity is mainly due to insufficient food production due to rainfall variability, land degradation, and diminishing returns of agricultural inputs as well as market opportunity. These factors combined with socio-demographic pressure, often intensify households vulnerability to food insecurity and poverty. The most affected are mainly small scale farmers because they have limited access to livelihood assets and hold low ability to cope with adverse effects of climate change impacts.

Notwithstanding, rural households have been attempting to adjust their livelihood in order to cope with diverse shocks and stress whether it's endogenous or exogenous. However, the decisions of households to adjust their practices and structures to avoid perceived impacts to things they value or to benefit from opportunities associated with climate shocks, depends principally to their livelihood strategy, the assets they have at their disposal and their ability to deal with new climate dynamic demands (Grothmann and Patt 2005). Despite the numeral farmers' responses to climate stimulus, yet, food insecurity remains big concern and continues challenging many vulnerable households. This situation attracts the attention of several development institutes that provide targeted assistance to the most vulnerable population groups. Direct interventions are viewed as the most effective solution for addressing vulnerable households' specific needs and improving the quality of their coping mechanism. However, knowledge of the processes by which individuals or communities actually cope or adapt to changes in conditions over time is key component for effective supports and strategies implementation (Yohe and Dowlatabadi 1999, Bryant, Smit et al. 2000). Yet, few studies argued the legitimacy of putting coping strategies firmly on the food security and famine mitigation agenda. Therefore, this study seeks to examine the behavior of farming households in coping with food insecurity in light of climate variability. Specifically, the

study: determine the households' livelihood strategies; analyze households' coping mechanism in response to food stress, and assess the factor affecting the adoption of specific coping strategy.

2. Literature review: Coping and adapting strategies

At all time people and community attempted to adjust their livelihood and cope with exogenous or endogenous stimulus, with differing level of success. The options employed for this adjustment are expected to have court or long term outcome. Adaptive behavior studies provide an insight on the processes by which individual households or communities adapt to changes in conditions over time (Yohe and Dowlatabadi 1999, Bryant, Smit et al. 2000). Adaptation is an adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts; its refers to changes in processes, practices, and structures to reduce potential changes or to benefit from opportunities associated with climate shocks (Smit and Pilifosova 2001). A first step would be to establish, at the conceptual level, the difference between adaptation strategies as short-term responses to abnormal conditions, and the process of permanent adaptation that brings about fundamental changes in the production systems concerned (Davies 1993). There is a tendency for 'coping strategies' to become shorthand for a complex web of processes at work, making for great confusion in identifying what is being talked about. Coping strategies are employed to reduce the impacts of shocks or stress and adaptive responses prevent future risks (Changnon, Changnon et al. 1997, Vincent, Cull et al. 2013). Hence, coping strategies tend to be ad hoc over shorter time period whereas adaptive responses are implemented over period of several decades. Coping strategies are therefore remedial actions and reduce the challenges of adaptation (Kelly and Adger 2000). Both of the responses are implemented in the same area and are constrained by economic, social, technological, institutional, and political conditions. From economic perspective, coping strategies may be more expensive than adapting strategy and vice-versa depending to context and nature material used but the effect of each interacts. For example, reforestation activities that planned to reduce greenhouse gases concentration would reduce the cost of coping strategies regarding the temperature decrease; however, adapting activities that require the use of emit greenhouse gases objects make coping strategy more costly.

3. Methodology

3.1 Study area description

The study was undertaken in the Aguie Department of the Maradi Region in south-central Niger. The research focused on two purposively selected local villages, namely Guidan Dan May Gari and Guidan Kodaou, located at 13°51′21″N and 08°18′12″E . The Department of Aguie covers an area of approximately 1794 km² and has a population of 245,996 people (INS 2014). The population density is approximately 137 inhabitants per km² (Aissétou 2010; INS 2014). The ethnic distribution of the population is predominantly Hausa (83%), while Fulani and Buzaye represent 10% and 6%, respectively. The main economic activities of the local community are herd grazing, agro-forestry, and crop production.

The climate of Aguie Department is Sahelian, characterized by distinct dry and rainy seasons. The rainy season usually starts in May or June and ends around August-September. According to Niger meteorological data, Aguie Department receives an average of 522 mm/year, and has an average minimum temperature of 21.6°C and an average maximum temperature of 35.8°C (INS 2014). However, there is a wide spatial and temporal variation in the annual rainfall received throughout the Aguie Department and this creates substantial challenges for farming productivity and results in inconsistency of supply of food to families and markets.

Indeed, the Maradi Region has been facing an acute food shortage mainly due to adverse climatic conditions that are making agriculture more difficult. The region is one of several in Niger that was severely impacted by the local food crises of 2005 and 2006 (Haglund et al. 2011). The region is also facing issues of land tenure and related conflicts, and consequently environmental degradation of common-use resources (Aissétou 2010). This situation has resulted in limited pastures especially in the dry season and often strong competition for pasture and water resources (Andres and Lebailly 2013). All of these factors increase the livelihood vulnerability of the people in the region (Kanta 2007). This situation has motivated several Non Government Organizations (IFAD, CARE International, and Save the Children) and Regional Development Institutions (FAO) to intervene in this area through numerous activities including farmer awareness-raising, training, and capacity strengthening for climate risks mitigation.

3.2 Sampling technique and data collection

The research used a mixed-method approach, combining qualitative and quantitative data. The approach focused on understanding households' coping mechanism. Research participants were selected using a multi-stage sampling approach. Firstly, the two villages were purposely selected with the help of local government rural development service, department of extension service, based on villages level of exposure to rainfall variability (rainfall distribution and parasites attacks), number of projects in the village, and culture diversity (based mainly on ethnicity). Guidan Dan May Gari village where no major projects were implemented was considered as

neutral, accounted for 226 households and Guidan Kodaou village characterized by frequent droughts and parasite attacks and diverse ethnicity (with different agriculture practice) had 220 households. A total of 80 households in each of the two villages were randomly selected based on the household lists provided by the local government. A reconnaissance visit was made to each of the villages to verify the accuracy of the random selection criteria. This survey was pre-tested on 10 key informant farmers who were chosen randomly, and the information collected served to amend the questionnaire accordingly. In the fifth and final step, 80 households from each village were randomly selected for surveying. The total sample of 160 households represents 35% of the households within the two villages.

The 160 household heads were interviewed between March and June 2016. The data collection tools included semi-structured questionnaires interviews, and resource mapping complemented by background information obtained from local administrations and Non-Government Organizations (NGOs) including documentation on their development projects. The questionnaire covered topics including household socio-demographic and economic characteristics (i.e. ethnic group; the number, gender and schooling levels of household members; the age, level of schooling and profession of the household head; years of farming experience; membership to a farmers association; receipt of aid from an institution; and the household's annual income from different sources [agriculture, livestock, forestry, trade, wage labor, remittances from migrated family members and credit]), farm characteristics (i.e. farm size, type and number of animals, soil fertility appreciation, type and production volume for each crop), and farmers' coping mechanism to food stress (i.e. smoothing consumption, expenditure reduction, income diversification activities, small trade, wage labor, undesirable food consumption, assets selling, borrow food or money, exodus). The farmers were also asked to rank in order their 5 main income sources. All interviews were conducted in the local language (Hausa). The data from individual interview were recorded using field notes. The choice of dependents and independents variables was based on literature review and data availability on the field.

3.3. Data analysis

The qualitative data were edited and coded in Microsoft Excel. Both qualitative and quantitative data were analyzed using the Statistical Package for Social Scientists (SPSS version 21.0). Descriptive statistics were used to summarize the data distribution into means, frequencies and percentage (%), and these results were reported as figures, and tables. K-Means cluster analysis was run to categorize the households into 6 strategic groups based on the productive assets (farm size, and the number of animal in terms of tropical livestock units [UTL]), the main source of income (share of income from each activities), and main occupational activities. Statistical (inferential) analysis was undertaken using Probit regression to determine the influence of farmer characteristics and different land-use activities on the adoption of coping strategies. We denote Y_{ij} as the dependent variable, i.e., the adoption of j food insecurity coping strategies adopted by households in the study area; X_{ij} is a vector of independent variables used in the study which are the farmers' characteristics; β_i is the vector of binary regression coefficient and ε_{ij} is the intercept.

The empirical model is written as:

$$y_{ij}^* = \beta_0 + \sum \beta_0 X_{ij} + \varepsilon_{ij} \ (Eq_1)$$
$$y_{ij} = \begin{cases} 1 \ if \ y_{ij}^* > 0 \\ 0 \ if \ y_{ij}^* \leq 0 \end{cases} (Eq_2)$$

Y_{ij}^* is directly an unobserved latent variable. All we observe is Y_{ij}, a binary variable that equals one if a specific strategy is adopted and zero otherwise. A farm household (i) will adopt strategy j ($Y_{ij} = 1$) if the expected benefit is greater than zero ($Y^*_{ij} > 0$) and otherwise if the expected benefit is equal to or less than zero ($Y_{ij} = 0$, $Y^*_{ij} \leq 0$). The model is estimated using Maximum Likelihood Estimation (MLE) technique.

4. Results and discussion
4.1 Description of households' socio-economic characteristics

The results presented in Table 1 show that the majority of household heads are males (88.80%) and 91.30% of the interviewed households are from the Hausa ethnic group, with only 8.70% from the Fulani ethnic group. Cluster analysis results reveals that the majority of households are agro-pastoralists (86.87%) followed by farmers (25.63%).

Table 1: Households livelihood strategies and characteristics

Variables	Scales	Frequency	Percent %	Income $	UTL	Farm size ha	Production kg
Livelihood	Pastoralists	6	3.75	5965	14.33	8.92	3260
strategies	Farmers	41	25.63	1475	1.75	4.66	1577
	Agro-pastoralists	75	46.87	1293	2.57	3.56	906
	Public employees	8	5.00	2972	1.78	2.75	922
	Entrepreneurs	20	12.50	893	1.44	2.70	875
	Wage employees	10	6.25	856	0.88	2.70	913
Gender	Males	142	88.80	1562	2.58	3.93	1191
	Females	18	11.20	1200	2.01	3.17	945
Ethnicity	Hausa	146	91.30	1347	1.78	3.81	1130
	Fulani	14	8.70	3346	10.15	4.18	1520
	Total	160	100	1522	2.51	3.84	1164

Descriptive analysis indicate that the average households' farm size and crop production volume are respectively 3.84 ha, and 1164 kg. The average of UTL and per capita income are respectively 2.51 and 1522$. However, the distribution of these indicators varies according gender, ethnicity, and livelihood strategies. According to gender, households headed by men have the highest average score indicator and regarding ethnicity, Fulani have the highest average score of indicators. Table 1 results reveal that pastoralists have the highest farm size (8.98 ha), UTL (14.33), crop production (3260 Kg), and per capita income ($5965). Farmers are the second larger farm size holders (4.66 ha) and food producers (1577 kg), whereas agro-pastoralists are the third larger in terms of farm size (3.56 ha) and food production (906kg). Public service employees are ranked second in terms of per capita income ($2972) while entrepreneur households hold the lowest food production (875 kg), and the wage employees the lowest UTL (0.88), and per capita income ($856).

4.2 Households' coping strategies for food insecurity
Coping mechanism is a process through which a household employs it ability to deal with the effects of a given shock. The coping mechanism employed by households depends on shock nature and extent as well as households' adaptive capacity and the assets they have at their disposal. Usually households employ a combination of strategies in responding to a crisis. This study attempts to review the most frequent coping strategy employed by households to cope with food stress. The results are presented in Table 2.

Table 2: Summary of the frequent strategies employed by households to cope with food stress.

Scale	Exodus	Assets selling	Undesirables food use	Borrow food or money	Wage labor	Small trade	Reduce expenditure	Reduce consumption	Transhumance
Not at all	70.00	70.00	64.40	45.00	55.60	71.20	7.40	33.30	98.75
Occasionally	13.10	10.40	8.80	21.90	13.10	12.50	42.60	19.50	0.00
Often	10.60	6.20	8.80	22.50	18.10	7.50	23.00	30.80	0.62
Usually	6.30	13.40	18.00	10.60	13.20	8.80	27.00	16.40	0.63

Table shows that most frequent strategies employed by households are expenditure reduction (92.6%), smoothing consumption (66.40%), and borrow food or money (55.00%). Households reduce expenditure by prioritizing their purchases. The frequency of this strategy implementation depends to the extent to which household is affected by the shocks as well the shocks duration and the food households have at their disposal. Likewise, households often implement the strategies of smoothing consumption or borrowing food or money to buy food. Smoothing consumption includes the adjustment of per day number of meals (73.12%) or the quantity of food consumed (86.87%). Börner et al. (2015) reported that in response to climate-related shocks, households are more likely to reduce their consumption (Börner, Shively et al. 2015). Some households also explore social net works borrowing food or money to buy food from relatives, traders, or warrantage association. Alinovi et al. (2009) have similar findings, they argued that the primary strategies employed by households when facing a food shock are smoothing consumption, reducing non essential expenditure (Alinovi, Mane et al. 2009).

Households' coping strategies include also assets selling, small trade, waged labor, and migration. Aïssetou and Boureima (2006) reported that in the various regions of Niger six types of coping strategies are predominant including animals' selling, petty trade, sale of others personal assets, agricultural wage labor, recourse to solidarity networks, and the migration. Assets selling strategy is assumed to be the most frequent strategy used by the households. Surprisingly, the results reveal that few households (30.00%) are selling assets in the process of coping mechanism. There is evidence that households during food stress, preferred to preserve their assets (animals, farms, seeds) and endure the shocks by exploring others alternative strategies until a certain degree of hunger when all the options have been reached. Even reaching the critical threshold, households prefer to exchange their capital with another same or lesser economic value and use the extra money to purchase food or to undertake a revenue-generating activity. Our findings are in line with De Wall (1990) and Corbett (1988)

results who found that during food insecurity, households prioritized the preservation of assets and go several days hungry (Corbett 1988, De Waal 1991).

The study reveals that few households employed the strategies of waged labor (44.40%), undesirable food consumption (35.60%), migration (30.00%), and small trade (28.80%). Undesirable food consumption consists of eating non-favorite or wild food items not consumed in the normal situation whereas waged labor comprises mainly agriculture waged labor. Aïssetou and Boureima (2006) reported that in Maradi region, households are more likely to engage in agriculture waged labor when primary strategies such as consumption reduction collapsed.

Livestock coping responses include also the strategy of transhumance, which, is the regular movement of herds with their animals between fixed points to exploit seasonal availability of fodder (Blench 2001). This strategy is very traditional but is still viewed as effective to respond to shock and stress. The study reveals that 1.25 % of household employs the strategy of transhumance. Alinovi et al. (2010) and Zampaligré et al. (2014) reported that some farmers are more likely to migrate with their animals for seasonal grazing or in search of water source to cope with extreme climate evens (Alinovi, D'errico et al. 2010, Zampaligré, Dossa et al. 2014).

4.3 Households' coping mechanism by livelihood strategies

To better understand households' ability to cope with food stress, the study attempts to analyze households coping mechanism by livelihood strategies. Figure 2 shows the frequency of households' responses.
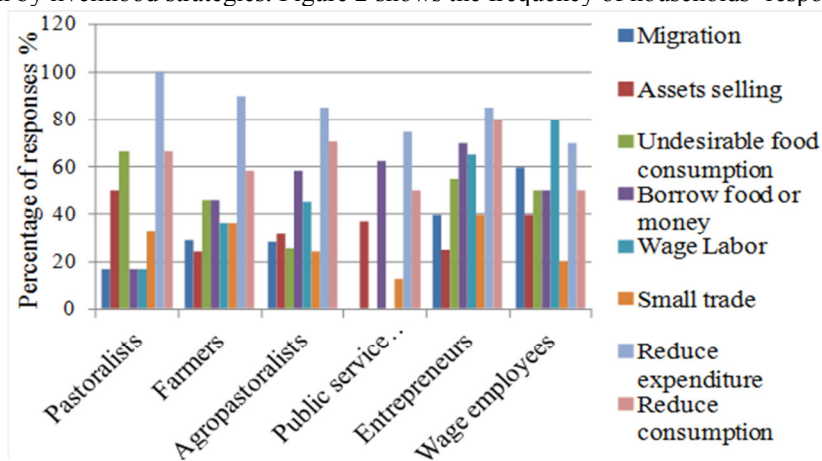

Figure 2: Households' coping strategies by livelihood group

The results reveal that when households face food stress, they start by reducing the non-essential expenditure associated with consumption reduction (reducing the number and or the quantity of daily meal). Public service employees combined expenditure reduction (78.00%) and borrowed food or money (62.00%) whereas waged employees prefer to engage in wage labor (80.00%) and reducing expenditure (70.00%). The results reveal also that pastoralists in spite of the high ownership of assets, prioritize the consumption of undesirable foods (66.67%). However, 50.00% of pastoralists sell assets to buy food during a food shortage period. However, within the community, pastoralist group has the highest percentage of households employing the strategy of selling assets. They are less engaged in migration (16.67%), borrow food or money (16.67%), and wage labor (16.67%) because of their isolation from the village and thus deprived from the social network opportunities to benefit from loan and / or paid labor.

Importantly, the results reveal also that public service employees implement few strategies 5 out of 8 strategies) compare to entrepreneurs and waged employees (8 out of 8). In the study area, it does appear that the more the household is vulnerable, the more they diversify their coping strategies. Therefore, specific attention must be given to entrepreneurs and waged employees.

The study indicates that only pastoralists are employing the strategy of transhumance and even within pastoralist, only 34.00% are still using this strategy. Transhumance is assumed to be Fulani ethnic practice enabling them to cope easily with shocks and stress, and reduce livestock losses (Seo 2010, Crane, Roncoli et al. 2011).

4.4 Factor influencing the adoption of coping strategies

The knowledge of factors influencing the adoption of households coping strategies are very important to understand the dynamism of households to cope with shocks as well as for policy support. Probit model was used to assess the influence of selective variables on the different coping strategies. The results are summarized in Table 3.

Table 3: Influence of selected socio-economic characteristics on coping strategies adoption

Modal	Variables	Estimate	Std. Error	Z	Chi-square
Migration	Food coverage	-0.058*	0.035	-1.672	194.85
	Food aid	0.243***	0.080	3.044	(N=160)
	Intercept	-0.887	0.255	-3.478	
Assets selling	Ethnicity (Hausa = 0)	-1.040*	0.475	-2.192	173.45
	Education level	0.231*	0.091	2.539	(N=160)
	Strategies score	-0.102*	0.043	-2.396	
	Adaptive capacity	0.263**	0.101	2.606	
	Livestock	0.059*	0.030	1.955	
	Intercept	0.009	0.531	0.017	
Undesirable food consumption	Household size	0.029*	0.017	1.658	147.15
	Education rate	-0.898*	0.421	-2.131	(N=160)
	Strategies score	-0.133**	0.049	-2.726	
	Soil fertility (Less fertile = 0)	0.289*	0.119	2.422	
	Intercept	-1.019	0.454	-2.246	
Borrow	Gender (Male = 0)	0.909***	0.249	3.647	181.66
	Ethnicity	-1.179***	0.444	-2.655	(N=160)
	Education level	0.155*	0.083	1.857	
	Food stock	0.000*	0.000	-2.058	
	Daily meal	0.320**	0.118	2.716	
	Intercept	-1.446	0.659	-2.194	
Wage labor	Income source diversification	0.251**	0.096	2.623	159.41
	Adaptive Capacity	-0.067*	0.092	-0.732	(N=160)
	Revenue	0.000**	0.000	-2.685	
	Intercept	-1.897	0.431	-4.397	

*, **, and *** denotes significance level at 10%, 5% and 1%. Only significant results are reported

The strategy of migration is influenced negatively by food production and positively by food aid. A unit increase in household food production decrease the likelihood of the strategy adoption by 5.80%. This implies that the more the household produce, the less the chance for a household to leave for migration. The positive sign of food aid implies that the household who has members engaged in migration are more likely to receive food aid. This is because the household with low food production (food insecure) are the target of food aid and as explain above, the less the household produces, the more likely a member leaves for migration. The results reveal that Fulani are 3 times more likely to adopt selling assets strategy than Hausa. The strategy of asset selling is also positively influenced by education level, adaptive capacity and the size of livestock. Obviously, the households employing few coping strategies are more likely to sell their assets in the process of coping mechanism. This is the case of public service whose livelihood relies less on agriculture sector.

The results show that undesirable food consumption strategy is negatively influenced by household education rate and strategy score. The household who has the higher rate of education are 2 times less likely to use undesirable food for consumption and the household with higher strategy score are 3 times less likely to consume undesirable during the shocks.

Gender, ethnicity, and education are assumed to significantly influence the borrowing food or money. The results reveal that women-headed household, Hausa ethnic group, and household head with higher education are more likely to access to credit service in terms of food or money. The results reveal also that the households with more than 3 daily meals are more likely to borrow food or money.

The results indicate a negative association between waged labor, adaptive capacity, and revenue. Households with less adaptive capacity and/or have less revenue is more likely to engage in waged labor. Additionally, the results show that waged labor employees are more likely to engage in income diversification activities. This is because of their higher sensitivity to shock mainly due to their lower adaptive capacity.

In general households' capability to change what they do to cope with specific shocks, is influenced by their socio-economic context such as demography, education, caste, ethnicity, assets, production, revenue and land tenure (Shaw 1974, Ellis 1998). Some empirical studies attempted to determine the influence of these characteristics on strategies implementation (Maxwell, Ahiadeke et al. 1999, Laraia, Siega-Riz et al. 2006). For example Zampaligré et al. (2014) found that size of cattle have positive influence on transhumance and Bryan et al. (2013) found that food or other aid received have negative influence on destocking (Bryan, Ringler et al. 2013)

Conclusion

This study attempted an analysis of households' coping strategies for food insecurity. The different coping strategies were reviewed and the study identifies expenditure reduction (92.6%), smoothing consumption (66.40%), borrowing food or money (55.00%), waged labor (45.00%), and undesirable food consumption as the frequent strategies employed by households. The results reveal that the adoption of specific strategy depends on

household's livelihood and its socio-economic characteristics. Depending on livelihood strategies, the study show pastoralists (50.00%) and wage employees (80.00%) are respectively more likely to apply assets selling and wage labor whereas the majority of entrepreneurs (70.00%) and public service (62.00%) preferred to borrow food or money. Regarding households' characteristics, results from probit analysis show that household's decision to adopt a specific coping strategy is significantly influenced by gender, ethnicity, annual revenue, food production, livestock size, food stock, education, adaptive capacity, and number daily meal.

In the light of this analysis, it appears that most of the existing coping mechanisms are used to ensure immediate food access for households, but their short duration does not allow for the recovery of the most affected households by recurrent shocks.

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