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# Small-scale farmers' coping strategies to extreme weather events in Upper Guinea

Demba Aïssata Samoura [a,b,*], Bolanle Wahab [c], Olalekan John Taiwo [d], Alpha Issaga Pallé Diallo [e], Obadia Kyetuza Bishoge [a,f]

[a] *Pan African University of Life and Earth Sciences Institute (Including Health and Agriculture), Ibadan, Nigeria*
[b] *Faculty of Sciences and Techniques, University of N'Zérékoré, N'Zérékoré, Guinea*
[c] *Department of Urban and Regional Planning, University of Ibadan, Ibadan, Nigeria*
[d] *Department of Geography, Faculty of the Social Sciences, University of Ibadan, Ibadan, Nigeria*
[e] *Centre for Environmental Studies and Research, Gamal Abdel Nasser University, Conakry, Guinea*
[f] *National Institute for Medical Research, Dar es Salaam, Tanzania*

**Abstract**

Extreme weather events pose a serious threat to subsistence farming and food security in Upper Guinea, where most farmers rely heavily on rain-fed agriculture. Following crop failures, farmers use what is available to them to try to maintain household food security. This paper investigated the coping strategies chosen by farmers in Upper Guinea and the motivating factors behind them. A multistage sampling method was used to select a purposive random sample of 1,500 farm households within nine selected livelihood zones (Bassando, Dion-Niandan Inter-River, Fié basin, Foutanian Piémont, Kolokalan High Valley, Middle Plateau, Solima's High Plateau, Soudanese Plateau and Woulada plateau) of Upper Guinea affected by extreme weather events. Approaches including household surveys, focus group discussions, key informant interviews and field observations were used to collect data. The multivariate probit regression (MVP) model was used to identify factors influencing small-scale farmers' choice of coping strategies during periods of extreme weather events. Results from the MVP model showed that differences in the perception of risk factors and socioeconomic characteristics of farm households determined these choices. The main factors motivating farmers' choice of coping strategies were awareness of extreme weather events, gender, the experience of crop failures, and ownership of assets. Other factors such as age, farming experience, household size, and educational level, were also determinants of farmers' choice of coping strategies. Local institutional support to farmers that could drive widespread adoption of climate-smart agriculture could improve livelihood production and community resilience in this region.

*Keywords:* drought, flood, livelihood, resilience, sustainable livelihoods

## 1 Introduction

Millions of African farmers are experiencing difficult living conditions because of extreme weather events that reduce agricultural output and destroy man's properties (Kumssa & Jones, 2010). However, from the Hyogo framework for action 2005-2015 to the Sendai framework for disaster risk reduction (DRR) 2015-2030, African States still face key challenges in implementing strategies put in place to address their respective concerns and face global environmental disturbances (Nicodemus & Dennis, 2021). DRR strategies have been underway for years but efforts to build resilience have failed as most of the countries lack financial, institutional, and technical capacities to deal with climate change-induced disasters (Manyena, 2016). Hence, dealing with climate change (CC) and its subsequent consequences is the most serious development challenge of several African countries especially in sub-Saharan Africa (SSA) (Codjoe & Atiglo, 2020).

* Corresponding author – samoura.demba@paulesi.ng.org

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Guinea is sensitive to extreme weather events induced by CC and its capacity to successfully cope or adapt to the current changing environment remains weak and uncertain as it does not have any DRR strategies in place (Van Niekerk *et al*., 2020). The agricultural sector which employs nearly 80 % of the economically active population, mainly driven by small-scale farmers is the most affected (Guinean government [GG], 2018). However, the country's economic progress depends on the performance of the agricultural sector, which contributes 20 % to the national GDP (World Bank, 2018). Simultaneously, enduring poverty exacerbated by poor basic services, limited market access, and the absence of infrastructure for production, has led to rural-urban migration and limited rural economic development initiatives (African Development Bank Group, 2018).

Upper Guinea is known as the most climatically vulnerable area in Guinea, as it is frequently hit by weather-related hazards such as bushfires, drought, flood, and high temperatures, which severely affect the production and food security of the population (United States Agency for International Development [USAID], 2017). Among the four regions that make up Guinea, Upper Guinea records the highest mean annual temperature (more than 37 °C during the dry season) and the lowest mean annual rainfall which is unevenly distributed (1200 mm in the northern part and 1600 mm in the southern part). This region is also swept from east to south by a hot and dry wind known as Harmattan (Kante *et al*., 2019). These factors, combined with communities' heavy dependence on forest resources, have led to significant damage to soil quality and negative vegetation dynamics, resulting in frequent flooding after rains and drought episodes (Guinea-United Nations Framework Convention on Climate Change [Guinea-UNFCCC], 2015). Although this area accounts for 39 % of the country's land area and is home to most of the country's farmers, food production is still far from meeting consumer demand, and the share of rice imports, especially from China and India, is increasing at an alarming rate (Koivogui *et al*., 2018). Frequent crop failures, mainly due to adverse climatic conditions, rainfall disruptions and failure to monitor and manage extreme weather conditions, worsen the socioeconomic conditions of rural households, particularly those with limited resources and capacities (Harvey *et al*., 2014; Coulibaly *et al*., 2015; Dube *et al*., 2018).

Crop failures lead to household food shortages and constrain farmers to find suitable coping strategies to ensure and maintain food security and good nutrition within households. The adequacy and efficiency of farmers' coping mechanisms depend on numerous socio-economic factors which understanding is critical in designing tailored policy interventions or adoptions of technological options (Rakgase & Norris, 2014; Umar *et al*., 2019). While farmers' perceptions and adaptation behaviours have received much attention in CC scientific debates (Limantol *et al*., 2016; Singh & Chudasama, 2017; Aniah *et al*., 2019; Oyebola *et al*., 2020; Dakurah, 2021), coping strategies which allow farmers' to generate income and adapt to climate change remain poorly explored. Moreover, the site-specific diversity of coping options requires more scientific evidence to provide useful information to inform policy decision-making.

In the context of unforeseen climate events, asset-based coping strategies significantly contribute to the alleviation of rural farm households' food insecurity (Chagomoka *et al*., 2016) while its analysis helps to enhance the resilience of the farming sector (Bahta, 2020). To date, no study has been conducted in Guinea, particularly in Upper Guinea, on factors influencing households' decisions to adopt risk-coping strategies. Therefore, this study is the first to specifically address farmers' coping strategies under adverse climatic conditions in Guinea. Hence, this paper identifies the determinants of farmers' choice of coping strategies and provides policy and decision-makers with targeted recommendations to address farmers' most pressing development needs to improve resilience at the local level.

## 2 Materials and methods

### *2.1 Study area*

Upper Guinea (Fig. 1) is the third national geographic region of Guinea after Lower- and Middle Guinea and followed by Forest Guinea. Its location on the western edge of Niger's River vast basin offers small-scale farmers suitable conditions for agricultural production through floodplains. Moreover, it is made up of seventeen livelihood zones (LZs) covering 70,000 km² of cultivable land where farmers practise rain-fed agriculture, using the production mainly for subsistence and selling the surplus on the local market, the proceed of which is used to buy other needs (Institut de Recherche Agronomique de Guinée [IRAG], 2001; Holt, 2016). As a very fragile area, the whole region will continue to be marginalised due to the new climatic conditions combined with rapid population growth putting greater pressure on renewable resources (Kante *et al*., 2019).

### *2.2 Household survey*

A multi-stage sampling technique was used to select communities under study. First, out of the seventeen LZs that make up Upper Guinea, nine LZs that are most affected

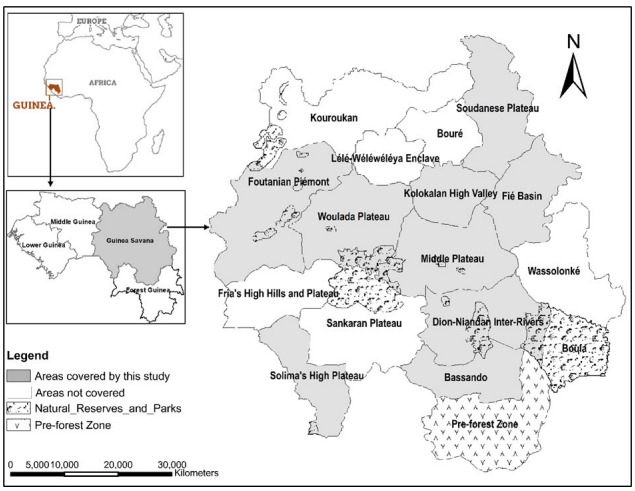


**Fig. 1:** *The location of the study area in Guinea showing also the livelihood zones of Upper Guinea. Source: Adapted from Institut de Recherche Agronomique de Guinée (2001).*

by extreme weather events were selected: Bassando, Dion-Niandan Inter-River, Fié basin, Foutanian Piémont, Kolokalan High Valley, Middle Plateau, Solima's High Plateau, Soudanese Plateau, and Woulada plateau. Within each selected LZ, rural communities (RCs) at high risk due to their proximity to flood-prone areas and or susceptible to drought were selected based on guidance provided by local environmental bodies and the coordinators of humanitarian affairs. As a result, twenty-two RCs with 548,153 individuals were considered as the study population. From these individuals, a purposive sample of 1,500 households was chosen as for a population of over 150,000 inhabitants, a purposive sample size of 1,500 households is required (Neuman,1991). Population sizes were used for estimating sample sizes rather than household sizes due to inconsistencies in existing households' data. Moreover, the choice of affected communities was made under the guidance of local environmental bodies and humanitarian affairs coordinators while affected farming households were identified based on community leaders' guidance. Based on the purposive sample of 1,500 respondents, a probability proportional to size sampling (PPS) method was performed to determine each community's sample size within each selected livelihood zones. To ensure reasonable repartition of the total population as communities differ in the number of inhabitants, the 1,500 individuals were ventilated across selected LZs by using equation 1.

$$S_i = \frac{(N_i * 1,500)}{\text{Total population of the selected LZs}} \qquad (1)$$

Where $S_i$ determines the number of households selected by livelihood zones and $N_i$ represents each livelihood zone's total population. Table 1 gives the obtained results from equation 1.

**Table 1:** *Sampled households' distribution by livelihood zones.*

| *Livelihood zones* | *Sample size* |
|---|---|
| Bassando | 41 |
| Dion-Niandan inter-river | 108 |
| Fié basin | 153 |
| Foutanian Piémont | 188 |
| Kolokalan High Valley | 306 |
| Middle plateau | 374 |
| Solima's high plateau | 50 |
| Soudanese plateau | 215 |
| Woulada plateau | 65 |
| Total | 1,500 |

Source: Adapted from National Institute of Statistic-Guinea (2021).

The selection of households or individuals as respondents within the locations or RCs was based on systematic sampling as there were no population lists in the areas under study. Households were selected by walking through the locations and visiting the houses at pre-determined intervals, according to the sample size required in each location (Table 1).

Closed-ended and open-ended questions were used to collect data from respondents. To minimise inconsistency in data, respondents under 40 years of age and unmarried respondents were excluded as they may not have extensive farming experience and in particular may not be compelled to engage in coping mechanisms (Umunnakwe and Olajide-Adedamola, 2015). Within each household, the household's head either male or female responded to the questionnaire. Questionnaires were completed on farmers' accessible coping strategies, sociodemographic characteristics, and economic conditions. In addition, focus group discussions (FGDs) and key informant interviews (KIIs) were used to gather additional information that could not be obtained from household surveys. The relevant members were selected on the base of their in-depth farming experience and knowledge of their environment. The FGDs were attended by 8-12 persons per community, depending on gender, and consisted of various community members including farmers, religious leaders, community kings, farming organisations, and school teachers. In each community, two farmers were selected as KIIs based on their significant and relevant contributions to the debates on issues raised at the FGDs.

From the centre to the northern part of the study area, the local language Maninka was used for data collection, while

in the southern part, the language Djallonka was used to collect data. Additionally, direct field observations were conducted to obtain further information on local agricultural activities and resources.

### 2.3 Data analysis

Household survey data were first recorded in Ms Excel version 2019 and then coded for descriptive and inferential statistics. Descriptive statistics were used on households' socio-demographic characteristics to generate frequency tables, mean and standard deviation for analysis purposes whereas the multivariate probit (MVP) model was used to identify explanatory factors which were likely to influence farmers' choices of coping strategies. The MVP model was preferred to account for independence between practices as farmers might adopt more than one coping strategy and these may be ex-ante coping strategies and ex-post coping strategies (Coulibaly *et al*., 2015). The ex-post coping strategies include borrowing money or food, casual labour, small-scale mining, small trade and business, selling household assets, purchasing food from the market and expecting help from relatives, while ex-ante coping strategies were only fishing and gathering wild food (Table 2). Following Kangogo *et al*. (2021), the MVP regression model used is described by a set of dummy dependent variables $Y_{ik}$ as follows:

$$Y_{ik} = X_i\beta_k + \epsilon_i, \quad k = 1, .....8$$
$$Y_k = \left\{ \begin{array}{c} 1 \; if \; Y_{ik}^* > 0 \\ 0 \; otherwise \end{array} \right\} \quad k = 1, .....8 \tag{2}$$

Where $k$ represents farmers' choice of coping strategies including borrowing money, casual labour, fishing/gathering wild foods, small-scale mining, small trade and business, selling household assets, purchasing food from the market, and expecting help from relatives practised by $i^th$ farm household. $Y_{ik}$ is the latent variable determined by unobserved explanatory variables $X_1, X_2, X_3, \ldots X_i$. Then, $\beta_k$ and $\epsilon_i$ are respectively the vector of parameters to be estimated and the error term.

In the context of adoptions of multiple coping strategies, the error term jointly follows a multivariate normal distribution with zero conditional mean and variance and symmetric covariance matrix $\Omega$ is given by equation 3:

$$\Omega = \begin{bmatrix} 1 & \rho_{12} & \rho_{13} & \rho_{14} & \rho_{15} & \rho_{16} & \rho_{17} & \rho_{18} \\ \rho_{21} & 1 & \rho_{23} & \rho_{24} & \rho_{25} & \rho_{26} & \rho_{27} & \rho_{28} \\ \rho_{31} & \rho_{32} & 1 & \rho_{34} & \rho_{35} & \rho_{36} & \rho_{37} & \rho_{38} \\ \rho_{41} & \rho_{42} & \rho_{43} & 1 & \rho_{45} & \rho_{46} & \rho_{47} & \rho_{48} \\ \rho_{51} & \rho_{52} & \rho_{53} & \rho_{54} & 1 & \rho_{56} & \rho_{57} & \rho_{58} \\ \rho_{61} & \rho_{62} & \rho_{63} & \rho_{64} & \rho_{65} & 1 & \rho_{67} & \rho_{68} \\ \rho_{71} & \rho_{72} & \rho_{73} & \rho_{74} & \rho_{75} & \rho_{76} & 1 & \rho_{78} \\ \rho_{81} & \rho_{82} & \rho_{83} & \rho_{84} & \rho_{85} & \rho_{86} & \rho_{87} & 1 \end{bmatrix} \tag{3}$$

Where $\rho$, is the correlation between the error terms.

Data from FGDs and KIIs were analysed through content analysis (CA) (Bengtsson, 2016). The CA aims to turn a lot of raw data into usable evidence through data reduction methods (Hawkins, 2013). The overall collected information from field observations in addition to those obtained from FGDs and KIIs were integrated into the discussion and used to comment on the study results.

## 3 Results

### 3.1 Respondents' sociodemographic characteristics

Among the 1,500 selected respondents, 10.7 % were females and were chosen where men were absent. The youngest respondents were 40 years old and the oldest respondents were 87 years old. Many households were between 10–20 members (60.3 %). Others had up to 20 members (8.7 %) while those with less than 10 members accounted for 31 %. The socio-demographic characteristics demonstrated that Upper Guinea was home to large households as a result of traditional mining activities of gold practised in the region and polygamy which negatively affected some households' food security.

*Farmers' perception of extreme weather events*

Results show that 87.3 % of respondents noticed a negative change in extreme weather events while 12.7 % of respondents were undecided to notice a change. Already, this demonstrates that farmers in Upper Guinea were aware of climate variability and its subsequent consequences on their sources of subsistence (Table 3).

### 3.2 Coping options available to smallholder farmers in the event of crop failure

Following crop failures, a range of coping strategies was used by farmers to avoid household food shortages due to unexpected crop failures. These strategies included borrowing money from wealthier people; practising casual labour; fishing/gathering wild food especially fruit, honey, and game; small-scale mining or traditional mining; small-scale trade and business with notably crop products, firewood or charcoal; selling household assets such as livestock, cash crops, and farmland; purchasing foods from the market in cash or on credit; and expecting help from relatives.

The adoption of one or more strategies by a particular farmer was based on certain factors and conditions such as availability and access to resources, means, suitability and costs. However, these coping strategies were driven by climate change and contributed to improving the food security situation of farm households.

**Table 2:** *Variables used in the multivariate probit regression model.*

| *Variables* | *Type* | *Description* | $\overline{X}$ | *SD* |
|---|---|---|---|---|
| *Dependent* | | | | |
| Borrowed money | Dummy | 1 if applied and 0 if not | 0.25 | 0.43 |
| Casual labour | Dummy | 1 if applied and 0 if not | 0.17 | 0.38 |
| Fishing/gathering wild foods | Dummy | 1 if applied and 0 if not | 0.35 | 0.47 |
| Small-scale mining | Dummy | 1 if applied and 0 if not | 0.13 | 0.34 |
| Small-trade and business | Dummy | 1 if applied and 0 if not | 0.21 | 0.41 |
| Sold household assets | Dummy | 1 if applied and 0 if not | 0.28 | 0.45 |
| Purchased food from the market | Dummy | 1 if applied and 0 if not | 0.10 | 0.30 |
| Expected help from relatives | Dummy | 1 if applied and 0 if not | 0.08 | 0.28 |
| *Independent* | | | | |
| Age | Scale | Age of HH (years) | 60.77 | 11.5 |
| Gender | Dummy | Gender of HH (1 for male and 0 for female) | 0.89 | 0.30 |
| Household size | Scale | Number of HH members (number) | 12.64 | 5.38 |
| Educational level | Scale | Year of formal education (years) | 1.87 | 3.30 |
| Farming experience | Scale | farming experience of HH head (years) | 18.32 | 9.92 |
| Experience of crop failures | Dummy | 1 if the farmer has experienced crop failures and 0 if not | 0.72 | 0.44 |
| Awareness of extreme weather events | Dummy | 1 if the farmer is aware of extreme weather events and 0 if not | 0.87 | 0.33 |
| Ownership of assets | Dummy | 1 if the farmer has assets and 0 if not | 0.49 | 0.50 |
| Membership of a farmer organisation | Dummy | 1 if the farmer is a member of a farmer organisation and 0 if not | 0.15 | 0.35 |

Note: $\overline{X}$ = mean and SD = Standard deviation.

**Table 3:** *Small-scale farmers' key perceived aspects of change (N=1,500).*

| *Farmers' perceived impact of CC* | *%* |
|---|---|
| Change in crop yield | 25.4 |
| Change in rainfall | 16.3 |
| Change in temperature | 4.1 |
| Increased drought episodes | 28.9 |
| Increased flood episodes | 12.7 |
| Do not know | 12.7 |

### *3.3 Factors influencing the choice of farmers' coping strategies*

The MVP model was used to identify factors influencing farmers' choice of coping strategies in the face of extreme weather events. The model has confirmed that choices of coping strategies in Upper Guinea were not mutually exclusive as the likelihood ratio test [chi2(28) = 210.811; Prob > chi2 = 0.000] rejects the null hypothesis, meaning that the covariance of the error terms across equations is not correlated. Moreover, the estimates showed that the model used fits adequately the data as the Wald test [Wald chi2(72) = 2096.70; Prob > chi2 = 0.000)] rejected the null hypothesis.

Globally, results showed that farmers' adoption of existing coping strategies was influenced by perceived climate change impacts and socio-economic characteristics, particularly gender, the experience of crop failure, and ownership of assets (Table 4). Other factors such as age, farming experience, household size, and educational level were also influencing farmers' decisions of coping strategies.

## 4 Discussion

Rainfed agriculture and climate-sensitive crop production have led to increased crop failures among small-scale farmers in Upper Guinea. In this study, coping options used by small-scale farmers consecutive to crop failures were examined, along with the factors that led them to choose these strategies. Results showed that among various coping strategies that helped farmers to buffer with climate stress, fishing and gathering wild foods, selling household assets, borrowing money, and practising small-scale trade and busi-

**Table 4:** *Results of the multivariate probit regression analysis of factors affecting farmers' coping strategies (N = 1,500).*

| *Variable* | *BMF* | *CL* | *FGWFs* | *SSM* | *STB* | *SHA* | *PFM* | *EHR* |
|---|---|---|---|---|---|---|---|---|
| Gender | 1.316*** | 0.024 | 0.172 | 0.191 | -1.498*** | 1.011*** | -0.605*** | -0.037 |
| | (0.172) | (0.161) | (0.115) | (0.183) | (0.117) | (0.211) | (0.132) | (0.148) |
| Age | -0.078*** | -0.142*** | -0.064*** | -0.105*** | -0.008 | 0.013* | 0.000 | 0.027*** |
| | (0.007) | (0.010) | (0.004) | (0.011) | (0.004) | (0.006) | (0.005) | (0.005) |
| Farming experience | -0.011 | 0.018* | 0.007 | -0.006 | -0.011* | -0.001 | 0.005 | 0.008 |
| | (0.007) | (0.008) | (0.005) | (0.009) | (0.005) | (0.008) | (0.007) | (0.006) |
| Awareness of extreme weather events | 0.563** | 0.291* | 0.934*** | -0.137 | 0.838*** | 0.871*** | -0.106 | 0.008 |
| | (0.178) | (0.145) | (0.121) | (0.142) | (0.157) | (0.185) | (0.166) | (0.241) |
| Household size | 0.060*** | 0.013 | 0.039*** | -0.002 | 0.004 | 0.011 | 0.072*** | -0.000 |
| | (0.010) | (0.010) | (0.007) | (0.011) | (0.007) | (0.011) | (0.010) | (0.009) |
| Education level | -0.084*** | -0.150*** | -0.058*** | 0.022 | 0.094*** | -0.063** | 0.096*** | -0.013 |
| | (0.022) | (0.019) | (0.011) | (0.016) | (0.011) | (0.018) | (0.015) | (0.016) |
| Membership in a farmers' organisation | 0.208 | -0.091 | 0.246** | -0.978*** | -0.103 | 0.066 | -0.197 | -0.196 |
| | (0.166) | (0.143) | (0.097) | (0.210) | (0.112) | (0.159) | (0.155) | (0.149) |
| Experience of crop failures | 1.530*** | -0.086 | -0.425*** | 0.288 | -0.397*** | 4.059*** | 5.438 | -0.153 |
| | (0.217) | (0.141) | (0.097) | (0.162) | (0.107) | (0.294) | (81.697) | (0.130) |
| Ownership of assets | -2.757*** | -0.141 | -0.061 | -0.264 | 0.643*** | 3.037*** | 0.534*** | -0.297** |
| | (0.158) | (0.103) | (0.076) | (0.112) | (0.090) | (0.139) | (0.105) | (0.106) |

BMF = Borrow money/food; CL = Casual labour; FGWFs = Fishing and gathering wild foods; SSM = Small-scale mining; STB = Small-scale trade and business; SHA = Sell household asset; PFM = Purchase food from the market; EHR = Expect help from relative. Standard error in parenthesis. Significance level: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$

ness, were the most viable. On the other hand, the results of the MVP model showed that experience of crop failures, awareness of changing climate, gender and age, were the key factors driving their choices of coping strategies. Overall, the findings highlighted that challenges induced by extreme weather conditions were likely to change the dynamics of subsistence farming since farmers lack proper coping and adaptation mechanisms.

Fishing and gathering wild foods (FGWFs) were the most popular coping option for a greater proportion of respondents (35 %). This could be explained by the population's access to poorly controlled natural resources. When women had unrestricted access to collect wild vegetal products such as African locust beans (*Parkia biglobosa*), mangos (*Mangifera indica*), or baobab fruits (*Adansonia digitata*), their involvement in hunting activities was not observed. This could be due to physical conditions and local customs.. These activities were motivated by farmers' awareness of extreme weather conditions, membership in a farmer-based organisation as well as household size. On the contrary, increasing crop failures, educational level, and age were likely to reduce these activities. Consequently, activities of FGWFs increased dramatically as farmers observed adverse weather conditions. These findings argue that the vulnerability of farming to extreme weather conditions was likely to increase food insecurity, rural-urban migrations and the decline of agricultural activities in favour of other livelihood opportunities. Similar observations were made by Harvey *et al.* (2014) in Madagascar or Mbuli *et al.* (2021) in Cameroon, where farmers experienced significant crop losses and severe food insecurity due to climate-induced stress.

Farmers' practices of borrowing money or food as well as selling household assets, were mainly driven by the experience of crop failures, awareness of changes in weather conditions and gender. Hence, crop failures constituted a direct stimulus of farmers' decisions to borrow money or sell their assets to prepare for and maintain households' access to food. Besides food issues, money loans enabled farmers to purchase inputs, fertilisers, pesticides or seeds. Moreover, observed changes in weather conditions were an indirect factor leading to these coping options. The results also showed that farmers with assets were less likely to borrow money to cover household expenses in the event of crop failures than farmers without assets. The study suggests that local community customs that promote gender discrimination in borrowing money and accessing assets could affect female headed households' access to credit facilities and assets. Contrary to our results, Rakgase & Norris (2014) found gender not significant in farmers' coping strategies in Limpopo Province in South Africa.

Practices of small-scale trade and business were more likely driven by the ownership of assets, awareness of ex-

treme weather events, educational level, and gender. Findings showed that amidst extreme weather conditions, farmers with assets were more likely to engage in small-scale trade and business for profit. Hence, the results showed that owning assets has the potential to buffer climate stress. Contrary to our results, Coulibaly *et al*. (2015) found the asset as a not determinant factor in the adoption of farmers' coping strategies, demonstrating the site-specific context of coping strategies. Already the awareness of extreme weather events motivated farmers with a higher educational level to engage themselves in small-scale trade and business. This shows that education influences behaviour and contributes to the preservation of livelihoods. The same observation was made by Alemayehu & Bewket (2017) in the central highlands of Ethiopia. However, the increase in crop failures was decreasing farmers' practice of small-scale trade and business. This can be explained by the fact that the practice of small-scale trade and business depended heavily on agricultural products in combination with charcoal production and wild food gathering as sources of cash. The study suggests that opportunities to make money off agriculture may be diminishing in favour of opportunities created by the development process that might be more attractive to rural people than necessary agricultural practices once they are severely affected by climate stress.

## 5 Conclusion and policy implications

Extreme weather events are a threat to farming households' food security due to increased crop failures consecutive to the adoption of various coping strategies. The MVP model was used to explore the factors motivating small-scale farmers' choice of coping strategies to deal with household food shortages due to crop failures. The results revealed that farming households adopted a range of coping strategies depending on the characteristics of their households and the economic opportunities accessible to them. The most common coping strategies used by the respondents were fishing and gathering wild foods followed by selling their assets and borrowing money. Key factors that motivated their choice of coping strategies were the experience of crop failures, the ownership of assets, the perceived extreme weather conditions, and gender. While farmers' ownership of assets could buffer climate stress, increased crop failures were likely to worsen household economic conditions and the loss of their household assets. The study recommends that local government should promote farmers' access to alternative livelihood options, extension services, climate information, and financial support to increase their income and strengthen their adaptive capacity to climate change.

Although the findings may not capture all farmers' coping strategies, they could still be useful for future studies looking at how farmers in Upper Guinea and other developing countries cope in a short term with climate-induced stress. In the long run, climate-adapted farming methods should be the way forward for farmers in this region.

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*Conflict of interest*

The authors declare no conflict of interest.

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