Agricultural risk assessment to enhance the food systems of the Mbororo minority community in the Northwest region of Cameroon

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Abstract

Increasing population pressure, coupled with the effects of climate change manifested by longer dry seasons, wildfires, and conflicts, threatens the food systems of minority communities. In the case of the Mbororo minority community of Northwest Region of Cameroon, these threats are exacerbated by already existing problems of marginalisation. This study assesses agricultural risks in the global context of food distribution and gross domestic product that also poses a specific threat to the food system of the Mbororo people. The study aims to (1) assess the types of agricultural risk encountered by the Mbororo community, (2) examine the likelihood and severity of these risks, and (3) appraise local risk management strategies adopted to minimise the negative impacts of these risks on the food system. The study makes use of a mixed method approach for data collection. Findings have revealed animal diseases (83 %), absence of infrastructures (83.6 %), price variation (76.6 %), and drought (75.8 %) as the most encountered risks in the case study area. Especially, drought, political insecurity, pest and rodent, farmer-grazer conflict, and crop and animal diseases emerged as the highest intensity or priority risks with the need for urgent management strategies intervention. Agricultural risk assessment is frequently used to assess and prioritize risks but has hardly been used in the case of minority groups such as the Mbororo community of Northwest Cameroon.

Keywords: coping strategies, diseases, frequent drought, risk prioritization, mitigation

1   Introduction

Global food systems are marked by tensions, threats, and conflicts (Tim, 1999), leading to increasing agricultural risk. Such risk may originate from many sources and practices, including crop management, markets and environmental impact and often lead to financial losses (Antón, 2009; Motha *et al.*, 2011) for the affected farm and farming communities. Evidence suggests that such risks hinder farmers' ability in making long-term decisions towards becoming risk-averse (Binswanger *et al*, 1983; Singh, 2018). Defined as "*the threat of loss or damage caused by an unfavourable event or other variables to which one is exposed to, but which event is uncertain*" (Kahan & Worth, 2018 p. 35), agricultural risks also add to other existing challenges facing food systems such as population pressure and internal conflicts (Thornton *et al.*, 2011).

Given these imminent threats to the food system, assessing agricultural risks in sub-Saharan African (SSA) countries is key to managing these threats and improving coping strategies in these countries (Dercon, 2002; World Bank Group, 2016). A closer look at the case of Cameroon as one of SSA countries shows that human and social capital are intensely affected by climate-related agricultural risks (Bang *et al.*, 2017). In highlighting the effect of climate-related risk in Cameroon, Bang *et al.* (2017) reported that, in the North region alone, 373,176 people were severely affected by floods between 2000 and 2015. Furthermore, climate-related risks affect mostly smallholder farmers because they heavily depend on rain-fed farming (Witt & Waibel, 2009). Due to climate change, farmers are finding it challenging to use their traditional knowledge of weather patterns to mitigate against agricultural risk (Witt & Waibel, 2009) therefore increasing their exposer and vulnerability to its negative consequences. Food insecurity, for instance, is a recurrent agricultural risk problem that affects most minority communities such as the

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case of the Mbororo minority community of the Northwest region of Cameroon (Booth & Smith, 2001).

The pastoral lifestyle of the Mbororo community (characterised by transhumance) makes them vulnerable, and vulnerable groups of people face the additional challenges of an economic downturn (McGuire, 201; Kimani-Murage *et al.*, 2011). Moreover, the Mbororo minority community's food insecurity situation is made worst because of limited access to basic needs including, clean drinkable water, health centres, electricity, and grazing land for their cattle (Ebile *et al.*, 2020). Enhancing the food system of the Mbororo community is essential to improve their food insecurity situation and agricultural risk management is one strategy to do so. According to Kahan & Worth (2018), risk can be avoided or its effects mitigated through pre-emptive actions. Furthermore, the authors state that understanding agricultural risk is a fundamental element in enhancing the food system.

The Mbororo community in Cameroon is part of the Fulbe ethnic tribe that spreads from East to West of the African Savana belt (Pelican, 2008). As reported by Pelican (2012), this ethnic tribe is divided into the Aku and the Jaafun subtribes. In Cameroon, socioeconomically, they are mostly agro-pastoralist and semi-nomads, and depend mainly on cattle for their livelihood (Pelican 2012; Ebile *et al.* 2020). Besides, this community forms around 10 % of the population in Northwest Cameroon and is often referred to as a stranger population (Pelican. 2011). The Northwest region is characterised by grasslands which is favourable for cattle production (Ebile *et al.* 2020), therefore, the Mbororo people settle on isolated and suitable hill tops around the region. Their settlements vary in sizes and usually range from five to hundreds of households (Pelican. 2008).

This study focuses on the Mbororo minority community of Northwest Cameroon as the case study area. It uses an exploratory action research approach comprising of qualitative and quantitative interviews, as well as focus groups discussions to (1), assess the types of agricultural risk encountered by the Mbororo community, (2) examine the gravity of these risks and their frequency and (3) evaluate the local mitigation and coping strategies adopted towards managing the negative impact of such risks on the food system.

1.1 Conceptual framework

This study makes use of the risk assessment and management cycle based on the "Platform for Agricultural Risk Management" by Kahan & Worth (2018), which consist of 5 stages: i) identification of potential risks, ii) analysis of the risk data, iii) identification of tools, iv) implement risk management tools and, v) monitor and result. In this study, we have modified, directly used, as well as added new stages,

to design an adapted framework that is suited for our study as illustrated in Fig. 1. The adapted version (Fig. 1) has 4 stages instead of 5 and these include: risk environment, evaluation of the risks, tools to manage risks, and recommendations.

For this study, the various types of risks encountered by the Mbororo community were evaluated based on these stages.
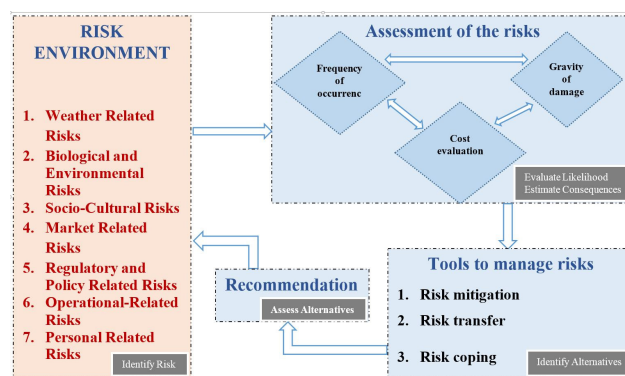

Fig. 1: *Conceptual risk assessment and management framework cycle, adapted and inspired by ideas from the Platform for Agricultural Risk Management stages by Worth & Kahan (2018).*

Specifically, the framework identifies seven types of risks to be assessed as indicated under the risk environment stage: (a) weather-related risks as, e.g., floods and droughts, (b) biological and environmental risks as, e.g., diseases, pests, wild animals, (c) socio-cultural risks as, e.g., political insecurity, farmer-grazer conflicts, protected area, (d) market-related risks as, e.g., price variations, market information, crop losses during production, processing, and storage and high production cost, (e) regulatory and policy-related risks that have to do with the absence of public infrastructures, (f) operational-related risks related with poor management and organizational structures, and (g) personal-related risks involving the death of a family member, illness, work accident, and family instability. Risk assessment requires monitoring the (a) frequency or the likelihood that the risks will occur, (b) severity or gravity of damage and (c) cost evaluation of the risk by estimating the consequences of the risks. Risk management tools are usually based on mitigation, transfer, and coping strategies. This study identifies which tool is already in use and recommends alternative tools to enhance the food system of the Mbororo community in Northwest Cameroon. Besides, it assesses the types of agricultural risk encountered by the Mbororo community and examines the gravity of these risks, their frequency and severity. In the subsequent sections of the paper, section 2 dwells on the methodology, highlighting the case study location, data collection and data analysis approaches. Section 3, elaborates

the findings of the study closely followed by section 4 that discusses these findings. The paper ends with section 5, that concludes as well as makes specific recommendations based on findings from the entire work.

2 Materials and methods

2.1 Study setting and location
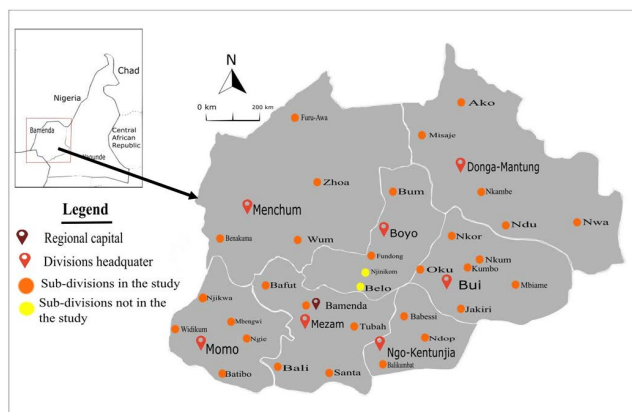
Fig. 2: *The map shows the divisions and sub-divisions in the Northwest region of Cameroon. Data was collected from subdivisions in orange, while those in yellow had no Mbororo communities hence no data was collected from these.*

The study was carried out in the Mbororo minority communities of the Northwest region of Cameroon. The region covers approximately 17,300 km² with a total population of about 2 million inhabitants and is divided into seven divisions which in turn are comprised of 34 sub-divisions (Fig. 2). The agro-ecological condition of this region is characterised by a mix of dense vegetal cover and hilly grasslands, with an annual rainfall of 1500 to 2000 mm (Neba, 2009) and temperature ranges of 13 to 25°C (Nformi *et al.*, 2014) depending on the period of the year. Traditionally, the indigenous Mbororo people are divided into two sub-tribes (i.e. the Jaafun and the Aku) and comprise peri-urban dwellers[1], agro-pastoral and nomadic socioeconomic groups (Pelican, 2008). All three groups practice different forms of pastoralism, whereby pastoralism with cattle rearing constitutes the sole means of livelihood and primary economic activity (Pelican, 2012).

2.2 Sampling and data collection approach

For data collection which took place from April 2017 to July 2018, we made use of a mixed method approach comprising of a quantitative survey, a semi-structured qualitative interview guide, as well as focus group discussions.

For the quantitative survey, questionnaires were administered to men or women that were household heads (i.e. women household heads in this case were widows) in case study communities. Firstly, all Mbororo communities and their ethnic names in the sub-divisions were identified in collaboration with an NGO called the Mbororo Social and Cultural Development Association to allow for randomization. Secondly, 32 of these Mbororo communities, villages or "*Ardorates*" (i.e. one from each sub-division) were randomly selected for administering the questionnaire by trained students from a nearby University (Bamenda University) and five NGO paralegals[2]. In total, 265 Mbororo men and women household heads were surveyed.

For qualitative data collection, we conducted 26 semistructured qualitative interviews with community leaders and members of NGOs working within the Mbororo communities and administered 7 focus group discussions. Guided questions in the interviews centred around riskmitigating opportunities related to insurance policies and microloans. Focus group discussions were held on key issues relating to mitigation, copping, and transfer strategies to managing risks. Because the livelihood of most Mbororo families is dependent on men who are directly responsible for the cattle, we had separate focus groups discussions with women and men in order to capture their respective perspectives. This decision for separating both groups was influenced by the traditional values of the Mbororos, which prohibits joint discussions between men and women in one setting.

2.3 Analysis and characterisation of agricultural risks

We analysed data on agricultural risks within the Mbororo community according to different parameters and techniques such as i) the damage caused by the risk, ii) the frequency of occurrence, and iii) the monetary cost of the risks, to account for the different agricultural risks encountered by farmers in their everyday lives (Fig. 1). The seven identified agricultural risks (Fig. 1) were first presented as percentages of the farmers who encountered these risks.

The overall impact of a given risk factor on the whole community was derived by combining the risk frequency and

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[1]Peri-urban dwellers: These are people or communities located mostly at the outskirts of the cities, but retain rural characteristics in their way of life, and in this case, by keeping livestock with the primary target of supplying to the urban market. Sometimes, these dwellers might live in the cities and keep livestock in these areas as part time farming activities to supplement their income (Žlender & Ward Thompson, 2017).

[2]Paralegals are people, qualified through education, training or work experience to perform substantive legal work that requires knowledge of legal concepts.

severity[3] responses from 265 respondents within the various sub-divisions. Risk frequency of occurrence was recorded at three levels; rare, often, and permanent.

For analysis and quantification of damage, the severity of risk was allocated a percentage to represent the damage caused by that risk. The percentages range from 0-30 %, 31-60 %, and above 61 %, representing rare, often, and permanent levels of damage caused by the risk, respectively.

The method for combining frequency and severity to get impact is based on a risk matrix for prioritization (Fig. 3), as initially proposed by Kahan & Worth (2018). However, we have modified the matrix level from five to three levels to fit the objectives of this study. Following Kahan & Worth (2018), using a matrix with a limited number of levels helps in categorizing agricultural risks and making decisions on risk management strategies. Using the frequency of occurrence and severity risk matrix, the weather, biological and environmental, and socio-cultural risks, respectively, were assessed.

Fig. 3: *Risk matrix, combining severity of damage and frequency of occurrence, adapted from the Platform for Agricultural Risk Management (Worth & Kahan, 2018).*
Note: The direction of the arrow shows an increase in frequency and severity.

The red colour in the matrix indicates that a given risk requires an immediate management strategy for reducing the average frequency and/ or average severity of the risks to reduce its impact. The orange colour indicates that risk might be acceptable but needs monitoring. In contrast, the green colour indicates a low risk that may not be managed because it is sufficiently controlled. Market-related, regulatory and policy-related, operational-related, and personal-related risks were not analysed using the risk matrix since these did not have a severity component or damage on crops or animal production. These risks were assessed individually, and the results were presented separately. Market-related risks were assessed using the frequency of occurrence and

loss of income experienced by the respondents. The risk frequency was assessed using three levels: rare, often, and permanent. The study computed the percentages of the respondents that lost income due to different market-related risks such as price variation, and access to market information. Operational risk categories critical to the Mbororo community, such as access to finances, infrastructure, and human resources, were assessed using focus group discussions. Participants were asked to rank these risks according to their perceived adverse impact. The first four types of risk within each category are presented in the results. Personal-related risks are either human-induced or natural and include illness, work accidents, the death of a family member, or family instability. The study assessed the percentages of the respondents that have encountered the various forms of personal risks, and some strategies taken to manage these risks.

2.4 Data analysis

SPSS software (version 22, IBM, Armonk, NY, USA) was used to analyse quantitative data to determine the percentage of the respondents that encountered various risks. The frequencies of occurrence and the severity of the risks were ranked and combined using a risk matrix system. MS-excel spreadsheet was used for graphically displaying the data from SPSS.

3 Results

3.1 General observations

Based on our findings, the livelihood of a typical Mbororo household is centred around livestock and most, own between 20-200 cattle and other livestock species such as sheep, horses, and chicken. Horses are a sign of prestige and used in transportation but do not rank close or equal to the cattle in terms of importance. While cattle are mostly owned and controlled by men, women mostly own and control the chicken and sheep. However, when it comes to selling, a woman is expected to consult the husband for approval. The food system of the Mbororo community is, therefore, mostly supported by animal production, implying any risk affecting the animals will, in turn, threaten the whole food system. However, some families with less cattle and equally less financially viable who are settled in their present locations do practise subsistence crop farming.

3.2 Agricultural risk encountered by the Mbororo community

The Mbororo communities encountered, to varying degrees, all the seven agricultural risks outlined in the frame-

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[3] The severity of risk refers to the damage of farmers' losses due to certain agricultural risks at a given time such as those outlined in the conceptual framework (Fig. 1).

work of the study. Table 1 shows an overview of the percentages of the Mbororo respondents that have encountered these agricultural risks.

Table 1: *The percentage of the Mbororo population that have encountered agricultural risks (N =265).*

Risk category	Risk	%
Weather-related risk	Flood	18.9
	Drought	75.8
	Heavy wind and hailstones	48.3
	Other shocks (earthquakes, landslide)	13.1
Biological and environmental risk	Crop and animal diseases	83
	Pest and rodents	78.1
	Low-quality inputs (chemicals and planting materials)	49.6
	Wild animal invasion	28.8
Socio-cultural risk	Political insecurity	70.1
	Farmer grazer conflict	56.9
	Protected area	20.2
Market-related risk	Price variation	76.6
	Lack of access to market information	52.3
	Production, processing, and storage loss	54.4
	Higher production costs	56.7
Regulatory and policy-related risks	The absence of public infrastructures (water, electricity, warehouse, tarred road)	83.6
Operations related risks	Poor management and organisational structure risks	34.2
Personal related risks	Personal risks (illness, work accidents, death or family instability)	60.1

The weather-related risks most encountered by the Mbororo population are drought (75.8 %), while animal and crop diseases (83 %) are the most encountered biological and environmental risks. Moreover, political insecurity is the most encountered socio-cultural risk (70.1 %), while price variation (76.6 %) is observed to be the most encountered market-related risk. The absence of infrastructures is rated as high risk (83.6 %). Operations-related risks like poor management are observed as the least encountered type of agricultural risk.

3.3 Prioritizations of risk categories

The resulting impact from combining the frequency of occurrence and severity using the risk matrix is given in table 2. This table indicates that drought is the most critical weather-related risk encountered by the Mbororo people, followed by heavy winds and hailstones, while flood and other shocks

have the least threatening impact. For biological and environmental risks, crop and animal diseases, and pests and rodents were the most critical risks encountered, whereas low-quality inputs had a medium impact, and wild animal invasions had little to no effect. Considering that: socio-cultural risks, political insecurity and farmer-grazer conflict were most critical; however, threats from the administration (e.g. in form of penalties or fines) arose because encroachment with cattle in to protected areas was low. In summary, of the eleven agricultural risks assessed using the risk matrix and prioritization method, five of them were of priority 1, two of priority 2, and four of priority 3.
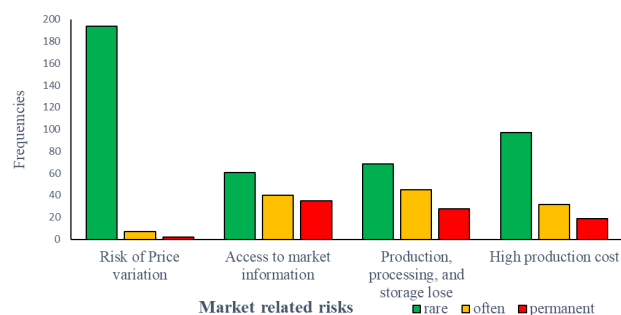
Fig. 4: *The levels of frequencies of occurrence of market-related risks.*

3.4 Market, regulatory, policy, operations and personal risks

3.4.1 Market-related risk

In this study, 203 respondents encountered all the market-related risks. From the 203 respondents who encountered the risk of price variation, 194 respondents said they rarely encountered the risk, 7 said often, and 2 said they permanently encountered this risk (Fig. 4). Access to market information and production, as well as processing and storage losses, are the most critical market-related risks encountered by the respondents. The respondents indicated that they lost income due to price variation (35.5 %), lack of market information (37.4 %), processing and storage loss (46 %), and high production cost (50 %) negatively impacting their profits.

3.4.2 Regulatory and policy-related risks

The presence or absence of public infrastructures like water points, electricity, warehouses, and proper roads affected agricultural production in the Mbororo community. Examining the frequencies of occurrence, 74.4 % of the respondents indicated that the lack of infrastructure was a constant problem, whereas 12.8 % of the respondents said they encounter challenges with an infrastructure often or rarely, respectively. The results showed that 58.3 % of the respondent

Table 2: *Risks impact levels from the combination of average severity and frequency.*

Risk	Average severity		Average frequency		Combined impact	
Weather-related risk						
Flood	rare	🟢	rare	🟢	low	🟢
Drought	permanent	🔴	often	🟡	high	🔴
Heavy wind and hailstones	often	🟡	often	🟡	medium	🟡
Other shocks (earthquakes, land-slide)	rare	🟢	rare	🟢	low	🟢
Biological and environmental risk						
Crop and animal diseases	permanent	🔴	permanent	🔴	high	🔴
Pest and rodents	permanent	🔴	permanent	🔴	high	🔴
Low-quality inputs (chemicals and planting materials)	often	🟡	often	🟡	medium	🟡
Wild animals invasion	often	🟡	rare	🟢	low	🟢
Socio-cultural risk						
Political insecurity	permanent	🔴	permanent	🔴	high	🔴
Farmer-grazer conflict	permanent	🔴	often	🟡	high	🔴
Protected area	rare	🟢	rare	🟢	low	🟢

Note: The risk matrix combines frequency levels and severity levels to give the impact of the various risks. The colours are used to indicate the strength of the impact and facilitate prioritization.

thought that the absence of public infrastructure resulted in low profits, 34.9 % felt that it limited their access to the markets, and 6.9 % did not feel it had an impact on either of the two categories.

3.4.3   Operations-related risks

Findings showed that for operations-related risks encountered by the Mbororo people, 32.6 % of respondents encountered finance challenges, 47.2 % faced infrastructure challenges, and 20.2 % encountered human resource problems. Four risks with the most negative impact under the different sub-groups of operations-related risks are:

- Finance: (1) Insufficient funds to pay workers at times and to respond to higher pay demands; (2) lack of funds for animal vaccination and welfare; (3) difficulty to receive microfinance from banks; and (4) prices of inputs for animal care are increasing annually.

- Infrastructure: (1) Lack of tools and good seed quality for crop farming; (2) increasing cost for fencing material; (3) cattle destroy farmer's crops because of no fence; and (4), not enough grazing land.

- Human resource: (1) workers do not want to go for transhumance because of a long dry season; (2) lack of trust since workers steal cattle and sell; (3) reluctance of the workers for taking cattle to graze on far-off

land with better grass, and (4) shortage of workers since most of them have moved to the city.

Table 3: *The percentage of the population that implemented management strategies.*

Agricultural risks	Management strategies put in place	Strategies implemented (in %)
Weather-related risks	• nothing	90
	• weather forecast	5
	• insurance	5
Biological and environmental-related risks	• nothing	38
	• used Chemicals	35
	• use improved inputs	4
	• build a fence	23
Socio-cultural related risks	• nothing	98
	• cope	2
Market-related risks	• nothing	45
	• cope	55
Infrastructural related risks	• nothing	29
	• cope	71
Personal related risks	• nothing	30
	• use home treatment	26
	• seek medical assistance (hospital)	41

3.4.4 Personal related risks

Results on personal-related risks indicated that respondents of the Mboraro people had encountered illness (50 %), work accidents (17.7 %), the death of a family member (26.6 %), and other types of risks such as instability related to movement and separations (5.7 %).

3.5 Local risk management strategies adopted to solve risks frequently encountered by the Mboraro community

Table 3 shows the various management strategies the Mboraro people used to manage the multiple risks their food system often encountered. It shows that most of the respondents did not show any reaction when they encountered particularly socio-cultural risks (98 %) and weather-related risks (90 %). However, in the case of weather related risk, cattle owners gave away cattle as insurance to their herds men in addition to the payment they receive for taking care of the cattle. The results clearly revealed a high level of coping, market and infrastructural risks categories. Coping mechanisms for socio-cultural risks were mainly the use of guard dogs to increase security against cattle theft. For infrastructure-related risks coping mechanisms were related to the purchase of cheap portable solar lamps, purchasing inputs from big cities at lower prices, paying for a fence construction around their farms to avoid conflicts, and sowing grass (forage) as supplements for feeding cattle during the dry season. For market-related risk, the mechanisms included meetings to stabilize the sales price for cattle, take advice from veterinarians, and introduce new animal species that produce more milk. Some individuals stated that they bought animals in the dry season when cattle were cheaper and sold during festive periods such as Ramadan and Christmas at high prices.

Adaptation or coping mechanisms for managing finance-related operation risks included selling cattle to buy inputs and to pay for labour, purchasing inputs when prices are low during the off-season and borrowing money from friends and family. Managing human-resource-related operation risks (e.g. to avoid stealing of cattle) included i) cattle owners (especially the rich and settled ones with herds men taking care of their cattle) accompanying their herds men in transhumance activities, and ii) making unannounced control visits to check their cattle. Some participants believed that personal-related risks such as illness were the most difficult to manage because of the insufficient health care system; thus, 26 % of the respondents turn to home treatment using herbs and traditional medicines.

4 Discussion

4.1 Agricultural risk encountered by the Mboraro community

Agricultural risks may negatively impair the food system of many communities depending on the intensity of the risk (Binswanger *et al*, 1983; Singh, 2018). Findings from the current study showed that the respondents have encountered all seven risks under investigation. Furthermore, a high percentage of respondents encountered these risks, which indicates that the Mboraro community's food system is under pressure. These threats to the food system of the Mboraro community might also negatively affect other communities as for instance urban cities that depend on meat and milk from the Mboraro community (Tim, 1999). Specifically, the results have shown that the livelihood of the Mboraro community is centred especially on cattle, though a few of these families' substitute home consumption by practising subsistence crop farming. For this reason, a high percentage of the community experiencing drought, pests and animal diseases related risks implied that their source of livelihood were at risk. Other studies in Cameroon have also found pests to be a threat to crop production in other localities such as Ndop and the West region (Pouokam *et al*., 2017; Fai *et al*., 2019). These results suggest that the Mbororos find it challenging to sustain their food system due to prolonged droughts with not enough pasture for cattle grazing. However, respondents feared most the foot-and-mouth cattle disease. Recent research has shown that the disease is very contagious, with a high morbidity rate (Spickler, 2015).

The global impact of foot-and-mouth disease is enormous due to the large numbers of animals affected causing direct losses due to reduced production or indirect losses caused by control costs (Knight-Jones & Rushton, 2013). Schmitz (2005) holds the view that constraints within the value chain negatively impact the food system. Since market-related risks and risks associated with a lack of infrastructure were shown to be high in the current study, this means the cattle value chain within the Mboraro community is threatened. Commercialisation provides a source of income for many households globally to overcome credit-related challenges and mitigate shocks (Strasberg *et al*., 1999), and if this is threatened, their whole livelihood is at risk. The findings of the current study are consistent with those of Phillip *et al*. (2009), who showed that challenges in marketing, processing, and lack of cold storage facilities in abattoirs constrain the livestock value chain in Nigeria and negatively impacted the food system.

4.2 Prioritizations of agricultural risk

Managing agricultural risk necessitates the prioritization of potential risks according to their intensity, and risks with a high priority should be handled urgently (Kahan & Worth, 2018a). It is necessary to prioritize risks so that holistic strategies can be developed to mitigate their potential effects on agricultural systems. Agricultural risk management is continuously evolving and differs depending on country factors such as the form of government, economy, infrastructure, and culture, (Székely & Pálinkás, 2009). Thus, providing data on different local management strategies helps mitigate similar risks in different localities. Drought, crop and animal diseases, pests and rodents, political insecurity, and farmer grazer conflict were the high priority risks that threaten the food system of the Mbororo people. These priority risks are similar to those reported in other studies within the context of agriculture in sub-Saharan Africa (e.g., Thornton *et al.*, 2011; Nchanji *et al.*, 2018;). In contrast, some low priority risks in the current study, such as floods, were of a high priority in other studies in different localities (Bang *et al.*, 2017; Witt and Waibel, 2009). Thus, it is essential to provide data on the risks faced by many different communities to construct an agricultural risk scenario for this region and formulate management recommendations.

4.3 Risk management strategies

Risks are managed either by mitigating, coping with, or transferring the impact of the risks (Antón, 2009). Risk management strategies require a detailed assessment of the intensity and severity of the encountered risk. This study demonstrated that most Mbororo people did nothing to manage the risks they encountered, with over 90 % of the people taking no action related to weather and 98 % for sociocultural related risks, mainly due to lack of knowledge and insufficient support from the local government authority. Nevertheless, a smaller portion of the action (2 %) could be observed from the part of local leaders via conflict management (e.g. farmer grazer-conflicts). These results agree with earlier findings, stating that minority communities have limited access to basic infrastructures compared to their counterparts in the same locality (Booth & Smith, 2001), which might be why most respondents did nothing against these risks.

More so, the location of most Mbororo households at the outskirts of most villages (e.g., isolated hilltops) at an average distance of 2km to main village centers. This creates an accessibility problem, which adds to the issue of marginalization (i.e., a combination of what they feel and what they have experienced over the years). Besides, these challenges have resulted in their being socially disconnected from the general population. In this regard, most Mbororos are not fully integrated into village activities, hence not having access or benefit from the wider knowledge-sharing circles within the villages. For example, during data, collection respondents testified that they are hardly invited to join or participate in village council meetings, nor are they represented in most of these councils. For these reasons, Mbororo farmers living in the same region often have limited access to meteorological data from local weather stations compared to their non Mbororo counterparts in the same locality (Awazi *et al.* 2019). However, some respondents used one of the three methods to manage risks, as discussed in the next section.

4.3.1 Risk mitigation

Risk mitigation refers to actions taken before a risk event occurs to reduce the likelihood of risk or reduce the severity of losses (Kahan & Worth, 2018a). Few Mbororo people started diversifying their food system from cattle to crop farming as a mitigation strategy; however, the majority of the population is still reluctant to practice crop cultivation. Other research has proven that diversification is an excellent risk-mitigating tool in many communities worldwide because it brings resilience to rural communities (Herforth, 2013). Moreover, the Mbororo people mitigated biological and environmental-related risks by using drugs (e.g., animal vaccination and treatment of ticks) to treat their cattle and improve pasture land by sowing Guatemala (Tripsacum laxum) and Bracharia (Brachiaria eruciformis) grass seed for cattle forage (Mtengeti *et al.*, 2001). Improved pastures were only recently introduced in the Mbororo community, however, it is being used in many other communities for mitigating drought (Vrieling *et al.*, 2016). Generally, environmental threats are often tilted against areas that are already vulnerable and have the least resources for adaptation (Myers *et al.*, 2017).

4.3.2 Risks transfer

Risk transfer considers contractual shifting (removal) of risk from one party (e.g., the farmer) to another party (e.g., an institution such as an insurance company) that is better able to cope with the risk (Kahan & Worth, 2018). However, risk transfer was not a common management strategy amongst the Mbororo people because only 5 % of the population were involved in any form of insurance (e.g. giving away cattle to ensure that herdsmen are more effective in carrying out their duty). In some countries like Nigeria, private and government insurances try to help farmers better cope with their risks, but these institutions are not efficient (Epetimehin *et al.*, 2011). Interestingly, the Mbororo have a tradi-

tional form of partial risk transfer by guaranteeing the herdsman, in addition to his salary, a certain number of cattle if he works well for a certain length of time. The deal helps the owner to ensure that the herdsman will take care of the cattle as his own. The low percentage of the Mbororo population using insurance is confirmed by other research, showing that agricultural insurance in Africa is not reliable and people do not trust these companies (Njegomir & Demko-Rihter, 2018). Though other studies have shown possibilities for positive insurance application (Ndagijimana *et al.*, 2020), insurance institutions in Africa need much work to gain the trust of farmers. Besides, Ntukamazina *et al.* (2017) have recommended strong public-private partnerships, and improved quality as well as availability of weather data as options towards improving risk management strategies in Africa.

4.3.3   Risk coping

Some risks cannot be mitigated or transferred, and in such cases, people need coping strategies that help absorb the impact of the risk (Kahan & Worth, 2018). Coping strategies in the Mbororo community were mainly related to the sale of cattle when financial losses were experienced. For instance, cattle owners are often forced to sell their cattle to pay for crop destruction caused by their cattle. This tallies with the findings of Strasberg *et al.* (1999), who stated that selling assets is still one of the most basic forms to cope with agricultural risks around the world. Moreover, NGOs are also helping the Mbororo cope with conflict-related risks by resolving the conflict between farmers and grazers on their platform called "in search of common ground" (Valentine, *et al.*, 2014). NGOs play a crucial role in mitigating risks across many different situations such as natural disasters, hunger, poverty and conflicts, and essential in mitigating agricultural risks (Nikkhah & Redzuan, 2010).

5   Conclusions and recommendations

Considering that enhancing the food system of rural communities will improve agricultural production and livelihood, this study aimed to assess agricultural risks affecting the food system of the Mbororo community and propose management strategies. The study found that the food system of the Mbororo community is (1) heavily reliant on livestock production, (2) fragile because it suffers from all agricultural risks under investigation, (3) facing high priority agricultural risk such as drought, crop and animal diseases, pest, insecurity and farmer-grazer conflict that need urgent intervention, and (4) unstable due to their inability

to mitigate or transfer some of these risks. It is recommended to prioritize risks for effective and sequential management of potentially detrimental impacts on the food system. Risks of high priority such as drought, animal and crop diseases, and farmer-grazer conflict should be urgently managed because their impact is not only on the food system but also on livelihood. For example, drought increases the likelihood of farmer-grazer conflicts that negatively impact the Mbororo people's food system. Since the Mbororo community's food system is anchored around livestock production, foot-and-mouth disease was the main threat to cattle production without any practical solution in place. Furthermore, improved access to agricultural risk management tools such as microfinance, insurance, and training would mitigate these risks for the Mbororo community. The study recommends that already existing management strategies used by a minor proportion of the Mbororo people should be encouraged and promoted. These strategies include:

- introducing grass varieties such as Guatemala and Bracharia for cattle forage primarily for dry seasons. However, this might incur additional costs for fencing, but the overall benefit might outweigh the costs;

- diversification of farming systems through vegetable production for food security;

- improving milk production through the acquisition and adoption of high milk-producing cow breeds;

- developing microfinance and insurance schemes to mitigate risk induced vulnerability;

- The local government should enforce the platform's power "in search of common ground" in resolving the conflict between farmers and grazers within the region.

Ethics approval

The study protocol received ethical clearance from the Ethical review committee of the University of Bamenda Northwest region Cameroon. The protocol was assigned the identification number 2018/0054UBa/FHS/IRA approved on 20/07/2018. Furthermore, informed consent was obtained from all respondents during data collection.

Declaration of interest statement

The authors declare that they have no conflict of interest.

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