Determinants of the Risk Perception of Farmer-Herder Conflicts: Evidence from rural Nigeria

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Abstract

The study investigates the determinants of rural households' risk perception of farmer-herder conflict in Nigeria. A farmer-herder conflict risk perception model is constructed and tested with a sample of 401 rural households in Nigeria. Results show that age, farming experience, language diversity, farm size, crop diversity, livestock diversity, ownership of formal title to land, settlement density and location are significant predictors of household risk perception of farmer-herder conflict. We carry out further analysis of farmer-herder conflict risk perception related to (1) food production and supply, (2) household physical security and wellbeing. Findings highlight the importance of policies that facilitate more sustainable herding practices to inhibit the onset of farmer-herder conflicts.

Keywords: Risk perception; farmer-herder conflict; Nigeria

JEL classification: C24, D81, Q12

1. Introduction

An increasing number of climate disasters and the consequent scarcity of land resources in recent times have increased the frequency of farmer-herder (FH) resource-use conflicts in many developing countries. The worsening clashes between nomadic herdsmen and farming communities in most parts of sub-Saharan Africa (SSA), especially in Nigeria, has remained a cause for concern. In Nigeria, rapid population growth further worsens the situation. A report by the institute for economics and peace shows that fatalities resulting from FH conflicts perpetuated by the Fulani militia, increased from 63 deaths in 2013 to 1224 deaths in 2014 in Nigeria (IEP, 2015). In 2015, the number of deaths recorded by Fulani militia decreased by about 50% (IEP, 2016), while a report by Amnesty International indicates a total of 3,641 fatalities from FH conflicts occurring between January 2016 and October 2018. The upsurge in these FH conflicts have adverse consequences for rural livelihoods and security.

FH conflicts have been found to not only have a negative impact on agricultural output and labour (George, Adelaja, & Awokuse, 2020), but to also reduce farming household's food security (Nnaji, Ratna, Renwick, & Ma, 2020a). Through their impact on agricultural productivity and food supply, these clashes not only jeopardise the prospects of farmers but also wider society. How rural households perceive the risk of farmer-herder conflicts has been found to negatively influence their use of productive inputs which in turn will have dire consequences for their productivity and income (Nnaji, Ratna, Renwick, & Ma, 2020b). Therefore, ascertaining the factors that determine how farmers perceive the risk of FH conflicts is important to inform initiatives and strategies that help improve their productivity.

A systematic review of farmers' risk perceptions of agricultural risk by Duong, Brewer, Luck, and Zander (2019) found very few studies have explored the socio-economic characteristics that explain risk perceptions. To the best of our knowledge, this is the first study that investigates the factors that influence FH conflict risk perception and thereby improves understanding of what elements influence how farmers react to the risk of FH conflicts. Since risk perceptions differ depending on prior exposure to the adverse events and individual ability and preparedness to mitigate adverse consequences (Kahneman & Tversky, 1982; Knuth, Kehl, Hulse, & Schmidt, 2014). Also, past experience of a hazard influences risk attitude and risk perception of that hazard which in turn influences the management strategies adopted to mitigate adverse effect of the hazard should it occur (van Winsen et al., 2016), a knowledge of the determinants of FH conflict risk perception is relevant. Furthermore, extant literature shows that awareness of farmers' risk perception is vital for making policy strategies in support of agricultural risk management as well as the development and facilitation of programmes targeted at rural farmers (Sulewski & Kłoczko-Gajewska, 2014).

The objective of this study is to examine the socio-demographic and cultural determinants of rural households' FH conflict risk perception. This paper presents what we believe is the first study to investigate the factors influencing risk perception of FH conflicts. We do this using household level primary data from rural Nigeria. Nigeria a good choice for study area because of the recent increase in FH conflicts in the country. The survey questionnaire collected information on FH conflict incidences, rural household's socio-demographic characteristics and their worry about various outcomes as a result of already occurred FH conflicts. Responses were used to construct a FH conflict risk perception assessment for the participating households. A multiple linear regression model is used to analyse data for the study.

This study contributes to the literature on risk perception of FH conflict in several ways**.** First, to the best of our knowledge, this is the first attempt to empirically explore the determinants of farmers risk perception of FH conflicts. Identifying the factors influencing rural households' FH conflict risk perception is important because of its implications for their production decisions and subsequently food security. FH conflict risk perception was found to negatively influence

their use of innovative agricultural input, which eventually affects their productivity and subsequent food security. Understanding of the factors that influence farming households' FH conflict risk perception will improve the creation of strategies directed at managing FH conflicts and the risks associated with it. Second, this paper constructs a sub-indices of FH conflict risk perception as it relates to food production and supply as well as physical insecurity and wellbeing. This enables us to determine what demographic and cultural factors shape how rural households perceive FH conflicts from the perspective of food production or individual wellbeing and safety.

The rest of the paper is organised as follows. Section 2 presents a review of related literature. Next, we present the conceptual framework and empirical strategy in section 3. Section 4 introduce data, variable measurements, and descriptive statistics. The empirical results are presented and discussed in section 5, while the final section concludes.

2. Review of Related Literature

Risk is an objective measure of the probability of a hazardous event occurring (Slovic, Fischhoff, & Lichtenstein, 1982). In contrast, risk perception is a psychological construct and can be defined to be individual subjective judgement when evaluating and describing hazards (Knuth et al., 2014; Slovic, 1987; Slovic, 2000). Perception of risk differs from individual to individual, and is as a result of personal assessment of objective risk and their inherent ability to prevent or cope with the adverse event if it occurs (Doss, McPeak, & Barrett, 2008). This implies that individual risk perception of an adverse event is not only established on the probability of such event happening - for instance, the probability of an earthquake – but also on their subjective evaluation of their vulnerability to the adverse event (Doss et al., 2008). Their subjective evaluation brings together their expectations about the probability of the event occurring with their readiness or ability to mitigate various eventualities should the even occur.

Extant literature has found age, gender, educational level, and farming experience, farm size and off-farm work to have a significant influence on farmers' perceived source of agricultural risks (Aditto, 2011; Il Islam, Rahman, Sarker, Sarker, & Jianchao, 2021; Rizwan et al., 2020). A systematic review of farmers' perception of agricultural risks found climate change, human and market risks to be most feared risk in the crop sector (Duong et al., 2019). The authors also found educational attainment, age, gender, farm size, farming experience, income and location were also found to influence how farmers' perceive the sources of agricultural risks (Duong et al., 2019). Similarly, Lobos et al. (2018) found climate events to be the main source of perceived risk for blueberry producers in Chile. Aditto (2011) also found age, gender, education, off-farm work, farm size and location to significantly influence farmer's perceived risk from different sources of risk in Central and North-east Thailand. In this study, we focus on the risk perception of FH conflicts because of the recent increase in occurrence of FH conflicts and its detrimental impact on rural livelihoods and food security (Nnaji et al., 2020a). Also, there has been no study examining the socio-economic factors influencing the risk perception of FH conflicts.

Exposure to an involuntary hazard has been found to increase the perceived risk of such hazard and its consequences in the future (Knuth et al., 2014). Hence, for an involuntary hazard, an individual's risk perception is mostly likely affected by their personal experience with that particular type of hazard and/or information they have about it (Knuth et al., 2014; Tversky & Kahneman, 1973). Since FH conflicts are involuntary clashes, individual farmer's risk perceptions of FH conflicts will encompass more than just the objective likelihood of it occurring but their prior experience of FH conflicts, indirect exposure to the conflicts through information about prior occurrences and their personal ability to mitigate its adverse effects. Objectively measuring the risk of FH conflict is difficult because of the nature of the conflict. Though, farmers behaviours are influenced not only by the probability of FH conflict occurring but by their ability to deal with the resulting issues should it occur. Determining what influences how

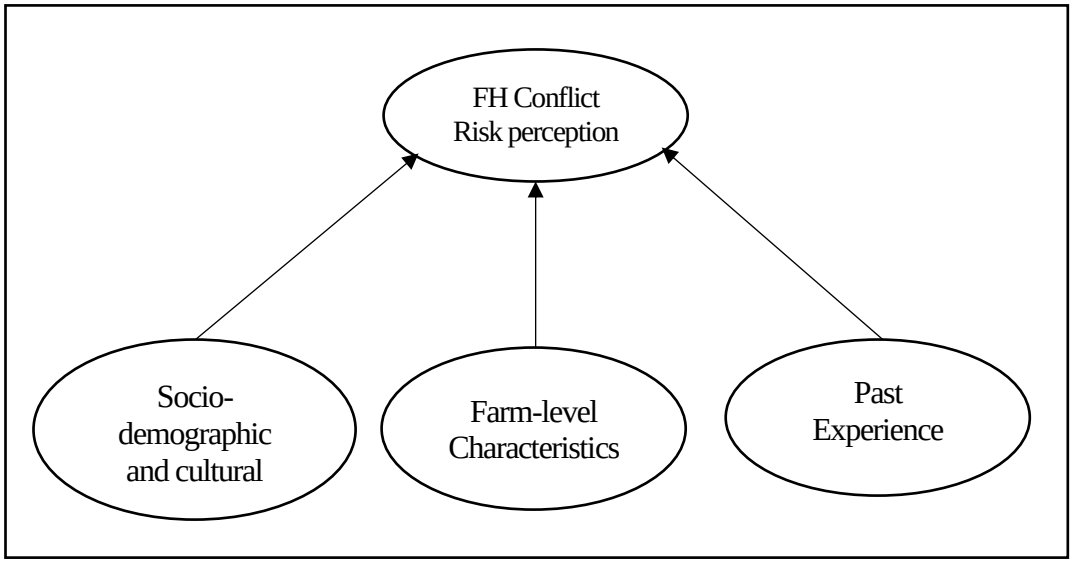
farmers perceive the risk of FH conflict is important because it has been found to influence their production decisions and invariably their productivity (Nnaji et al., 2020b). Existing literature shows that an understanding of farmers' perceived risk of different agricultural hazards is vital for the establishment of efficient risk management policy initiatives (Sulewski & Kłoczko-Gajewska, 2014). Similarly, an awareness of the factors influencing the risk perception of FH conflicts is fundamental in designing instruments for agricultural polices as well as risk management mechanisms for farmers.

3. Conceptual Model and Empirical Strategy

3.1 Conceptual Framework

The conceptual framework is inspired by the Van Raaij (1981) framework on economic behaviour and Van der Linden (2015) comprehensive climate change risk perception model (CCRPM) which suggests that climate change risk perception is a function of the cultural context, psychological processes and personal experience with the risk. Our conceptual framework illustrates how socio-demographic factors, socio-cultural factors, farm-level characteristics and past knowledge and experiences can influence FH conflict risk perception. Our conceptual model is presented in Figure 1.

Figure 1. Conceptual Framework of FH Conflict Risk Perception



Most studies on the factors influencing the risk perception of adverse events like climate change, hurricanes, earthquakes etc., find socio-demographic variables to be significant predictors. Age of farmer or household head has been found to have both a positive (Il Islam et al., 2021; Ndamani & Watanabe, 2017; Rizwan et al., 2020) and negative (Lucas & Pabuayon, 2011; Peacock, Brody, & Highfield, 2005; Savage, 1993) effect of risk perception of different hazards. Having a female household head was found to positively influence risk perception (Savage, 1993; Van der Linden, 2015). Education of the farmer has a positive influence on risk perception on hazards one hand (Ndamani & Watanabe, 2017; Peacock et al., 2005; Qasim, Qasim, Shrestha, & Khan, 2018) and a negative effect on the other hand (Lucas & Pabuayon, 2011; Rizwan et al., 2020; Savage, 1993). Income was found to have an increasing effect on the risk perception of hazardous events (Ndamani & Watanabe, 2017; Savage, 1993). Socio-cultural

factors are the social norms and cultures that affects the feelings, thought process and behaviours of individuals. Van der Linden (2015) in a study of the United Kingdom found social norms to have higher influence on the risk perception of climate change compared to sociodemographic factors. Extant literature has found a significant relationship between individual social and political practices and their risk perception of climate change. Religious practice language diversity in household and are included in the

Existing studies have found farm-level characteristics influence farmers' risk perception. Farm size was found to have a positive influence the risk perception of farmers (Il Islam et al., 2021; Lucas & Pabuayon, 2011). The years of farming experience have also been found to have a positive influence on farmers risk perception of climatic issues (Il Islam et al., 2021). Studies on risk perception of adverse events agree that past individual experience or exposure to the adverse event has a positive influence on their perceived risk of such event (Dessai & Sims, 2010; Van der Linden, 2015; van Winsen et al., 2016). Even when the objective risk is known, individual's risk perception is still subjective because of their varying capacity to determine the probability of loss or exposure to loss as a result of the adverse event (Ahsan, 2011). Most existing literature have found a positive influence of past experience of a risky event on individual subjective risk perception of that event (Qasim et al., 2018; Van der Linden, 2015). Although, a study in Sweden found men with more lifetime experiences of a risks (natural disasters, fire, drowning etc.) had less severe risk perceptions than other respondents (Sund, Svensson, & Andersson, 2017). This implies that personal risk experience may also negatively influence risk perception, depending on how their risk experience changes their thought process. Due to the nature of FH conflicts, we hypothesize that past exposure to FH conflicts will have a positive influence on rural households' FH conflict risk perception.

3.2 Empirical Strategy

An ordinary least squares (OLS) regression was used to determine the socio-demographic factors affecting rural household's risk perception of FH conflicts. The FH conflict risk perception indices are modelled as a function of several factors including socio-demographic characteristics of household and household head (age, gender, education, farming experience, marital status etc), agricultural activities (crop diversification, livestock farming, type of crop cultivation), tenure security (possession of land title to largest farmland), exposure to FH conflict and geographical location of household.

To determine the factors affecting rural household's risk perception of FH conflicts, we construct two different FH conflict risk perception indices as it concerns: (1) food production and supply, (2) household physical security and wellbeing. We then model the determinants of the risk perception of FH conflict as follows:

$$RPI_i = \sigma + \beta \boldsymbol{X_i} + \mu_i \quad (1)$$

where RPI_i is the FH conflict risk perception index of the ith household; σ is the intercept; $\boldsymbol{X_i}$ is a vector of household, household head and farm-level control variables that can influence household's risk perception of FH conflicts, and μ_i is the error term.

4. Data, Variable Measurements, and Descriptive Statistics

4.1 Data

The study was carried out in Nigeria. A multistage sampling procedure was used in selecting households for the survey. In the first stage, two geographical zones – food secure and food

insecure, were purposively selected based on preliminary analysis of secondary data.[1] In the second stage, one State in each zone and five Local Government Areas (LGA) in each State were purposively chosen based on a prior occurrence of FH conflict. In the third stage, two towns in each LGA, two villages in each town and about 10 households in each village were randomly selected. A total of 401 households were sampled for the study.

To ensure unambiguous survey questions and response categories, we conducted a pilot study of 25 farming households in the study area. Results of the pilot survey informed refinement of the survey questionnaire. The survey was administered between May and June 2019 by trained enumerators to guarantee the quality of information collected. Data collected was related to the 2018 planting season and focused on socio-economic characteristics of household, household head, farm-level characteristics, frequency of FH conflict occurrence etc. Table 1 presents a description and summary statistics of the key variables used in our estimation.

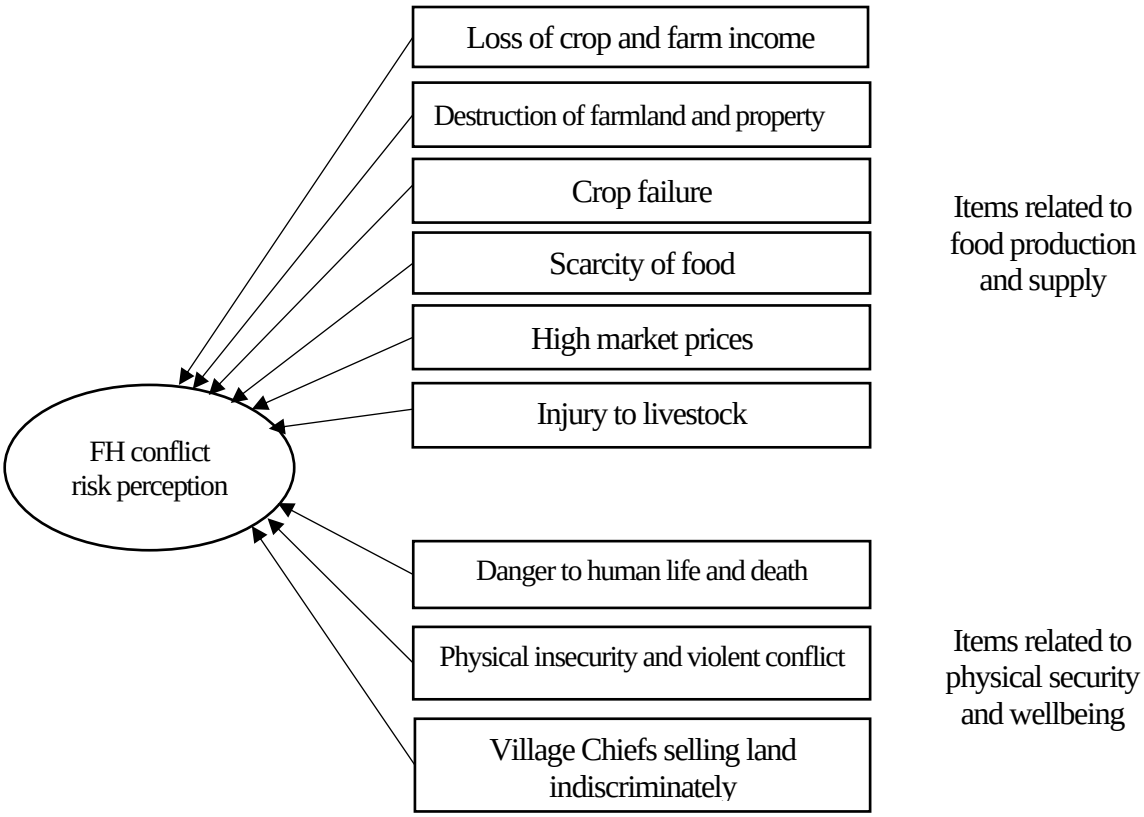
4.2. Variable Measurements

4.2.1 Risk Perception of FH Conflict

In this paper, we measure rural household's risk perception of FH conflict. This captures rural household's perceived hazard from FH conflicts that encompasses their knowledge of the FH conflicts and their ability to cope with its consequences. Figure 2 shows a pictorial representation of the construction of our FH conflict risk perception index. We propose that rural household's subjective risk perception of FH conflict is based on their individual knowledge of the problem and stems from their worry of its effect on their family. As shown in Figure 2, we debate that rural household's the risk perception of FH conflict stems from worry about the effect of FH conflict on their farm production and food supply and also its effect on physical insecurity and wellbeing.

[1] Preliminary analysis of the 2015-2016 Nigerian General Household Survey (GHS) showed that the northcentral and southeast geopolitical zones are the most food secure and least food secure zones in Nigeria.

Figure 2. Construction of the FH Conflict Risk Perception Index and Sub-indices



Household heads were asked several questions on how worried they were about certain issues regarding previously occurred FH conflicts. Nine questions were used to construct a holistic assessment of household FH conflict risk perception (Figure 2). The first six questions asked respondents how worried they were about loss of crops and farm income, destruction of farmland and property, crop failure, high market prices for food, scarcity and food and injury to livestock as a result of FH conflicts. The remaining questions asked how worried they were about physical insecurity, violent clashes, danger to human life and the indiscriminate selling of communal land by their community head. The response categories for all questions ranged from between extremely worried to not worried at all. The FH risk perception index was derived from a nine-item scale using exploratory factor analysis. Empirical results suggests that these nine items are quite related. The average inter-item correlation of 0.455 with a minimum or 0.30 and a maximum of 0.78 and an alpha (α) of 0.8439. To further probe the source of their perceived risk, two sub-indices were constructed to capture their risk perception of FH conflict as it concerns: (1) food production and supply (α= 0.837) and (2) household physical security and wellbeing (α= 0.481).

4.2.2 Control Variables

Following existing literature, the socio-demographic variables age, gender, education, dependency ratio, and marital status of household head were included to capture the impact of socio-demographic characteristics of the household head on household risk perception of FH conflicts. Farmer characteristics like age (Cohn, Macfarlane, Yanez, & Imai, 1995; Il Islam et al., 2021; Otani, Leonard, Ashford, Bushroe, & Reeder, 1992; Rizwan et al., 2020), education have been found to be significant predictors of risk perception (Il Islam et al., 2021; Rizwan et al., 2020; Savage, 1993)

We also include a set of farm-level variables like farm size, type of crop production, crop diversification proxied by the number of crops cultivated farm household, livestock diversification proxied by the number of number of livestock grown by farm household, and farming experience of household head. Farm size (Bar-Shira, Just, & Zilberman, 1997; Harrison, Lau, & Rutström, 2007; Hartog, Ferrer-i-Carbonell, & Jonker, 2002; Il Islam et al., 2021; Lucas & Pabuayon, 2011) and farming experience (Rizwan et al., 2020) has been found to be important predictors of risk perception and attitude.

A variable for ownership of formal title deed to largest farmland was included to capture the impact of land tenure security on household risk perception of FH conflicts. Distance from household to closest neighbour was included to capture the impact of household settlement dispersal on their risk perception of FH conflicts. A variable for prior exposure of FH conflicts in the preceding year was included in the model to determine how the past exposure to FH conflict influences their FH conflict risk perception. We expect that a prior exposure to FH conflict will be positively related to their FH conflict risk perception in the present.

4.3 Descriptive Statistics

Table 1 presents a description and summary statistics of all variables used in this study. On average, a rural household head in our sample is aged about 49 years, with 26 years farming experience, and above 8 years of formal education (Table 1). In our sample, a rural household on average cultivated about 3.86 acres of land, with about eight types of crops. The mean distance to the closest neighbour is 320 metres and 15.41 kilometres to the closest city. On average FH conflicts occurred about 4 times in the last year. Table A1 in the appendix shows the pairwise correlation matrix of all variables used in the study. No multicollinearity problems were detected.

Table 1. Description and Summary Statistics of Key Variables

Variable	Description	Mean (SD)
FH conflict risk perception	Household Risk perception of FH conflict	-0.001 (0.671)
Age	Age of household head (years)	49.43 (14.46)
Gender	1 if household head is female, 0 otherwise	0.24 (0.43)
Education	Education of household head (years)	8.64 (26.83)
Religion	1 if household is Christian, 0 otherwise	0.94 (0.23)
Marital status	1 if household head is married, 0 otherwise	0.86 (0.35)
Dependency ratio	Number of household members below 18 and above 60 years	0.40 (0.23)
Household size	Number of household members (persons)	9.44 (6.82)
Language	The number of languages spoken in the household	2.20 (0.78)
Household income	Total household income (₦10,000)	30.69 (20.40)
Farming experience	Household head's years of farming	26.83 (15.25)
Farm size	Total area of cultivated farmland (acres)	3.86 (3.85)
Crop diversification	The number of crops cultivated by household	7.52 (3.15)
Livestock diversification	Types of livestock cultivated by household	1 (1.04)
Distance to city	Distance from household to closest city (km)	15.41 (9.72)
Distance to closest neighbour	Distance from household to closest neighbour (km)	0.32 (0.43)
Migration status	1 if household migrated to the community, 0 otherwise	0.12 (0.33)
Formal land title	1 if household has title deed to largest farmland, 0 otherwise	0.14 (0.35)
FH conflict exposure	1 if household is in a community that has experience FH conflict in the last five years, 0 otherwise	0.63 (0.48)
Frequency of FH conflict	Number of FH conflicts in the community in 2018 (0-28)	3.95 (6.20)
Location	1 if household is located in Northcentral zone, 0 otherwise	0.50 (0.50)

Note: ₦ is Nigerian currency (US$1 = ₦ 380), SD refers to standard deviation

Table 2 shows the mean differences in key variables by gender of household head. Male-headed households were found to have significantly higher risk perception of FH conflict than female-headed households as well as more household members. A reason for this could be because of their increased worry about the threat of FH conflicts on their household members. Male household heads were also significantly more educated, with a higher probability of being married than female household heads. Although female-headed households were found to have a larger mean size of cultivated land, they had a lower number of crops & livestock reared as well as and less income than male-headed households. This implies that even though female-

headed households have larger farm sizes, it was not as productive and profitable as that of male-headed households.

Table 2 Mean Differences in Key Variables by Gender of Household Head

Variables	Male	Female	Mean Difference
FH conflict risk perception	0.11 (0.03)	-0.35 (0.08)	0.46***
Age	49.28 (0.84)	49.89 (1.43)	-0.60
Education	9.22 (0.28)	6.80 (0.59)	2.42***
Religion	0.94 (0.01)	0.96 (0.02)	-0.02
Marital status	0.95 (0.01)	0.55 (0.05)	0.41***
Dependency ratio	0.40 (0.01)	0.41 (0.03)	-0.01
Household size	10.28 (0.42)	6.84 (0.39)	3.44***
Language	2.37 (0.04)	1.67 (0.06)	0.70***
Household income	33.49 (1.16)	21.92 (1.89)	11.56***
Farming experience	27.30 (0.89)	25.34 (1.45)	1.97
Farm size	3.53 (0.21)	4.92 (0.43)	-1.39***
Crop diversification	7.74 (0.17)	6.80 (0.34)	0.94***
Livestock diversification	1.06 (0.06)	0.80 (0.08)	0.26***
Distance to city	14.09 (0.52)	19.57 (1.05)	-5.48***
Distance to closest neighbour	0.30 (0.02)	0.37 (0.05)	-0.07
Migration status	0.12 (0.02)	0.12 (0.03)	1.27
Formal land title	0.17 (0.02)	0.05 (0.02)	0.12***
FH conflict exposure	0.71 (0.03)	0.78 (0.04)	-0.07*
Frequency of FH conflict	4.75 (0.39)	1.43 (0.20)	3.31***
Location	0.65 (0.03)	0.03 (0.02)	0.62***

Note: standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Male-headed households were found to be located significantly closer to the nearest city, have more formal property rights as well as less FH conflict exposure than female-headed households. Variables with insignificant differences between male and female-headed households include the age, religion, dependency ratio, farming experience, distance to closet neighbour, and migration status.

5. Results and Discussion

Results of the OLS estimation of the determinants of the risk perception of FH conflict is presented in Table 3. Results for the risk perception of FH conflict relating to food production and supply and physical security and wellbeing is reported (Table 4).

5.1. Factors Influencing the Risk Perception of FH Conflicts

Table 3 presents three models predicting FH conflict risk perception using OLS regressions. All models in Table 3 passed the Ramsey Regression Equation Specification Error Test (RESET) and link test, indicating correct model specification with an absence of omitted variables. Also,

all three models had coefficient of determination higher than 40%. This implies that all models in Table 3 were able to explain more than 40% of the variance in FH conflict risk perception. Model 1 in Table 3 includes a dummy variable that captures if the community has experienced a FH conflict in the last 5 years. Model 2 includes a variable capturing the frequency of FH conflict occurrence while, Model 3 contains an interaction variable that captures the mediating effect of frequency of exposure to FH conflicts on how female-headed households FH conflict risk perception.

Table 3. Estimation Results for Different Models of FH Conflict Risk Perception with and without an Interaction between FH Conflicts and Gender of Household Head.

VARIABLES	(1) coefficient	(2) coefficient	(3) coefficient
Age	-0.005* (0.003)	-0.005* (0.003)	-0.006* (0.003)
Gender	-0.101 (0.097)	-0.101 (0.098)	-0.179 (0.116)
Education	0.007 (0.007)	0.006 (0.007)	0.005 (0.007)
Religion	0.007 (0.110)	0.009 (0.110)	0.025 (0.112)
Marital status	0.092 (0.120)	0.105 (0.119)	0.112 (0.120)
Dependency ratio	0.177 (0.151)	0.176 (0.151)	0.197 (0.151)
Household size	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)
Language	0.087** (0.042)	0.089** (0.043)	0.089** (0.043)
Household income	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Farming experience	0.009*** (0.003)	0.009*** (0.003)	0.009*** (0.003)
Farm size	-0.017** (0.007)	-0.017** (0.007)	-0.016*** (0.007)
Crop diversification	0.034*** (0.010)	0.034*** (0.010)	0.032*** (0.010)
Livestock diversification	0.065** (0.025)	0.066** (0.025)	0.067** (0.026)
Distance to city	0.001 (0.003)	0.001 (0.003)	0.001 (0.003)
Distance to closest neighbour	0.313*** (0.062)	0.312*** (0.062)	0.321*** (0.063)
Migration status	-0.260*** (0.098)	-0.261*** (0.098)	-0.256*** (0.098)
Formal land title	-0.420*** (0.083)	-0.421*** (0.084)	-0.414*** (0.084)
FH conflict exposure	0.384*** (0.080)	0.392*** (0.093)	0.374*** (0.092)
Frequency of FH conflicts		-0.001 (0.004)	-0.002 (0.005)
FH conflict and gender interaction			0.056* (0.033)
Location	0.438*** (0.071)	0.442*** (0.075)	0.445*** (0.075)
Constant	-1.115*** (0.274)	-1.117*** (0.274)	-1.133*** (0.275)
Observations	401	401	401
R-squared	0.428	0.428	0.434

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Results show that the coefficient for age of household head has a negative and statistically significant effect on FH conflict risk perception for all three models. This implies that younger farmers have higher levels of FH conflicts risk perception. A reason for this could be that younger farmers have less farming and conflict-resolution experience which manifests in their increased perceived risk of FH conflicts. This finding is similar to that of Savage (1993) and Peacock et al. (2005) studying hazard and hurricane risk perceptions, but contrary to that of Ndamani and Watanabe (2017), (Rizwan et al., 2020) and (Il Islam et al., 2021) who studied farmers climate change risk perception. The coefficient of the variable representing the number of languages spoken in the household is positive and statistically significant. This implies that the higher the number of languages spoken in a household, the higher their FH conflict risk perception. A reason for this may be that more linguistically diverse households may reside in more culturally diverse communities and are therefore more sensitive to the threat of FH conflicts. The variable farming experience variable has a positive and statistically significant coefficient for all three models. This finding suggests that the more number of years the household head has spent in farming, the higher their risk perception of FH conflicts. The increased farming knowledge and awareness about FH conflicts may make farmer and s wearier about it and how it may affect their households.

The coefficient of the farm size variable is negative and statistically significant. This suggests that the more farmland the household has under cultivation, the lower their risk perception of FH conflicts. This finding is contrary to a prior expectation. A potential reason may be that households with more land under cultivation have reduced fear of losing their entire crop yield due to FH conflicts or may be wealthy enough to have protection over their farmland. This finding disagrees with that of Lucas and Pabuayon (2011) and who studied the risk perceptions of rain-fed lowland rice farmers in Ilocos Norte, Philippines. Conversely, the finding disagrees with result of Il Islam et al. (2021) who studied farmers risk perception and attitudes associated with environmental and climate issues in Bangladesh. The coefficient of the variables representing crop and livestock diversification are positive and statistically significant for all three models. This indicates that rural households with a higher number of crop and livestock portfolio have higher FH conflict risk perception. This finding is similar to that of Rockmore (2020), who found farmers reduce their crop and livestock portfolios as the objective risk of violence increased. The distance to closest neighbour variable has a positive and statistically significant impact on FH conflict risk perception for all three models. This implies that how dispersed the village is increases rural household's risk perception of FH conflicts. A reason for this finding may be that households living far away from their closest neighbours may be more vulnerable to violent attacks during a FH conflict because of a lack of immediate help from nearby neighbours in the event of a FH conflict. Conversely, for all three models, the coefficient for the variable capturing household's possession of a formal title to their largest farmland is negative and statistically significant. This suggests that tenure security, in the form of the possession of a formal title to land, reduces rural household's FH conflict risk perception because of the secure tenure and formal claim to their farmland. Other studies have found increased tenure security to not only improve rural household prospects for food security but improvement in farming practices as well as increased investment in productive inputs (Abdulai, Owusu, & Goetz, 2011; Ghebru & Holden, 2013; Kousar & Abdulai, 2016).

For all models in Table 3, the coefficient of the FH conflict exposure variable is positive and statistically significant. This indicates that households in communities that have experienced FH conflicts at least once in the last five years have higher risk perception of FH conflicts. This finding is in consonance with findings of Qasim et al. (2018) who found that past experience of landslides increases landslide risk perception. Furthermore, the location variable has a positive and statistically significant effect on the risk perception of FH conflicts. This shows that

households living in the North Central geopolitical zone has higher risk perception of FH conflict that those living in the South East geopolitical zone. This may be explained by the fact that the northcentral geopolitical zone is mainly agrarian, producing majority of the food consumed in the country and has more occurrences of FH conflicts. Other socio-economic characteristics like gender, education level, religion, marital status, dependency ratio, household size and income had no significant impact on FH conflict risk perception.

A variable for the number of occurrences of FH conflict was included in Model 2, Table 3. Results show no significant impact of the frequency of FH conflict occurrence on rural household's risk perception of FH conflict. In Model 3, Table 3, an interaction term between gender of household head and frequency of FH conflict was included. This is to capture the moderating effect of the frequency of FH conflict occurrences on the impact of gender of household head on FH conflict risk perception. Results show that the coefficient of the interaction term is positive and statistically significant. This finding indicates that an extra occurrence of FH conflict increases female-headed households risk perception of FH conflict by 0.058 units. Surprisingly, the individual variables of gender and incidence of FH conflict are insignificant by themselves.

5.2. FH Conflict Risk Perception as a Two-dimensional Construct

To probe the differences in risk judgements and the source of their perceived risk in more detail, the nine risk perception items were divided into two. Two sub-indices are constructed to capture rural household's risk perception of FH conflict as it concerns: (1) food production and supply and (2) physical security and wellbeing. Table 4 presents results of the multiple linear regressions with the two sub-indices capturing FH conflict risk perception as it relates to food production (model 1) and physical insecurity (model 2) as outcome variables.

The results for model 1 (column 2, Table 4) show that the variables age, language diversity, crop diversification, distance to closest neighbour, formal land title and FH conflict exposure and location are significant predictor of FH conflict risk perception relating to food production and supply. Specifically, findings imply that households located in the North Central zone, with younger heads and more years of farming experience have higher risk perception of conflict relating to food production and supply. In addition, households that have experience FH conflicts in the past, living farther away from their closest neighbour, with higher language and crop diversification have greater risk perception of conflict relating to food production and supply. On the other hand, possession of formal title to farmland reduced FH risk perception relating to food production and supply.

Table 4. Estimation results for models of FH conflict risk perception relating to food production and physical insecurity and wellbeing

VARIABLES	(1) RP coefficient	(2) FP coefficient	(3) PI coefficient
Age	-0.005* (0.003)	-0.007* (0.003)	-0.003 (0.003)
Gender	-0.101 (0.097)	-0.107 (0.113)	-0.093 (0.116)
Education	0.007 (0.007)	0.002 (0.008)	0.016** (0.008)
Religion	0.007 (0.110)	0.007 (0.129)	0.048 (0.114)
Marital status	0.092 (0.120)	0.138 (0.133)	-0.013 (0.139)
Dependency ratio	0.177 (0.151)	0.236 (0.157)	0.055 (0.175)
Household size	-0.004 (0.004)	-0.001 (0.005)	-0.011** (0.005)
Language	0.087** (0.042)	0.099** (0.051)	0.063 (0.046)
Household income	0.000 (0.001)	-0.002 (0.002)	0.004** (0.002)
Farming experience	0.009*** (0.003)	0.009*** (0.003)	0.010*** (0.003)
Farm size	-0.017** (0.007)	-0.014 (0.008)	-0.025** (0.011)
Crop diversification	0.034*** (0.010)	0.037*** (0.012)	0.028** (0.012)
Livestock diversification	0.065** (0.025)	0.047 (0.030)	0.104*** (0.028)
Distance to city	0.001 (0.003)	-0.002 (0.004)	0.008** (0.003)
Distance to closest neighbour	0.313*** (0.062)	0.355*** (0.071)	0.232*** (0.077)
Migration status	-0.260*** (0.098)	-0.309*** (0.112)	-0.153 (0.126)
Formal land title	-0.420*** (0.083)	-0.472*** (0.101)	-0.317*** (0.082)
FH conflict exposure	0.384*** (0.080)	0.524*** (0.090)	0.090 (0.090)
Location	0.438*** (0.071)	0.396*** (0.083)	0.539*** (0.094)
Constant	-1.115*** (0.274)	-1.110*** (0.318)	-1.151*** (0.309)
Observations	401	401	401
R-squared	0.428	0.397	0.340

Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The results for model 2 (column 3, Table 4) show that the variables education, household size, household income, farming experience, farm size, crop diversification, livestock diversification, distance to city, distance to closest neighbour, formal land title and location are significant predictor of FH conflict risk perception relating to physical insecurity and wellbeing. Explicitly, results imply that households with educated household heads, more income and that live farther away from the city have higher risk perception of FH conflict concerning physical insecurity. This implies that the farther away from a city a household lives, the higher the fear of adverse effect of a FH conflict. A reason for this may be the lack of security personnel in remote areas where the household is located. In contrast, possession of formal title to farmland as well as the higher area of land cultivated and number of household members, the lower their risk perception of FH conflict regarding physical insecurity and well-being. An explanation for this is that with a larger household size, there is more confidence in their ability to protect their property and dependents in the event of a FH conflict. Findings agree with that of Legesse and

Drake (2005) who found livelihood diversification and family size reduced smallholder farmer's risk perception of land scarcity and high crop prices in Ethiopia. The FH conflict exposure variable is an insignificant predictor for the risk perception of FH conflict regarding physical insecurity.

Compared to the overall risk perception of FH conflict model (model 1, Table 4), results of the determinants of the sub-indices of FH conflict risk perception (Table 4) show that while education, household size, and income are more important predictors of FH conflict risk perception concerning physical insecurity and wellbeing, age of household head and FH conflict exposure are important predictors of FH conflict risk perception concerning food production and supply.

6. Conclusion

For the holistic measure of FH conflict risk perception, age of household head, farm size, and possession of a formal title to farmland had a negative significant effect on FH conflict risk perception, while language diversity, farming experience, number of crops household cultivates, types of livestock reared, distance between household and nearest neighbour, and exposure to FH conflict and being located in the northcentral zone had a positive significant influence on FH conflict risk perception. Splitting the FH conflict risk perception index into two sub-indices capturing FH conflict risk perception as it relates to food production and physical insecurity, we estimate the regression models again. Results show that education and household income and size, farm size, and distance from household to the city are more important predictors of FH conflict risk perception concerning physical insecurity and wellbeing, while age, language diversity, and FH conflict exposure are more important predictors of FH conflict risk perception concerning food production and supply.

Findings recommend the enactment of initiatives that facilitate procurement of formal titles to land resources as well as encourage gradual shift to more sustainable herding systems. Studies have shown that how farmers respond to any kind of risk is an important factor in determining their agricultural production choices. Hence, strategies that improve farmers' capacity to cope with FH conflict risks should be facilitated.

Findings have implications for governmental and non-governmental agents willing to influence the risk behaviour of rural households to FH conflicts by means of targeted interventions, for instance, increasing tenure security through the provision of formal title to owned land. These findings will help policy makers understand the thought process of rural dwellers, facilitate understanding of how they will respond to policy changes as regards FH conflict and consequently aid the development of efficient risk management initiatives. Although, this study provides vital understanding on what affects FH conflict risk perceptions, further research is needed to understand how climate and time-varying variables influence the risk perception of FH conflicts. This can be done by using longitudinal data to control for time and climate effects.

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Appendix

Table A1 Pairwise correlation matrix of all variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) RPIs	1.000														
(2) Age	-0.040	1.000													
	(0.426)														
(3) Gender	-0.297*	0.018	1.000												
	(0.000)	(0.721)													
(4) education	0.102	-0.443*	-0.200*	1.000											
	(0.042)	(0.000)	(0.000)												
(5) Religion	0.008	-0.216*	0.039	0.186*	1.000										
	(0.867)	(0.000)	(0.434)	(0.000)											
(6) Marital status	0.197*	-0.154*	-0.496*	0.265*	0.051	1.000									
	(0.000)	(0.002)	(0.000)	(0.000)	(0.308)										
(7) Dependency ratio	0.044	-0.052	0.025	-0.011	-0.016	0.123	1.000								
	(0.381)	(0.299)	(0.619)	(0.828)	(0.753)	(0.014)									
(8) Household size	0.180*	0.117	-0.216*	-0.016	-0.066	0.191*	-0.123	1.000							
	(0.000)	(0.019)	(0.000)	(0.754)	(0.188)	(0.000)	(0.014)								
(9) Language diversity	0.267*	-0.062	-0.385*	0.262*	-0.047	0.252*	-0.095	0.318*	1.000						
	(0.000)	(0.218)	(0.000)	(0.000)	(0.347)	(0.000)	(0.057)	(0.000)							
(10) Household income	0.114	0.025	-0.243*	0.157*	-0.079	0.118	-0.028	0.182*	0.153*	1.000					
	(0.022)	(0.623)	(0.000)	(0.002)	(0.116)	(0.019)	(0.577)	(0.000)	(0.002)						
(11) Farming experience	0.159*	0.714*	-0.055	-0.442*	-0.151*	-0.089	-0.042	0.185*	0.029	0.116	1.000				
	(0.001)	(0.000)	(0.269)	(0.000)	(0.002)	(0.076)	(0.401)	(0.000)	(0.561)	(0.021)					
(12) Farm size	-0.072	0.087	0.155*	-0.110	-0.138*	-0.039	-0.018	0.078	-0.022	0.125	0.103	1.000			
	(0.152)	(0.082)	(0.002)	(0.028)	(0.005)	(0.438)	(0.715)	(0.118)	(0.660)	(0.012)	(0.039)				
(13) Crop diversification	0.263*	0.113	-0.128	-0.006	-0.035	0.058	0.044	0.179*	0.114	0.208*	0.191*	0.229*	1.000		
	(0.000)	(0.024)	(0.010)	(0.900)	(0.491)	(0.243)	(0.385)	(0.000)	(0.023)	(0.000)	(0.000)	(0.000)			
(14) Livestock diversification	0.202*	0.044	-0.106	0.049	0.041	0.075	0.000	0.139*	0.123	0.278*	0.180*	0.108	0.346*	1.000	
	(0.000)	(0.375)	(0.034)	(0.324)	(0.411)	(0.135)	(0.996)	(0.005)	(0.014)	(0.000)	(0.000)	(0.030)	(0.000)		
(15) Distance to city	-0.092	0.040	0.242*	-0.167*	-0.187*	-0.204*	0.014	-0.185*	-0.303*	-0.048	-0.068	0.219*	-0.064	0.031	1.000
	(0.067)	(0.421)	(0.000)	(0.001)	(0.000)	(0.000)	(0.784)	(0.000)	(0.000)	(0.339)	(0.177)	(0.000)	(0.204)	(0.539)	
(16) Distance to closest neighbour	0.104	-0.058	0.069	-0.073	-0.194*	-0.023*	0.017	-0.026	-0.021	-0.018	-0.136*	0.108	-0.206*	-0.183*	0.317*
	(0.038)	(0.247)	(0.168)	(0.143)	(0.000)	(0.648)	(0.740)	(0.607)	(0.673)	(0.726)	(0.006)	(0.031)	(0.000)	(0.000)	(0.000)
(17) Migration status	-0.227*	-0.113	0.007	0.121	0.025	-0.023	0.064	-0.192*	-0.065	0.068	-0.199*	-0.073	-0.187*	-0.044	-0.000
	(0.000)	(0.024)	(0.889)	(0.016)	(0.619)	(0.645)	(0.201)	(0.000)	(0.194)	(0.175)	(0.000)	(0.160)	(0.000)	(0.377)	(0.998)
(18) Formal land title	-0.127	-0.090	-0.144*	-0.127	-0.127	0.072	0.068	0.084	-0.016	0.077	0.137*	0.046	-0.077	0.062	-0.123
	(0.011)	(0.071)	(0.004)	(0.011)	(0.011)	(0.148)	(0.171)	(0.094)	(0.744)	(0.122)	(0.006)	(0.353)	(0.122)	(0.215)	(0.013)
(19) FH conflict	0.224*	-0.025	0.067	0.224*	0.224*	0.012	0.116	-0.122	0.029	-0.083	-0.148*	0.020	-0.051	0.092	0.285*

exposure															
	(0.000)	(0.615)	(0.179)	(0.000)	(0.000)	(0.808)	(0.020)	(0.015)	(0.560)	(0.099)	(0.003)	(0.696)	(0.312)	(0.067)	(0.000)
(20) Frequency of FH conflict	0.310*	-0.125	-0.229*	0.310*	0.310*	0.023	0.090	0.136*	-0.050	0.235*	0.275*	0.099	0.024	0.218*	-0.145*
	(0.000)	(0.012)	(0.000)	(0.000)	(0.000)	(0.647)	(0.073)	(0.006)	(0.318)	(0.000)	(0.000)	(0.049)	(0.626)	(0.000)	(0.004)
(21) Location	0.401*	-0.176*	-0.529*	0.401*	0.203*	0.074	0.339*	-0.084	0.413*	0.476*	0.059	0.075	-0.185*	0.067	-0.506*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.137)	(0.000)	(0.094)	(0.000)	(0.000)	(0.236)	(0.135)	(0.000)	(0.181)	(0.000)

Table A1 Continued

Variables	(16)	(17)	(18)	(19)	(20)	(21)
(17) Distance to closest neighbour	1.000					
(18) Migration status	0.055	1.000				
	(0.270)					
(19) Formal land title	-0.154*	-0.038	1.000			
	(0.002)	(0.451)				
(20) FH conflict exposure	0.063	0.018	0.018	1.000		
	(0.211)	(0.726)	(0.726)			
(21) Frequency of FH conflict	-0.072	-0.135*	0.069	0.387*	1.000	
	(0.153)	(0.007)	(0.170)	(0.000)		
(22) Location	-0.150*	-0.214*	0.174*	-0.181*	0.368*	1.000
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	