

Scotland's Rural College

What do we know about Nigerian farmers attitudes to uncertainty and risk? A systematic review of the evidence

Begho, T; Daubry, Tare Philip ; Irabor , Arnold Ebuka

Published in:
Scientific African

DOI:
[10.1016/j.sciaf.2022.e01309](https://doi.org/10.1016/j.sciaf.2022.e01309)

Print publication: 01/09/2022

Document Version
Publisher's PDF, also known as Version of record

[Link to publication](#)

Citation for pulished version (APA):

Begho, T., Daubry, T. P., & Irabor , A. E. (2022). What do we know about Nigerian farmers attitudes to uncertainty and risk? A systematic review of the evidence . *Scientific African*, 17, Article e01309. <https://doi.org/10.1016/j.sciaf.2022.e01309>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal ?

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



What do we know about Nigerian farmers' attitudes to uncertainty and risk? A systematic review of the evidence

Toritseju Begho^{a,*}, Tare Philip Daubry^b, Irabor Arnold Ebuka^c

^a Rural Economy, Environment & Society, Scotland's Rural College (SRUC), Peter Wilson Building, King's Buildings, W Mains Rd, Edinburgh, EH9 3JG, UK

^b Federal Ministry of Agriculture and Rural Development, Nigeria

^c Faculty of Agriculture, Delta State University, Abraka, Nigeria

ARTICLE INFO

Article history:

Received 10 February 2022

Revised 16 July 2022

Accepted 8 August 2022

Editor: DR B Gyampoh

Keywords:

Behaviour
decision making
agriculture
risk
uncertainty

ABSTRACT

In developing countries, specifically Nigeria, the vulnerability of smallholder farmers to agricultural uncertainties and risks is a major concern. Several studies that examine Nigerian farmers have highlighted how risk attitudes influence farming decisions. However, there is a gap in the synthesis of evidence necessary to enhance our understanding of farmers' attitudes to uncertainty and risk. Thus, we conducted a systematic review of the literature to understand farmers' attitudes to uncertainty and risk and the implication on farm-decision making. After the final screening, 39 papers met the inclusion criteria for our review. We find that the literature on the topic in Nigeria is small but expanding. We also find that risk attitude is measured through econometric and experimental methods, with the former being the most popular method. Twenty-six (26) papers (67%) reported that most farmers are risk-averse, although at different levels. The most consistent predictors for risk attitudes are age, household size, education, income, poverty status, farm size and access to credit. Other significant determinants of farmers' attitudes towards risk are household size, years of farming experience, health status, leadership position, and organisation membership. Attitudes to risk were also used to explain the differences in several farm decisions and livelihood strategies. Although the reference to risks took a relatively different perspective and constructs, the overarching finding was that a risk-averse farmer is more likely to make production and management decisions that will result in a lower average return. One benefit of our findings is that policymakers will be informed to accurately predict the choices and behaviour of farmers under different policy interventions. We conclude that there is a need for more empirical research, and accordingly, we suggest a research agenda that could address the gaps identified.

© 2022 The Author(s). Published by Elsevier B.V. on behalf of African Institute of Mathematical Sciences / Next Einstein Initiative.

This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>)

Introduction

Farmers, especially those in low-and middle-income economies, face several sources of uncertainty and risk (such as weather, climate, diseases, price, market, and institutional, among others). As a result, these farmers operate in precari-

* Corresponding author.

E-mail address: Toritseju.Begho@sruc.ac.uk (T. Begho).

ous conditions [10,45]. Previous global studies have found that attitudes to uncertainty and risk play an important role in farm decisions [9,30,40,66]. Similarly, several studies in Nigeria have highlighted the influence of risk attitudes on farmers' decision-making. However, as these studies have examined the effect of risk attitudes on specific decisions (e.g., adoption, participation in intervention schemes or specific farm management decisions), there is no holistic information necessary to generate sufficient attention to the role risk attitudes play in farm decision making. Besides, independently, the available studies cannot provide strong support for or dispute the assertion that farmers are generally risk-averse. Thus, we systematically reviewed the literature to provide a higher-level synthesis of the evidence. The objective of this paper was to (a) evaluate the extent to which risk attitude is considered in farm decision-making, (b) identify the approaches used, (c) provide empirical insight into farmers' risk attitudes, (d) evaluate the quality of the studies and (e) suggest a research agenda to address the gaps identified.

Our goal is for a holistic understanding of farmers' attitudes to uncertainty and risk, which would guide the design of risk management instruments and strategies that could help reduce the potentially disruptive effects. Therefore, this review could effectively increase accuracy in predicting Nigerian farmers' future choices and behaviour, at least in the aggregate, and guide policy design.

The importance of measuring risk attitudes of Nigerian farmers

In Nigeria, over 80% of farmers are categorised as smallholders [8]. These farmers constitute 50% of working Nigerians. Notably, half of these smallholder farmers fall within the poorest 40% of the population (World [75]). Considering that many farmers are already in a precarious situation, the uncertainty and risk associated with farming threaten farmers' resilience and sustainability. Besides, the absence of insurance markets exacerbates the problem [5,53]. Recently, there have been interventions aimed at improving the livelihood of smallholder farmers. To achieve this goal, it is important that there is empirical evidence of farmers' behaviour in the context of risk and uncertainty and discernment of its sensitivity to acceptance of the intervention.

Globally, there are generalisations about the risk attitudes of farmers. Specifically, smallholder farmers are stereotyped as being highly risk-averse. However, these generalised assumptions have been disputed with evidence [32,72]. Also, findings from studies beyond Nigeria may not reflect the behaviour of Nigerian farmers. This is because evidence shows that risk attitudes vary across regions, impacted by the differences in cultural and institutional factors [29,32]. Hence, it is important to collate the relevant empirical evidence on Nigerian farmers to provide a holistic interpretation of the findings in past studies and produce reliable and accurate conclusions.

The rest of the paper is organised as follows. In section 2, we briefly present the relevant concepts and context. Section 3 presents the steps in selecting the eligible studies for the systematic review. In Section 4, we report our findings, then discuss the finding in Section 5 and propose a research agenda. Finally, in section 6, we conclude the paper.

Concepts and context

In the agricultural economics literature, econometric estimation based on empirically observed data has been used to determine risk attitude. The variance of return is employed to measure risk as with the portfolio optimization mean-variance approach of Markowitz [43]. Other methods are the safety-first criterion [62] which is premised on a decision-maker considering outcomes below a particular level as a disaster and the threshold varying per individual. Thus, in a risky situation, each individual tends to make decisions that minimize the probability of attaining a disaster. Besides econometric methods and self-assessment of risk attitudes, a predominant elicitation instrument is the lottery-choice tasks. This task takes numerous forms, e.g., the easier to comprehend Eckel and Grossman task where participants of the experiment are given a set of 50–50 gambles, a sure outcome and a number of risky outcomes with linearly increasing expected payoffs and associated risk that is estimated as the standard deviation of expected payoffs). On the other hand, in the popular Holt and Laury task, participants are presented with ten decision tasks from which they have to choose between a pair that is riskier than the other. The probabilities are systematically varied, and the expected value changes with a new lottery pair.

As opposed to estimations based on field data, experimental methods permits that the elicitation process and conditions are controlled and identical for all participants. Considering that the attitudes of every participant can be observed individually, this method is advantageous over the field data methods. For a detailed discussion of the different elicitation instruments, readers can refer to Andersen et al. [7], Lönnqvist et al. [42], and Crosetto & Filippin [26].

Concept and sources of uncertainties and risks in agriculture

Farmers make decisions in the presence of a multitude of uncertainties and risks. Across studies in the literature, risk has been used interchangeably with uncertainty. We distinguish between risk (known probabilities) and uncertainty (unknown probabilities). For simplicity, we adopt De Groot & Thuriik [27] definition for risk as those circumstances in which the outcome is unknown, but the probability distribution governing that outcome is known, while uncertainty refers to those circumstances in which both the outcome and probability distribution are unknown. Unlike the case of risk, under circumstances of uncertainty, there is no valid basis for classifying instances. As such, there are no probabilities to not know, and probability logic does not exist for such cases. In the literature, an individual is generally categorised as risk-averse,

risk-neutral or risk-seeking [31,36,39], with a similar classification for uncertainty. For simplicity, we refer to risk aversion (respectively risk-seeking) in a standard albeit weak context in which an individual prefers a random variable less (more) than the degenerate random variable with the same mean [25]. There is also evidence that risk attitude is domain-specific [74]. Hence, most decision-makers exhibit risk aversion for gains and risk seeking over losses (see [70]).

A categorisation of the sources of uncertainties and risks in agriculture suggests that there are five main groups, namely: (i) production uncertainties (which are attributed to natural growth processes of crops and livestock, including weather related factors), (ii) price and market uncertainties (input and output price fluctuations that characterises agriculture in many low-and middle-income economies), (iii) financial uncertainties (v) institutional uncertainties (brought about by government actions) and (v) uncertainties from human or personal factors [41,71].

Methods

Information sources and search strategy

We conducted a comprehensive systematic literature search using multiple electronic databases, i.e., Web of Science, Google Scholar and SCOPUS. The combination of multiple databases is crucial to conducting efficient searches in systematic reviews as it eliminates or reduces the chances that eligible studies on a particular topic are left out [21]. In developing the strategy to search the electronic databases, we combined the key terms (risk, uncertainty, attitudes, behaviour, preference, farmers, crop, livestock, animal, and Nigeria) using Boolean operators. We scanned abstracts of papers returned by keyword searches for relevance. We also scanned the references of papers returned from the keyword searches (backward reference searching) to confirm no eligible papers were missed.

Eligibility criteria

Studies eligible for inclusion met the following criteria. The papers (i) measured or elicited risk or uncertainty attitudes, (ii) were published between 1991 and 2021, and (iii) focused on farmers in Nigeria (iv) the paper was published in a peer-reviewed journal or a conference proceeding. We excluded other grey literature, review and conceptual papers as these fell outside the scope of the review.

Data extraction/screening of articles

For data extraction and quality assessment, each paper was independently reviewed by two authors in line with the inclusion and exclusion criteria of the screening tool. The third author resolved any inconsistency.

Assessment for methodological quality

We assessed each study for methodological quality following the UK Department for International Development (DFID) guidance for assessing the strength of evidence based on the conceptual framing, methodology, analysis, relevance, and contribution. We assigned each paper a rating ranging from low to high for each domain.

Data analysis

We extracted information on the sample size, farm types, methodological approaches, and main findings. We used descriptive statistics to summarize the relevant information from the eligible studies. However, several factors did not permit a meta-analysis of the findings. Specifically, the limited number of papers, the heterogeneity of the studies due to the different elicitation methods and scoring, e.g., among studies that used Likert type self-report vs multiple price list vs hybrid experiment to categorize farmers' risk attitudes. In addition, some studies are missing important information that would otherwise have been used to compute the meta-analysis. These issues implied that a meta-analysis might be meaningless.

Results

Description of included studies

The search yielded 496 articles comprising journal papers, conference papers and grey literature (Fig. 1). The 244 papers consisted of articles returned in more than one database. Thus, we dropped 273 duplicates. Further screening of the title, abstract and full text resulted in a further 214 being dropped. After the final screening, 39 papers met the inclusion criteria for our review. The assessment of the strength of evidence was low-to-moderate, with only 12 papers (31%) satisfying the criteria for strong strength of evidence.

The studies that constitute this review measured risk attitudes from three farm types: namely crop farmers (30), poultry farmers (6) and fish farmers (3). Over the years, there has been an increase in the number of studies suggesting that the literature is growing. As shown in Fig. 2, 76% of the papers that met the inclusion criteria in this review were in the last ten

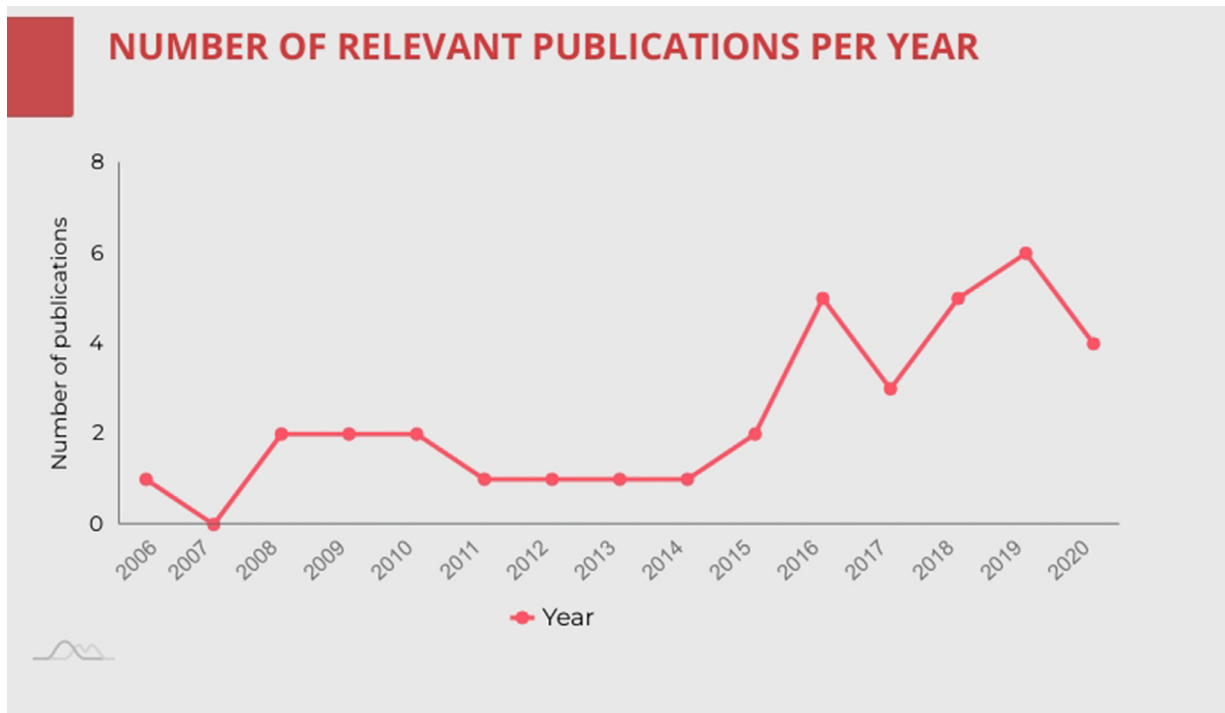


Fig. 1. Year of publication of the identified research articles
Source: Authors compilation

Table 1
Measurement methods and elicitation techniques characteristics summarized.

Methods	Number of studies
*Attitudinal Scale	13
Experiment	
Multiple Price List	2
Becker–DeGroot–Marschak	1
Hybrid	2
Econometric*	
Safety-first	21
Mean-variance optimization method	1
Paired comparison method	1

*Used in addition to other methods hence total > 39.

years, with peaks in 2019 (6 publications). Notably, there were only two empirical papers on uncertainty/ambiguity. The remaining 37 studies examined risk attitudes. A common feature across the studies that measured uncertainty/ambiguity was that farmers’ behaviour under uncertainty/ambiguity was similar to that of risk, albeit not a replica. Hence, our discussion onwards will refer mainly to risk attitudes.

Measurement methods and elicitation techniques

Risk attitude estimation by econometric methods is predominant in the literature examined (Table 1). Of the different econometric methods, the Safety-first approach was the most popular (29 papers). However, only 5 studies were based on an experiment. Of these experiment-based studies, 2 employed the Multiple Price List, 2 used hybrid tasks, while the Becker–DeGroot–Marschak method was used in 1 study. For the (11) studies that employed alternative measures of risk attitude using attitudinal scales, farmers were asked to rank the level they are willing to take risks on a scale. Otherwise, farmers were asked questions that required them to state their risk attitude, e.g., “What is your general attitude toward risk?”.

Empirical insight into farmers risk attitude

On the one hand, compared to 4 papers in which most of the farmers were risk seeking, 26 papers (67%) reported that the majority of farmers are risk averse, albeit at different levels (i.e., low to high risk aversion). On the other hand,

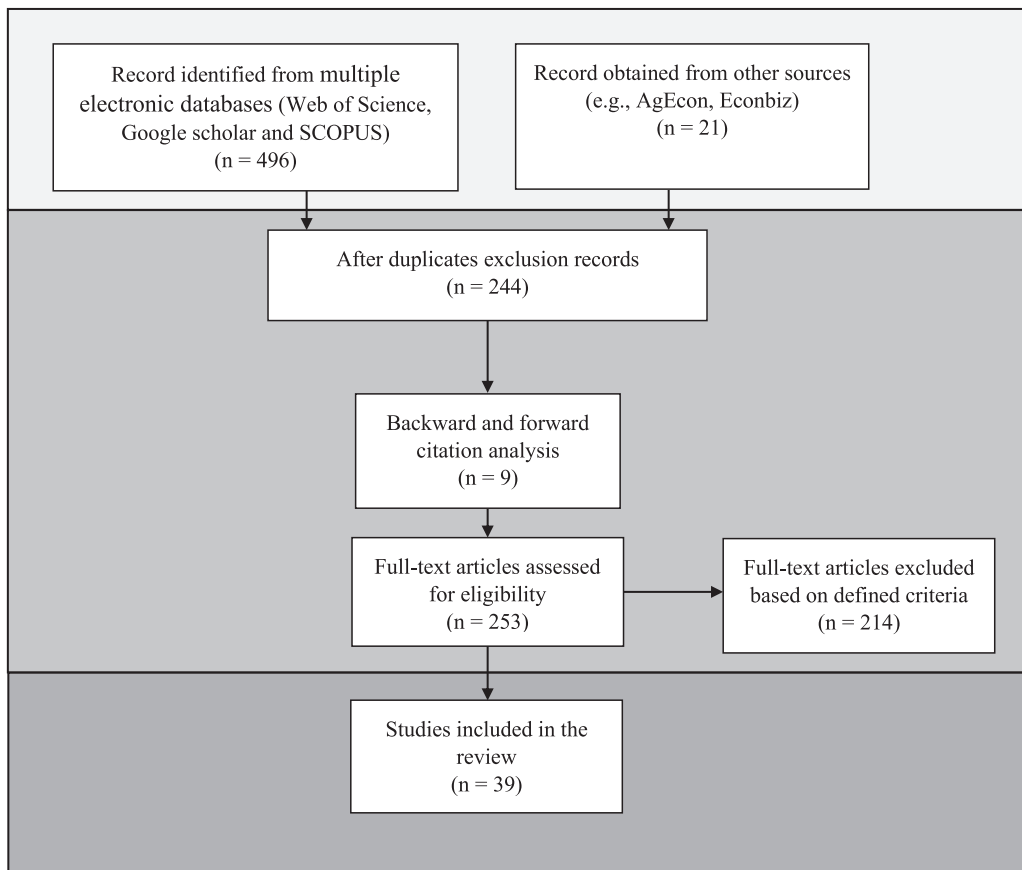


Fig. 2. Study selection process for the systematic review

the findings in 4 of the papers were mixed as there was no majority (Table 2). That is, farmers, risk attitudes in those papers were more heterogeneous. Also, contrary to previous assumptions, we find (2) studies that observed risk neutral attitudes among farmers. This review highlights that although most Nigerian farmers are risk averse, all farmers do not have homogenous attitudes toward risk. In this light, we categorise the studies into regions to examine whether risk attitudes differ by region given the heterogeneous settings of Nigeria in terms of factors such as agroclimatic conditions and culture, which are known to influence risk attitudes. The summary in Table 3 indicates that farmers in the Southwest region of Nigeria appear more risk-seeking compared to other regions. As such, a 'one size fits all' risk management approach is likely to be ineffective.

The determinants of risk attitude

A total of 27 papers (69%) examined the factors affecting farmers' risk attitudes. The most consistent predictors for risk attitudes are age, household size, education, income, poverty status, farm size and access to credit. Other factors identified as significant determinants of farmers' attitude towards risk are household size, years of farming experience, health status, leadership position and organization membership. The effect of age on risk attitude is contradictory to many past studies in other countries as we find mixed results. One set of studies ($N = 11$) found that the relationship between age and risk attitude was mainly negative, suggesting that older farmers tend to be more risk averse. While another group of studies ($N = 6$) reported that risk aversion decreases with age, considering that older farmers have experience in making economic decisions under uncertainty. Most studies find that larger farm owners were more likely to take a risk. Since most small-holder farmers are in the lowest income category in Nigeria, the postulation is that farmers become less willing to commit their meagre earnings to chance.

Similarly, poverty was predominantly associated with higher levels of risk aversion. That is, farmers whose incomes fall below the poverty line were less willing to take risks. Availability of social networks was also reported to drive risk seeking attitude. Further, neighbourhood-effect was a significant determinant of farmers' attitude toward risk, i.e., residing in a cluster of farmers with similar risk attitudes tends to impact individual farmers' risk attitude.

Table 2
Summary of studies on risk attitudes of farmers in Nigeria.

Study	Sample size	Farm type	Risk attitude(majority)	Measurement methods
Adubi [1]	192	Crop	NS	E
Ajetomobi & Binuomote [2]	360	Poultry	Moderately risk averse (68%)	E
Ajjjola et al. [3]	120	Crop	Risk seeking (97%)	E
Akinola [4]	70	Poultry	Risk seeking (53%)	E
Ambali, O. I. [6]	329	Crop	Risk averse* (M)	X
Aye & Oji [12]	120	Crop	Risk averse (99%)	E
Ayinde & Obalola [15]	120	Crop	NS	E
Ayinde [13]	240	Crop	Risk neutral (84%)	E
Ayinde [14]	240	Crop	Risk neutral (88%)	E
Ayinde et al. [16]	250	Crop	Risk averse to seeking	E
Ayinde et al. [17]	120	Crop	Risk averse (86%)	E
Begho [19]	158	Crop	Highly risk averse* (52%, 72%)	X
Bello et al. [20]	300	Crop	Risk seeking* (NS)	X
Bwala & Bila [22].	120	NS	Moderately risk averse (75%)	E
Fanifosi, et al. [28]	120	Crop	Intermediate risk averse (75%)	E
Ibeawuchi [34]	60	Crop	Risk seeking (78%)	E
John et al. [38]	256	Crop	Risk averse (100%)	X
Ndem & Osondu [46]	518	Crop	Risk averse (69%)	E
Nmadu et al. [47]	100	Crop	Risk averse (53%)	E
Obalola & Ayinde [48]	120	Crop	Risk averse (75%)	X
Obalola et al. [49]	120	Crop	Risk averse to neutral	E
Obayelu et al. [50]	200	Poultry	Risk averse (52%)	E
Ojo et al. [51]	120	Crop	Risk averse (50%)	E
Oladimeji et al. [52]	277	Fish	Risk seeking (52%)	E
Olarinde & Manyong [54]	350	Crop	Risk averse (100%)	E
Olarinde et al. [55]	350	Crop	Highly risk averse (50%)	E
Olarinde et al. [56]	348	Crop	Risk averse to neutral	E
Oluwatayo & Timothy [57]	130	Fish	Intermediate risk averse (55%)	E
Onyemauwa et al. [58]	81	Crop	Risk averse (97%)	E
Oparinde et al. [60]	200	Fish	Highly risk averse (57%)	E
Oparinde et al. [59].	320	Crop	Risk averse to neutral	E
Osoimehin [61]	150	Crop	Risk seeking (NS)	E
Sadiq et al. [63]	97	Crop	Risk averse (NS)	E
Sadiq et al. [64]	376	Crop	Risk averse (61%)	E
Salman et al. [65]	75	Poultry	Low risk averse (100%)	E
Sanusi et al. [67]	207	Crop	Highly risk averse (55%)	E
Timothy et al. [69]	130	Poultry	Probable risk averse (70%)	E
Vihi et al. [73]	120	Crop	Risk averse (60%)	E
Yusuf et al. [76]	120	Crop	Risk averse (58%)	E

X = Experimental, E = Econometric, NS = Not specified. * = domain specific, M = mixed.

The role of risk attitude in farm decisions and livelihood strategies

Attitudes to risk were used to explain the difference in the adoption of technologies and agronomic practices (5 studies), farm management strategies (9), poverty (2), participation in intervention schemes (3), willingness to pay (1) and off-farm participation decision (3). The estimation was mainly through regression analysis. The findings on the impact of risk attitude on adoption are mixed. For some risk management tools or strategies (e.g., high-yielding variety crops and the use of modern technologies), risk-averse farmers were less likely to adopt these. On the other hand, risk averse farmers mainly adopted other risk management strategies such as crop diversification, pooling resources via cooperatives and informal pre-cautionary savings). Also, risk averse farmers mainly participated in national, or state intervention programs targeted at food security. Although the different studies refer to risks from a relatively different perspective and construct, the overarching finding is that risk averse farmers are more likely to make production and management decisions that will result in a lower average return . Considering that many farmers in Nigeria are trapped in the cycle of poverty, these studies contend that risk aversion could contribute to many farmers remaining poor.

Discussion

Implications of the findings

In agriculture, as compared to several occupations, there is a peculiarity in the decision-making environment since it is dominated by uncertainties and risks. Also, there is the fact that in many cases, the decisions are made by a single farmer. Thus, the farmers' risk attitude plays a significant role in the decision process. Further, risk aversion is reported to affect a single input use such as fertilizer. Also, the combination of inputs chosen by a risk-averse farmer will differ from those

Table 3
Risk aversion by region.

State	Region	Risk attitude (majority)
Abuja	FCT	RA
Benue	NC	RA
Oyo	NC	RN
Oyo	NC	RN
Kwara	NC	Mixed
Kwara	NC	RA
Niger and Kwara	NC	RS
Niger	NC	RA
Kwara	NC	RS
Nasarawa	NC	RA
Borno	NE	RA
Sokoto	NW	NS
Katsina, Kano and Kaduna	NW	RS
Kebbi	NW	RA
Sokoto	NW	RA
Sokoto	NW	Mixed
Kaduna	NW	RA
Kaduna	NW	RA
Kaduna	NW	Mixed
Jigawa	NW	RA
Kaduna	NW	RA
Kaduna	NW	RA
Abia	SE	RS
Abia	SE	RA
Imo	SE	RA
Delta	SS	RA
Edo	SS	RA
Oyo	SW	NS
Not stated	SW	RA
Ogun	SW	RS
Ogun	SW	RS
Ogun	SW	RA
Oyo	SW	RA
Oyo	SW	RA
Oyo	SW	RS
Oyo	SW	RA
Ondo and Oyo	SW	RA
Ondo	SW	Mixed
Oyo	SW	RS
Ekiti, Ondo, Osun	SW	RA
Oyo	SW	RA
Oyo	SW	RA

RA = risk averse (varying extent), RS = risk seeking (varying extent), RN = risk neutral (varying extent).

chosen by a risk-neutral or risk-seeking farmer. Besides, the farmer's risk attitude influences the decision to adopt modern technology. These, in turn, have significant implications for yield and farm income. Therefore, to ensure that risk attitudes do not pose a limitation to making better farm decisions, the government could implement programs targeted at stabilizing farm incomes by decreasing the risks associated with farming, perhaps, through insurance.

Regarding direct policy implications, the impact could differ depending on farmers' risk attitudes. For example, the government promotion and dissemination of a high-yielding variety crop may not meet its goal if it is targeted at farmers that are risk averse. This is because most high yielding varieties require increased inputs to realize their higher responses. Thus, carrying additional risk. Thus, despite the yields being considerably higher, risk averse farmers may be unwilling to adopt it. We discuss further the implications for policy in section 6.

To what extent does this review align with the global literature?

We compare the current review to previous global reviews on the topic. This systematic review uncovered several key findings. First, the literature on Nigerian farmers' risk attitudes is nascent, unlike the global literature on the topic in general and those focusing on farmers in particular. However, it somewhat follows the trend in the wider literature wherein the number of studies increases over time.

In the global literature, the approaches for examining risk attitude range from first, an assumption of risk-indifference, and on that account, a goal of maximising expected gains or minimising expected losses and second, specifying a utility function. Third, employing a stochastic efficiency criterion that aligns with the assumptions of the expected utility theory.

Fourth is a direct measurement method of risk attitudes (see [44]). This review corroborates the global literature [18,37] that experimental and econometric approaches are the two approaches predominantly used in the literature to measure risk attitude.

Compared to the wider literature [11,36,68], the gap in Nigeria is wider in terms of the small number of experimental-based studies. We come back to this point in section 5.3. However, the instruments used in experimental elicitation of risk attitudes in studies included in this review align with most of the categories in global studies, i.e., Multiple Price List, Random Lottery Pairs, Ordered Lottery Selection, Becker–DeGroot–Marschak and hybrid procedures.

The findings that Nigerian farmers' risk attitudes differ with socio-economic factors, household characteristics, and geographic factors are largely consistent with global findings with a few exceptions such as age and poverty status. However, many global studies do not focus on the interactions of risk attitude with farmers' livelihood and poverty. As these are prevalent among farmers in Nigeria, the review shows that considerations for country differences are important and contribute to the holistic understanding of the role attitudes to risk play in economic decisions.

Overall, the evidence supports the assertion that Nigerian farmers are mostly risk averse. However, we make this generalization with caution as risk attitudes are domain and context specific. Again, a similar (risk averse) attitude has been reported among European farmers [36] and farmers in several low-and middle-income countries [33].

Challenges to conducting experiments to elicit farmers risk attitude in Nigeria

The direction of the wider literature indicates that experimental elicitation of risk attitude is the way forward. However, there are challenges to implementing experiments among farmers in Nigeria. This is mainly due to the level of cognitive burden the experiment poses. Most farmers would find it difficult to vary probabilities and payoffs in the manner presented in standard lottery experiments. Nmadu et al. [47] argue that many of the standard experiments used to elicit risk attitudes are unknown to or difficult to understand by farmers in Nigeria, thereby justifying the alternative methods adopted to measure farmers' risk attitudes. Other studies [23,24,35] have reported that the time involved, the level of general trust of the participants, the economic conditions and the barriers the use of electronic devices other than mobile phone poses makes conducting such experiments challenging to conduct among low literacy participants.

Researchers measuring farmers' risk attitudes in Nigeria via experiments have used hybrid methods to address some of these concerns. This approach highlights that authors have to design the experiment to reduce the cognitive burden and ensure that it captures and retains participants' interest. This reduces or eliminates the perception of undergoing a 'test' that some standard lottery methods induce. Also, experimental and non-experimental methods could be combined to provide more reliable measures of risk attitudes. Further, acknowledging that cultural aspects (e.g., beliefs nothing happens at random) may interact with interpreting probabilistic events and making provision to disentangle these factors from the experiment is crucial to improving experimentally derived risk attitude in Nigeria.

Research agenda

We outline a research agenda with the aim of stimulating discussion about future research directions that emerged from the review of the existing literature. Four fundamental research needs emerge, which we discuss. First, in terms of the methodological and elicitation methods. Risk attitude estimated by econometric estimation has not been compared to experimental results in any study in Nigeria. Therefore, testing and comparing the outcome of elicitation methods for consistency of risk attitudes will help uncover the 'better-suited' method. Besides, a move towards more experimental-based studies will also provide the platform to test several theories, including the popular prospect theory, which provides one of the leading descriptions of how a decision-maker assesses risk in an experimental setting. Also, future studies could estimate panel data to measure whether Nigerian farmers risk attitude is stable over time. Besides, the impact of new policies on farmers' risks attitude could also be examined from this dimension.

Second, it is necessary to improve the evidence base on uncertainty and ambiguity. Previous studies show that although the behaviour under uncertainty and risk are similar, one is not necessarily an accurate reflection of the other. The need to expand the literature on uncertainty is particularly important as many of the decisions that farmers take are under conditions of uncertainty. Third, the consideration in previous studies has been individual farmers or farm households as a single entity. There is a gap in our knowledge of whether and how an individual farmer's risk attitude is influenced by interactions with other farmers nearby. Thus, we observe a need to investigate the presence of spatial clusters of farmers with similar risk attitudes. The advantage to policymakers will be substantial. Fourth, to improve the quality and credibility of the data and future studies, more attention needs to be paid to the conceptual framing, methodology, analysis, relevance, and contribution of each study. This will result in more robust studies that satisfy a high criterion in terms of the strength of evidence.

Conclusion

Previous empirical studies examined the relationship between risk attitude and farm decision-making. We identified gaps in the synthesis of evidence needed to have a holistic understanding of farmers' attitudes to uncertainty and risk and how these attitudes shape agricultural decisions. Therefore, we conducted a systematic review of the literature, which

included 39 papers after applying exclusion and inclusion criteria. We found that the measurement of risk attitude is mainly through econometrics and experiment methods. Also, the results from our review suggest that most Nigerian farmers are risk averse but at different levels. Taken together, the studies provide evidence that age, household size, education, income, poverty status, farm size and access to credit are important predictors of risk attitudes. In other words, Nigerian farmers' risk attitudes differ with socio-economic factors, personal characteristics, and geographic factors. Further, the findings suggest that risk attitudes explain the difference in adopting technologies and agronomic practices, farm management strategies, poverty, participation in intervention schemes, willingness to pay and off-farm participation decisions.

This review consolidates previous findings in Nigeria and similar low- and middle-income countries that risk averse farmers tend to make production and management decisions that result in a lower average return if the associated uncertainty is lower. This suggests that researchers should focus on expanding the methodological and elicitation methods and carry out more studies on uncertainty and ambiguity to move the literature on attitudes and behaviour forward. The benefit of policy design is that policymakers will be informed to accurately predict the choices and behaviour of farmers under different policy interventions. It will also help policymakers to judge the effects of policy on farmers' risk attitudes. For example, policies that reduce poverty or increase wealth may change farmers' risk attitudes in the case where risk is influenced by wealth. However, we caution that any assumption of homogeneous behaviour integrated into policy design without consideration for context and domains will be fundamentally flawed.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

- [1] A.A. Adubi, Impact of socio-economic factors on risk behaviour of small farmers: an empirical evidence from Oyo North agricultural development project, Nigeria, *Afr. Dev. Rev.* 8 (1) (1996) 115–125.
- [2] J.O. Ajetomobi, S.O. Binuomote, Risk aversion among poultry egg producers in southwestern Nigeria, *Int. J. Poultry Sci.* 5 (6) (2006) 562–565.
- [3] S. Ajiola, O.A. Egbetokun, I.E. Ogunbayo, Impact of risk attitudes on poverty level among rural farmers in Ogun State, *J. Dev. Agric. Econ.* 3 (12) (2011) 581–587.
- [4] B.D. Akinola, Risk preferences and coping strategies among poultry farmers in Abeokuta Metropolis, Nigeria, *Glob. J. Sci. Front. Res.* 14 (5) (2014) 23–30.
- [5] S.B. Akpan, I.V. Patrick, S.U. James, D.I. Agom, Determinants of decision and participation of rural youth in agricultural production: a case study of youth in southern region of Nigeria, *Russian J. Agric. Socio-Econ. Sci.* 43 (7) (2015) 35–48.
- [6] O.I. Ambali, Farmers risk attitudes, locations and decisions to adopt improved rice varieties in Ogun State Nigeria, *Rev. Agric. Appl. Econ. (RAAE)* 22 (1340–2019–4165) (2019) 106–111.
- [7] S. Andersen, G.W. Harrison, M.I. Lau, E.E. Rutström, Behavioral econometrics for psychologists, *J. Econ. Psychol.* 31 (4) (2010) 553–576.
- [8] Anderson, J., Marita, C., Musiime, D., & Thiam, M. (2017). National Survey and Segmentation of Smallholder Households in Nigeria. Understanding Their Demand for Financial, Agricultural, and Digital Solutions.
- [9] S. Arinaitwe, M. Patience, I.A. Oscar, Analysis of risk attitudes and social capital in pineapple marketing: the case of small-scale farmers in Luwero district, Uganda, *Afr. J. Rural Dev. (AFJRD)* 2 (1978–2017–1916) (2017) 235–246.
- [10] A.B. Assouto, D.A. Houensou, G. Semedo, Price risk and farmers' decisions: a case study from Benin, *Sci. Afr.* 8 (2020) e00311.
- [11] G. Attanasi, N. Georgantzis, V. Rotondi, D. Vignani, Lottery- and survey-based risk attitudes linked through a multichoice elicitation task, *Theory Decis.* 84 (3) (2018) 341–372.
- [12] G.C. Aye, O. Oji, Effects of poverty on risk attitudes of farmers in Benue state Nigeria, *Econ. Financ. Rev.* 47 (2) (2009) 4.
- [13] Ayinde, O.E. (2016). Risk analysis in innovation system: a case-study of production of Vitamin A cassava variety among farmers in Nigeria (No. 310-2016-5440).
- [14] O.E. Ayinde, Risk analysis in innovation system: a case study of production of vitamin A cassava variety among farmers in Oyo state, Nigeria, *Gaziosmanpaşa Üniversitesi Ziraat Fakültesi Dergisi* 34 (3) (2017) 261–268.
- [15] O.E. Ayinde, T.O. Obalola, Effect of socioeconomic characteristics and income status on onion farmers risk attitude in Sokoto state, Nigeria, *Agricultura Tropica Et Subtropica* 50 (3) (2017) 141–146.
- [16] O.E. Ayinde, O.A. Omotesho, M.O. Adewumi, Risk attitudes and management strategies of small scale crop producer in Kwara State, Nigeria: a ranking approach, *Afr. J. Bus. Manag.* 2 (12) (2008) 217–221.
- [17] O.E. Ayinde, K.A. Bello, O.O. Ajewole, The Evaluation of Risk Attitude of Rice Farmers in Kwara State, Nigeria, *AJPAS J.* 3 (2016) 1–5.
- [18] Z. Bar-Shira, R.E. Just, D. Zilberman, Estimation of farmers' risk attitude: an econometric approach, *Agric. Econ.* 17 (2–3) (1997) 211–222.
- [19] T. Begho, Rethinking elicitation methods in examining the effects of domain and context on individual preferences under risk and ambiguity, *Int. Soc. Sci. J.* (2022).
- [20] Bello, M., Abdoulaye, T., Abdulai, A., Wossen, T., & Menkir, A. (2019). Modeling farmers' willingness to pay for stress tolerance in maize in northern Nigeria: how does the states of gains and losses matter?.
- [21] W.M. Bramer, M.L. Rethlefsen, J. Kleijnen, O.H. Franco, Optimal database combinations for literature searches in systematic reviews: a prospective exploratory study, *Syst. Rev.* 6 (1) (2017) 1–12.
- [22] M.A. Bwala, Y. Bila, Analysis of farmers' risk aversion in southern Borno, Nigeria, *Glob. J. Agric. Sci.* 8 (1) (2009).
- [23] J.C. Cardenas, J. Carpenter, Behavioural development economics: Lessons from field labs in the developing world, *J. Dev. Stud.* 44 (3) (2008) 311–338.
- [24] G. Charness, A. Viceisza, Three risk-elicitation methods in the field: Evidence from rural Senegal, *Rev. Behav. Econ.* 3 (2) (2016) 145–171.
- [25] A. Chateauneuf, M. Cohen, Risk seeking with diminishing marginal utility in a non-expected utility model, *J. Risk Uncertainty* 9 (1) (1994) 77–91.
- [26] P. Crosetto, A. Filippin, A theoretical and experimental appraisal of four risk elicitation methods, *Exp. Econ.* 19 (3) (2016) 613–641.
- [27] K. De Groot, R. Thuriik, Disentangling risk and uncertainty: When risk-taking measures are not about risk, *Front. Psychol.* 9 (2018) 2194.
- [28] G.E. Fanifosi, L.T. Ogunniyi, O.V. Aregbesola, T.A. Olaoye, J.O. Oladiran, O.A. Ajao, Evaluating poverty and risk attitude of maize farmers in Surulere local government area of Oyo State, Nigeria: a safety first analysis approach, *Int. J. Sci. Res. Multidisciplinary Stud.* 7 (6) (2021) Vol.
- [29] M. Ferreira, Cross-country Differences in Risk Attitudes towards Financial Investment, 2018 Available online <https://voxeu.org/article/cross-country-differences-risk-attitudes-towards-financial-investment> (accessed on 29 January 2022).
- [30] R. Greiner, L. Patterson, O. Miller, Motivations, risk perceptions and adoption of conservation practices by farmers, *Agric. Syst.* 99 (2009) 86–104 2–3.
- [31] V. Hannus, J. Sauer, Are farmers as risk-averse as they think they are? in: *Proceedings in Food System Dynamics*, 2020, pp. 165–173.
- [32] J. Henrich, R. McElreath, Are peasants risk-averse decision makers? *Curr. Anthropol.* 43 (1) (2002) 172–181.

- [33] T.M. Hurley, A review of agricultural production risk in the developing world, Working paper, 2010 www.harvestchoice.org.
- [34] C.I. Ibeawuchi, Risk attitude and risk management strategies among agribusiness entrepreneurs: case study of cocoa farmers in Abia State, Nigeria, *Nigeria Agric. J.* 51 (2) (2020) 310–317.
- [35] H.J. Ihli, B. Chiputwa, O. Musshoff, Do changing probabilities or payoffs in lottery-choice experiments affect risk preference outcomes? Evidence from rural Uganda, *J. Agric. Resour. Econ.* (2016) 324–345.
- [36] P. Iyer, M. Bozzola, S. Hirsch, M. Meraner, R. Finger, Measuring farmer risk preferences in Europe: a systematic review, *J. Agric. Econ.* 71 (1) (2020) 3–26.
- [37] J. Jin, R. He, H. Gong, X. Xu, C. He, Farmers' risk preferences in rural China: Measurements and determinants, *Int. J. Environ. Res. Public Health* 14 (7) (2017) 713.
- [38] J.A. John, G. Bennie, J. Henry, M.F. Viljoen, J.N. Nmadu, Risk Attitude of Monocrop and Intercrop Farmers in Kebbi State, 7, Risk, Nigeria, 2016.
- [39] D. Kahneman, A. Tversky, The psychology of preferences, *Sci. Am.* 246 (1) (1982) 160–173.
- [40] M. Kiggundu, A. Kigozi, H.K. Walusimbi, S. Mugerwa, Farmers' perception of calf housing and factors influencing its adoption on dairy cattle farms in Uganda, *Sci. Afr.* 12 (2021) e00805.
- [41] A.M. Komarek, A. De Pinto, V.H. Smith, A review of types of risks in agriculture: what we know and what we need to know, *Agric. Syst.* 178 (2020) 102738.
- [42] J.E. Lönnqvist, M. Verkasalo, G. Walkowitz, P.C. Wichardt, Measuring individual risk attitudes in the lab: task or ask? An empirical comparison, *J. Econ. Behav. Organ.* 119 (2015) 254–266.
- [43] H. Markowitz, Portfolio Selection: Efficient Diversification of Investments, 2nd ed., Basil Blackwell, New York/Cambridge, MA, 1959 Wiley/1991.
- [44] G.R. Marshall, K.A. Parton, G.L. Hammer, Risk attitude, planting conditions and the value of seasonal forecasts to a dryland wheat grower, *Aust. J. Agric. Econ.* 40 (3) (1996) 211–233.
- [45] M. Mwangi, E. Kituyi, G. Ouma, A systematic review of the literature on the contribution of past climate information services pilot projects in climate risk management, *Sci. Afr.* 14 (2021) e01005.
- [46] C.N. Ndem, C.K. Osondu, Risk sources and management strategies among cassava farmers in Abia State, 18, RISK, Nigeria, 2018.
- [47] J.N. Nmadu, G.P. Eze, A.J. Jirgi, Determinants of risk status of small scale farmers in Niger State, Nigeria, *J. Econ.* (2012) 92–108.
- [48] O.T. Obalola, O.E. Ayinde, Risk and risk management strategies of smallholder onion farmers in Sokoto state, Nigeria, *Acta agriculturae Slovenica* 111 (3) (2018) 559–566.
- [49] T.O. Obalola, K.O. Aboaba, B.O. Agboola, E.P. Ameh, B.B. Abubakar, Effect Of Information System on Risk Attitudes Of Rural Farmers In Goronyo Irrigation Scheme, Goronyo Local Government Area, Sokoto State, Nigeria, *Sci. Pap.* 21 (1) (2021).
- [50] O.A. Obayele, O.O. Olowe, T.G. Faleye, Do social networks have effects on the risk attitude of commercial poultry farmers? Evidence from Southwest Nigeria, *Rural Sustain. Res.* 38 (333) (2017) 2–13.
- [51] A.O. Ojo, K.K. Abubakar, M.A. Ojo, C.O. Adebayo, Risk Management Strategies of Sorghum Farmers in Federal Capital Territory (FCT) Abuja, Nigeria, *Ife J. Agric.* 31 (2) (2019) 1–18.
- [52] Y.U. Oladimeji, S.A. Galadima, A.A. Hassan, A.A. Sanni, S. Abdulrahman, H. Egwuma, A. Yakubu, Risk analysis in fish farming systems in Oyo and Kwara States, Nigeria: a prospect towards improving fish production, *Anim. Res. Int.* 16 (1) (2019) 3226–3237.
- [53] J.O. Olaoye, T.R. Amusa, T.A. Adekanye, Evaluation of the degree of agricultural mechanization index on the performance of some farm settlement schemes in Southwestern Nigeria, *Ethiopian J. Environ. Stud. Manag.* 10 (7) (2017).
- [54] Olarinde, L.O., & Manyong, V.M. (2008). Risk aversion and sustainable maize production in Nigeria: some challenges and prospects for agricultural and economic development (No. 307-2016-4922, pp. 67-72).
- [55] L.O. Olarinde, V.M. Manyong, J.O. Akintola, Attitudes towards risk among maize farmers in the dry savanna zone of Nigeria: some prospective policies for improving food production, *Afr. J. Agric. Res.* 2 (8) (2007) 399–408.
- [56] L.O. Olarinde, V.M. Manyong, J.O. Akintola, Factors influencing risk aversion among maize farmers in the Northern Guinea Savanna of Nigeria: Implications for sustainable crop development programmes, *J. Food Agric. Environ.* 8 (1) (2010) 128–134.
- [57] I.B. Oluwatayo, O. Timothy, Risk attitudes among catfish farmers in Oyo State, Nigeria, *Invest. Manag. Financ. Innov.* (12) (2015) 90–97 Iss. 4.
- [58] C.S. Onyemauwa, J.S. Orebiji, S.U.O. Onyeagocha, N.C. Ehirim, F.O. Nwosu, B.C. NG, Risk aversion among farmers of the national program for food security in Imo State Southeast Nigeria, *Risk* 4 (10) (2013).
- [59] L.O. Oparinde, T.T. Amos, O.A. Aturamu, A.G. Daramola, Attitudes towards risk and risk combating strategies among maize and cassava farmers in Southwest, Nigeria, *J. Econ., Manag. Trade* (2018) 1–12.
- [60] L.O. Oparinde, A.I. Fatuase, A.G. Daramola, Risk Attitudes and Poverty Status Nexus Among Fish Farmers in Ondo State, Nigeria, in: Proceedings of the Eighteenth Biennial Conference of the International Institute of Fisheries Economics and Trade held July 11-15, 2016 at Aberdeen Exhibition and Conference Center (AECC), Aberdeen, Scotland, UK, 2016.
- [61] K.O. Osotimehin, Accounting For Farmers' attitude Towards Risk In The Application Of Improved Farm Technologies: the Case Of Inorganic Fertilizer Use In Oyo North Area Of Oyo State, Nigeria, *Ife J. Agric.* 18 (1) (1996) 101–111.
- [62] A.D. Roy, Safety first and the holding of assets, *Econometrica* (1952) 431–449.
- [63] M.S. Sadiq, I.P. Singh, M.M. Ahmad, M. Lawal, J.B. Yunusa, Risk behavior of sesame farmers in Jigawa state of Nigeria, *SKUAST J. Res.* 21 (1) (2019) 101–107.
- [64] S.M. Sadiq, P.I. Singh, M.M. Ahmad, Productivity gap by gender among rice farmers in North-Central Nigeria, *Agric. Socio-Econ. J.* 21 (2) (2021).
- [65] K.K. Salman, W.M. Ashagidigbi, K.T. Jabar, Correlates of risk-aversion among poultry egg farmers in Ibadan, Nigeria, *J. Rural Econ. Dev.* 19 (1623-2016-134904) (2010) 46–60.
- [66] A.W. Sarwosri, O. Mußhoff, Are risk attitudes and time preferences crucial factors for crop diversification by smallholder farmers? *J. Int. Dev.* 32 (6) (2020) 922–942.
- [67] W.A. Sanusi, S.O. Tojola, G.E. Fanifosi, Effect of Poverty on Risk attitude of Smallholder Maize Farmers in Oyo State, Nigeria, *SSRG Int. J. Econ. Manag. Stud.* (SSRG-IJEMS) 6 (9) (2019) – Sep 2019.
- [68] P. Sauter, D. Hermann, O. Mußhoff, Risk attitudes of foresters, farmers and students: An experimental multimethod comparison (No. 1514), 1514, Georg-August-Universität Göttingen, Department für Agrarökonomie und Rurale Entwicklung (DARE), Göttingen, 2015 Diskussionsbeitrag.
- [69] A.J. Timothy, N.M. Sadiq, A. Gomina, C.N. Dawan, E.Y. Dodo, An assessment of risk mitigating strategies employed by poultry farmers in Kaduna Metropolis of Kaduna State, Nigeria: attitudinal scale approach, *J. Anim. Prod. Res.* 28 (2) (2016) 261–269.
- [70] A. Tversky, D. Kahneman, Advances in prospect theory: cumulative representation of uncertainty, *J. Risk Uncertainty* 5 (4) (1992) 297–323.
- [71] R. Ullah, G.P. Shivakoti, F. Zulfiqar, M.A. Kamran, Farm risks and uncertainties: sources, impacts and management, *Outlook Agric.* 45 (3) (2016) 199–205.
- [72] F.M. Vieider, P. Martinsson, P.K. Nam, N. Truong, Risk preferences and development revisited, *Theory Decis.* 86 (1) (2019) 1–21.
- [73] S.K. Vihhi, B. Jesse, A.A. Dalla, Y. Sadiku, Analysis of farm risk and coping strategies among maize farmers in Iere local government area of Kaduna State, Nigeria, *Asian J. Res. Agric. For.* (2018) 1–10.
- [74] J.A. Weller, A. Tikir, Predicting domain-specific risk taking with the HEXACO personality structure, *J. Behav. Decis. Making* 24 (2) (2011) 180–201.
- [75] World BankJobs in Nigeria: Closing the Gaps in a Polarized Labor Market, 2016 Retrieved on 29 January 2021 from <https://www.worldbank.org/en/country/nigeria/publication/nigeria-more-productive-jobs-profile-work-workers>.
- [76] S.A. Yusuf, W.M. Ashagidigbi, D.P. Bwala, Poverty and risk attitude of farmers in North-Central, Nigeria, *J. Environ. Agric. Sci.* 3 (2015) 1–7.