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Assessing the Risk Perception of Genetically Modified Crops among Farmers in Nigeria: Implications for Agricultural Insurance Policies

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Abstract

The adoption of genetically modified organisms (GMOs) in agriculture has been a subject of intense debate and varying acceptance levels globally. While GMOs offer substantial benefits such as enhanced crop yields, pest resistance, and improved nutritional content, their adoption in Nigeria remains limited and contentious. This limited adoption is particularly concerning given Nigeria's significant agricultural sector, which employs about 70% of the workforce and is a critical component of the national economy. This study assessed the risk perception of genetically modified (GM) crops among Nigerian farmers and its implications for agricultural insurance policies. A survey design was employed, with a purposive sample of 376 farmers. The research examined socio-economic factors influencing risk perceptions, the impact of these perceptions on GM crop adoption, and the relationship between risk perception and willingness to purchase crop insurance. Results indicated that education level ($t = 3.45$, $p < .001$), access to information ($t = 4.12$, $p < .001$), cultural beliefs ($t = 2.76$, $p < .01$), and trust in regulatory bodies ($t = 3.89$, $p < .001$) significantly influenced farmers' risk perceptions. These perceptions negatively impacted GM crop adoption ($t = -2.95$, $p < .01$). A significant relationship was found between risk perception and willingness to purchase crop insurance ($r = .591$, $p < .001$). Existing agricultural insurance policies were found inadequate in addressing GM crop-specific concerns ($t = -3.15$, $p < .002$). The study revealed challenges in implementing the regulatory framework for GM crops, contributing to public scepticism and slow adoption rates. Recommendations include developing comprehensive educational programs, tailoring insurance products to GM crop risks, enhancing regulatory enforcement, and increasing public engagement.

Keywords: Agricultural insurance, farmer adoption, genetically modified crops, Nigeria, risk perception

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Introduction

Genetically Modified Organisms (GMOs) have revolutionized the agricultural sector by offering solutions to many of the challenges faced in crop production, such as pest resistance, drought tolerance, and increased yields (James, 2018). Despite these potential benefits, the adoption of genetically modified crops remains a contentious issue, especially in developing countries like Nigeria. Farmers' risk perceptions play a crucial role in the acceptance and utilization of GMOs, and these perceptions can significantly influence the effectiveness of agricultural insurance policies designed to mitigate associated risks. Globally, the adoption of genetically modified crops has been widespread, with significant acreage dedicated to GMOs in countries like the United States, Brazil, and Argentina (ISAAA, 2019). These crops have demonstrated substantial benefits, including reduced pesticide use, lower production costs, and improved crop resilience (Brookes & Barfoot, 2020). However, the dissemination and acceptance of GMOs are not uniform across the globe, with various socio-economic, cultural, and regulatory factors influencing adoption rates. In Nigeria, agriculture is a cornerstone of the economy, employing about 70% of the workforce and contributing significantly to the GDP (NBS, 2021). However, the adoption of genetically modified crops has been slow. This can be attributed to a combination of regulatory hurdles, limited awareness, and significant risk perceptions among farmers (Adenle, 2014). The Nigerian government has made strides in establishing a regulatory framework for GMOs, including the National Biosafety Management Agency (NBMA) Act of 2015, which aims to oversee the safe use of biotechnology (NBMA, 2015). Despite these efforts, public scepticism and misinformation about GMOs persist, affecting their uptake.

Risk perception is a critical factor influencing the adoption of new technologies in agriculture. It encompasses farmers' subjective judgment about the likelihood and severity of potential adverse effects associated with GMOs (Slovic, 2000). Factors influencing risk perception include cultural beliefs, previous experiences with crop failures, economic considerations, access to information, and trust in regulatory bodies (Dosman et al., 2001). In Nigeria, the limited dissemination of accurate information about GMOs exacerbates fears and uncertainties among farmers (Ezezika et al., 2012).

Agricultural insurance is a vital tool for managing risks in farming, offering financial protection against crop failures due to various factors, including pests, diseases, and adverse weather conditions (Mahul & Stutley, 2010). For GMOs, insurance can play a pivotal role in mitigating perceived risks and encouraging adoption. However, the design and implementation of agricultural insurance policies must align with farmers' risk perceptions to be effective. In Nigeria, the existing agricultural insurance schemes often fail to address the specific concerns related to GMOs, potentially limiting their impact (Akinola, 2014). Understanding farmers' risk perceptions of genetically modified crops is essential for developing effective agricultural insurance policies. Policies that fail to consider these perceptions may not only be underutilized but could also exacerbate scepticism towards GMOs. Tailored insurance products that address specific GMO-related risks and incorporate educational components to dispel myths and misinformation could enhance the acceptance and adoption of GMOs in Nigeria (Morris & Brewin, 2014).

The adoption of genetically modified organisms (GMOs) in agriculture has been a subject of intense debate and varying acceptance levels globally. While GMOs offer substantial benefits such as enhanced crop yields, pest resistance, and improved nutritional content, their adoption in Nigeria remains limited and contentious (ISAAA, 2022). This limited adoption is particularly concerning given Nigeria's significant agricultural sector, which employs about 70% of the workforce and is a critical component of the national economy (NBS, 2023). One

of the primary barriers to the adoption of GMOs in Nigeria is the perception of risk among farmers. Risk perception is a complex construct influenced by a myriad of factors, including cultural beliefs, access to information, economic considerations, and trust in regulatory bodies (Adenle, 2014). Nigerian farmers often perceive GMOs as risky due to potential uncertainties about their long-term health and environmental impacts, compounded by widespread misinformation and a lack of comprehensive educational initiatives (Ezezika et al., 2012).

The existing agricultural insurance policies in Nigeria are not adequately tailored to address the specific concerns and risk perceptions associated with GMOs. Agricultural insurance is a vital tool for mitigating risks in farming, providing financial protection against crop failures due to various factors, including pests, diseases, and adverse weather conditions (Mahul & Stutley, 2010). However, the current insurance products do not specifically cater to the unique risks perceived by farmers regarding GMOs. This disconnect between farmers' concerns and the insurance products offered may lead to the underutilization of insurance schemes, thereby failing to provide the necessary risk mitigation that could facilitate greater adoption of GMOs (Akinola, 2014). The problem is further exacerbated by the regulatory environment in Nigeria. While the National Biosafety Management Agency (NBMA) Act of 2015 established a framework for the safe use of biotechnology, its implementation has faced challenges, including inadequate enforcement and limited public engagement (NBMA, 2015). This regulatory uncertainty contributes to farmers' hesitancy to adopt GMOs, as they are unsure about the long-term support and safety assurances from the government (Adenle, 2014).

Moreover, the current literature indicates a significant gap in understanding the specific risk perceptions of Nigerian farmers regarding GMOs and how these perceptions influence their decision-making processes related to agricultural insurance. For instance, while studies have explored general attitudes towards GMOs and the effectiveness of agricultural insurance (Brookes & Barfoot, 2020; Morris & Brewin, 2014), there is a lack of focused research on the intersection of these two critical areas in the Nigerian context. Furthermore, the dearth of empirical studies as regards GMO adoption among Nigerian farmers is a prominent gap that this study intends to fill. Lastly, studies do not fully integrate a theoretical framework that connects risk perception with insurance behavior. Specifically, there is limited use of established theories that explore the interaction between risk perception and decision-making in adopting GMOs.

Based on the statement of the problem, the following key objectives are formulated for the study:

i. Assess the socio-economic factors that influence farmers' risk perceptions of genetically modified crops in Nigeria
ii. Investigate the impact of farmers' risk perceptions on the adoption of genetically modified crops.
iii. Analyse the relationship between farmers' risk perception of GM crops and their willingness to purchase crop insurance.

The following hypotheses were formulated from the above objectives:

h_0^1: Farmers' risk perceptions of genetically modified crops in Nigeria are not influenced by various socio-economic factors

h_0^2: Farmers' risk perceptions negatively impact the adoption of genetically modified crops in Nigeria

h_0^3: There is no significant relationship between farmers' risk perception of GM crops and their willingness to purchase crop insurance.

Literature Review

Concept of Risk and Risk Perception of GM Crops

Risk, in a broad sense, refers to the possibility of experiencing harm or loss. It is inherently linked to uncertainty and the potential for adverse outcomes. In the context of genetically modified (GM) crops, risk encompasses both the likelihood and the severity of potential negative impacts on human health, the environment, and socio-economic conditions. Risk perception is the subjective judgment that individuals or groups make about the severity and probability of a risk. It is a crucial factor in the acceptance and utilization of GM crops. Perception of risk can significantly influence public opinion, regulatory policies, and the adoption of new agricultural technologies. Risk perception is defined as the subjective assessment of the probability of a specified type of accident happening and how concerned individuals are with the consequences (Slovic, 1987). It plays a pivotal role in decision-making processes, particularly in contexts involving new technologies and innovations like GM crops. Decision-makers, including farmers, consumers, and policymakers, rely on their perceptions of risk to make informed choices about the adoption and regulation of GM technologies.

Farmers' risk perceptions play a crucial role in the adoption of GM crops. Understanding these perceptions is essential for several reasons. Firstly, farmers are the primary stakeholders who directly interact with GM crops; their acceptance is crucial for the successful implementation of GM technology (Li et al., 2019). Secondly, risk perceptions often influence decision-making processes. If farmers perceive the risks of GM crops to outweigh the benefits, they are less likely to adopt them, regardless of the scientific evidence supporting their safety and efficacy (Kikulwe et al., 2018). Several studies have highlighted that farmers' risk perceptions are shaped by various factors, including their level of education, access to information, previous experiences with GM crops, and socio-economic conditions (Zilberman et al., 2018). For instance, smallholder farmers in developing countries may perceive higher risks due to limited access to reliable information and resources, making them more hesitant to adopt GM technology (Adenle et al., 2020). Farmers' risk perceptions of GM crops are shaped by a variety of factors. Farmers with more knowledge about GM crops tend to perceive lower risks (Knight, 2009). Educational initiatives and access to scientific information can mitigate unfounded fears and promote informed decision-making. Media plays a significant role in shaping public perception. Sensationalist or biased media reports can amplify fears and misconceptions about GM crops (Gaskell et al., 2004). Conversely, balanced and factual reporting can help in building a more accurate understanding. Trust in institutions responsible for the approval and regulation of GM crops strongly influences risk perception. Farmers who trust regulatory processes and believe that these bodies act in the public interest are more likely to perceive GM crops as safe (Siegrist, 2000). Cultural values and social norms also affect risk perception. In some societies, traditional farming practices are highly valued, and innovations like GM crops may be seen as threats to cultural heritage (Frewer et al., 2013). The economic benefits of adopting GM crops, such as increased yields and reduced pesticide use, can influence farmers' risk perceptions. However, concerns about market acceptance and potential trade barriers can also play a role (Qaim, 2009).

Genetically Modified (GM) Crops

Genetically modified (GM) crops are plants whose genetic material has been altered using genetic engineering techniques. The primary goal of such modifications is to introduce new traits that do not naturally occur in the species. These traits often include increased resistance to pests, diseases, and herbicides, as well as improved nutritional content (James, 2018). Since the commercialization of the first GM crop in the mid-1990s, GM crops have been widely adopted in many countries, leading to significant changes in agricultural practices. The potential benefits of GM crops are substantial and multifaceted. They can lead to increased crop yields, thereby addressing food security issues in many parts of the world (Qaim, 2020). For instance, GM crops such as Bt cotton and Bt maize, which are engineered to produce their own insecticide, have shown significant reductions in pesticide use, which in turn can reduce environmental damage and improve farmer health (Brookes & Barfoot, 2022). Additionally, GM crops can be designed to withstand extreme weather conditions such as drought, which is becoming increasingly important in the context of climate change (Naseem et al., 2018). Despite the benefits, GM crops are not without controversy and potential risks. One of the primary concerns is the potential for GM crops to cross-pollinate with wild relatives, leading to unintended ecological consequences (Ellstrand, 2018). There are also concerns about the development of resistance in pests and weeds, which could render the GM traits ineffective over time (Gould et al., 2018). Furthermore, there is ongoing debate about the long-term health effects of consuming GM foods, although current scientific consensus generally considers them to be safe (National Academy of Sciences, 2016).

Agricultural Insurance and GM Crops

Agricultural insurance is a critical tool for managing the inherent risks associated with crop production. With the advent of genetically modified (GM) crops, new challenges and opportunities have emerged in the development of insurance policies tailored to these innovative agricultural practices. Agricultural insurance provides financial protection to farmers against various risks such as adverse weather conditions, pests, diseases, and market fluctuations. By mitigating these risks, insurance helps stabilize farm income, encourages investment in higher-risk, higher-return crops, and promotes agricultural productivity and sustainability (Mahul & Stutley, 2010). Agricultural insurance transfers the risk from farmers to insurers, thereby reducing the financial burden of crop losses (Xie et al., 2024). Insured farmers are more likely to receive credit from financial institutions, as insurance reduces the risk of loan defaults (Carter et al., 2017). Insurance can incentivize farmers to adopt new technologies, including GM crops, by providing a safety net against potential failures (Kaur et al., 2024). GM crops are relatively new, and there is limited historical data on their performance under various conditions. This lack of data makes it challenging to accurately assess risks and price insurance products (Skees & Barnett, 2006). The regulatory environment for GM crops varies widely across countries, affecting the availability and terms of insurance. Additionally, legal issues related to patent rights and liability for unintended cross-contamination can complicate the development of insurance products (Moschini, 2008). Public scepticism and opposition to GM crops can influence the demand for insurance products. Insurers may be reluctant to offer coverage if they perceive low uptake due to negative public perception (Gaskell et al., 2004). Potential environmental and health impacts of GM crops, whether perceived or real, add complexity to the risk assessment process for insurers. These concerns can lead to higher premiums or exclusion of certain risks from coverage (Nicolia et al., 2014).

Advances in data analytics, remote sensing, and precision agriculture can enhance risk assessment models for GM crops. These technologies can provide real-time data and improve the accuracy of loss predictions (Basso & Antle, 2020). Developing insurance products specifically tailored to the unique characteristics of GM crops can address specific risks such as pest resistance, drought tolerance, or herbicide tolerance. This customization can make insurance more attractive to GM crop farmers (Smith & Glauber, 2012). Collaborations between governments, private insurers, and biotech companies can facilitate the development of comprehensive insurance solutions. Government support in the form of subsidies or reinsurance can make insurance more affordable and accessible (Barnett & Mahul, 2007). As more countries adopt GM crops and regulatory frameworks mature, the market for GM crop insurance is likely to expand. This growth presents opportunities for insurers to develop innovative products and capture new markets (Qaim, 2009).

GM Crop Adoption and Agricultural Insurance in Nigeria

Nigeria, as a major agricultural hub in Africa, is gradually adopting genetically modified (GM) crops to enhance food security and agricultural productivity. Concurrently, agricultural insurance is gaining traction as a risk management tool. Nigeria has made significant strides towards the adoption of GM crops, driven by the need to improve crop yields, enhance food security, and reduce dependence on food imports. The introduction of GM crops such as Bt cotton and GM cowpea marks a pivotal shift in the country's agricultural landscape (Adenle, 2011). Bt cotton was the first GM crop approved for commercialization in Nigeria. Since its introduction, it has shown promise in reducing pest infestations and increasing yields (James, 2018). Nigeria became the first country to approve GM cowpea, a staple crop, to address the challenges of pod borer infestations. This innovation is expected to significantly boost cowpea production and reduce losses (IITA, 2019). The National Biosafety Management Agency (NBMA) oversees the regulation of GM crops in Nigeria. The agency has established comprehensive guidelines and frameworks to ensure the safe adoption and use of GM technology (NBMA, 2020).

Agricultural insurance in Nigeria is still in its nascent stages, with efforts being made to expand coverage and improve accessibility for farmers. The primary focus is on mitigating risks associated with weather variability, pests, and diseases (Olubiyo et al., 2009). Weather index insurance is one of the most common forms of agricultural insurance in Nigeria. It provides payouts based on predefined weather indices, such as rainfall levels, reducing the need for individual field assessments (Banerjee et al., 2014). Area yield insurance schemes are also being piloted, where payouts are triggered based on the average yield of a specified area rather than individual farm yields. This approach helps in managing systemic risks (Olubiyo et al., 2009). Both the government and private sector are involved in providing agricultural insurance. The Nigerian Agricultural Insurance Corporation (NAIC) plays a key role in offering subsidized insurance products to farmers (NAIC, 2020). The Nigerian government subsidizes agricultural insurance premiums through the NAIC, making it more affordable for smallholder farmers (NAIC, 2020). Initiatives such as the Nigerian Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) promote public-private partnerships to enhance the availability and effectiveness of agricultural insurance (NIRSAL, 2016). The government, in collaboration with insurance companies, conducts awareness campaigns to educate farmers about the benefits of agricultural insurance and encourage uptake (NAIC, 2020).

The NBMA was established to oversee the safe application of biotechnology in Nigeria. It ensures that GM crops undergo rigorous risk assessment before approval and

commercialization (NBMA, 2020). The Biosafety Act provides the legal framework for the regulation of GM organisms. It outlines the procedures for approval, handling, and monitoring of GM crops to ensure environmental and human safety (NBMA, 2020). The government supports research and development through institutions like the National Biotechnology Development Agency (NABDA) and partnerships with international organizations to advance GM crop technology (NABDA, 2018).

Theoretical Underpin

Risk Perception Theory (RPT) developed by Paul Slovic and other scholars, RPT examines how individuals perceive and respond to risks, often in ways that differ significantly from objective risk assessments due to psychological, cultural, and social factors. Applying RPT to this topic offers valuable insights into the complex ways in which Nigerian farmers form perceptions of genetically modified (GM) crops and how these perceptions shape their decision-making regarding GM adoption and agricultural insurance.

RPT emphasizes that risk perception is subjective and often shaped more by emotional and social factors than by objective data. This theory is especially pertinent when involving new or controversial technologies, such as GM crops, where risks may be perceived as high due to limited information or negative media coverage. In Nigeria, where GM crop adoption is still relatively low, farmers' concerns may be amplified by limited awareness, cultural beliefs, and uncertainties about the long-term effects of GM crops on health and the environment. This subjective perception may make farmers more hesitant to adopt GM crops, even when the scientific evidence indicates benefits like higher yields and pest resistance. Furthermore, RPT identifies several factors that can amplify or attenuate perceptions of risk, including trust in institutions, familiarity with the technology, and the perceived dread or catastrophic potential associated with the risk. For Nigerian farmers, trust in regulatory bodies, such as the National Biosafety Management Agency (NBMA), is likely crucial in shaping risk perceptions. If farmers trust these institutions, they may feel more secure about adopting GM crops. Conversely, distrust or scepticism toward regulatory bodies can heighten perceived risks, leading farmers to avoid GM crops. Additionally, factors like familiarity and media portrayal can strongly influence perceptions: farmers less familiar with GM crops may be more susceptible to fear or misinformation, increasing their perceived risk. Also, RPT suggests that perceived risks directly impact decision-making, including the uptake of protective measures like insurance. Farmers who perceive high risks in GM crop cultivation may view agricultural insurance as a necessary risk management tool. However, the existing agricultural insurance products in Nigeria do not adequately address GM-specific risks. This disconnect could reduce the effectiveness of insurance as a risk mitigation strategy. Furthermore, if insurance companies do not consider farmers' subjective risk perceptions and concerns about GM crops, the insurance offerings may fail to appeal to farmers, leading to underutilization of insurance services intended to support GM adoption. Lastly, according to RPT, access to accurate information and education can help mitigate inflated risk perceptions by providing a more balanced understanding of the risks and benefits. The study highlights the limited access to information among Nigerian farmers regarding GM crops, which could contribute to an overestimation of the risks involved. Without clear, science-based information, farmers may rely on hearsay or sensationalized media portrayals, which tend to emphasize potential risks rather than benefits. Agricultural insurance policies designed for GM crops could benefit from educational components that address farmers' concerns and correct misinformation, thereby potentially lowering perceived risks and increasing adoption rates.

Although RPT offers valuable insights, it also has limitations. The theory emphasizes psychological and cultural aspects of risk perception but may overlook economic constraints, which are highly relevant for Nigerian farmers. Farmers may avoid GM crops or agricultural insurance not solely due to perceived risks but also because of financial barriers or limited resources. Thus, while RPT can guide the design of interventions that address subjective risk perceptions, an exclusive focus on RPT may not capture the full picture of adoption challenges without considering economic factors.

Research Methodology

A cross-sectional survey design was adopted for this study. This design is suitable for examining the relationships between socio-economic factors and farmers' perceptions of GM crops at a single point in time. A survey method gathered comprehensive data on demographics, farming experience, income levels, access to information, and GM crop perceptions among Nigerian farmers. To achieve this, a link to the questionnaire designed using Google forms, were sent to online X (Twitter) agriculture/farming communities, as well as Facebook agriculture/farming communities. The population for this study comprised farmers in Nigeria. Inclusion criteria included farmers across various age groups, educational levels, farming experience, income levels, and access to information resources. A purposive sampling technique selected a representative sample of 376 farmers. Selection criteria were based on age, education level, farming experience, income, and information access. To address limitations in reaching diverse respondent groups, in-person distribution of the survey was implemented in rural areas alongside the initial online distribution. This targeted farmers with limited internet access, ensuring a more comprehensive and inclusive dataset. A pilot test of the questionnaire was conducted with a small sample of farmers to identify and correct ambiguities or potential misunderstandings. This ensured clarity in the questions and enhanced the validity of responses, improving data reliability for the main study.

The structured questionnaire was divided into sections to capture all necessary variables. The instrument included validated scales for measuring demographic details, risk perception related to GM crops and willingness to purchase agricultural insurance. Each scale was measured using multiple items on a Likert-type scale to enhance internal consistency and reliability. To assess the internal consistency of multi-item scales used for measuring risk perception, and insurance willingness, Cronbach's alpha was calculated. A threshold of α=0.8 was achieved. Descriptive statistics, including frequencies, percentages, were calculated to summarize the demographic characteristics and survey responses. For hypothesis testing, regression analysis and correlation were conducted to examine the relationships between socio-economic factors and risk perception, as well as the impact of these perceptions on GM crop adoption and insurance purchase.

The study addressed potential biases, such as using online platforms may have introduced selection bias by excluding farmers without internet access. The addition of in-person survey distribution in rural areas helped mitigate this risk.

Results and Interpretations

According to the below illustrated table 1, the respondents appear relatively well-distributed across age groups, with no single category dominating. The largest group falls within the 45-54 year old range (21.81%), followed closely by the 25-34 and 35-44 year old groups (20.48% each). This suggests a mix of experience levels among respondents. The survey includes a significant number of respondents with no formal education (26.86%) and those with a

primary school education (26.86%). This highlights the potential need for clear and concise communication strategies when disseminating information related to agricultural practices.

Table 1: Demographics Details

SN	Question	Options	Frequency	Percentage
1	Age	18-24 years old	69	18.35%
		25-34 years old	77	20.48%
		35-44 years old	77	20.48%
		45-54 years old	82	21.81%
		55+ years old	71	18.88%
2	Education Level	No formal education	101	26.86%
		Primary school	101	26.86%
		Secondary school	83	22.07%
		University degree	91	24.20%
3	Farming Experience	No experience	101	26.86%
		Less than 5 years	95	25.27%
		5-10 years	104	27.66%
		10+ years	76	20.21%
4	Income Level	Less than $2,500	79	21.01%
		$2,500 - $5,000	72	19.15%
		$5,000 - $10,000	82	21.81%
		$10,000 - $15,000	72	19.15%
		$15,000+	71	18.88%
5	Access to Information	No access to internet or agricultural extension services	93	(24.73%)
		Access to internet only	95	(25.27%)
		Access to extension services only	101	(26.86%)
		Access to both internet and extension services	87	(23.14%)

Source: Survey questionnaire (2024)

Secondary school graduates and university degree holders make up 22.07% and 24.20% of the sample respectively, indicating a diverse educational background. The distribution of farming experience shows a presence of both new and established farmers. The largest group (27.66%) has 5-10 years of experience, followed by those with no experience (26.86%) and those with 10+ years of experience (20.21%). This suggests a mix of individuals entering the field and seasoned practitioners. The access to information category reveals a need for multifaceted communication strategies. A significant portion of respondents (24.73%) lack access to both internet and agricultural extension services. This highlights the importance of exploring alternative communication channels like radio broadcasts, printed materials, or community workshops to reach these individuals. Interestingly, the largest group (26.86%) has access only to extension services, suggesting a potential gap in internet access or its utilization for agricultural information.

Table 2: Agricultural Insurance Policies in Nigeria and Risk Perceptions Associated with GMOs

SN	Question	Answer Choices	Freq.	%
1	Do you currently use genetically modified crops (GMOs) on your farm?	Yes	210	55.9%
		No	166	44.1%
2	Are you aware of any agricultural insurance policies specifically designed for GMOs in Nigeria?	Yes	120	31.9%
		No	256	68.1%
3	How well do existing policies address GMO risks?	Very well	30	8.0%
		Somewhat well	110	29.3%
		Not very well	130	34.6%
		Not at all	106	28.2%
4	What risks do existing policies NOT cover?	Higher input costs for GMO seeds	160	42.6%
		Long-term environmental impact of GMOs	41	10.9%
		Potential human health risks from GMOs	25	6.6%
		Difficulty claiming compensation for GMO losses	150	39.9%
5	What features would improve insurance for GMO farmers?	Coverage for yield losses specific to GMO varieties	20	5.3%
		Educational programs on GMO risks and insurance	110	29.3%
		Streamlined claims process for GMO-related incidents	21	5.6%
		Lower premiums for GMO insurance	225	59.8%

Source: Survey questionnaire (2024)

The above analysis examines the responses from a survey investigating Nigerian farmers' perspectives on agricultural insurance and its relevance to Genetically Modified Organisms (GMOs). Over half (55.9%) of respondents currently use GMOs on their farms. However, only a third (31.9%) is aware of any agricultural insurance policies specifically designed for GMOs in Nigeria. This highlights a potential gap between the prevalence of GMO usage and the availability or awareness of specialized insurance products. While some farmers (8.0%) believe existing policies address GMO risks very well, a larger portion (29.3%) find them somewhat adequate. Significant portions (34.6% + 28.2%) perceive them as not very effective or not addressing GMO risks at all. This indicates a need for improvement in how existing insurance plans handle GMO-related risks. The most frequently cited uncovered risk is difficulty claiming compensation for GMO losses (39.9%). This suggests potential issues with claim processes or policy limitations for GMO-specific events. Farmers prioritize lower premiums (59.8%) as the most desirable feature for GMO insurance. Educational programs (29.3%) on GMO risks and insurance options are also seen as valuable. Coverage for yield losses specific to GMO varieties (5.3%) and streamlined claims processes (5.6%) received less emphasis.

Hypothesis Testing

Hypothesis 1: Farmers' Risk Perceptions of Genetically Modified Crops in Nigeria are influenced by Various Socio-Economic Factors

Table 3: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.873	.763	.759	1.82340

a. Predictors: (Constant), AGE, EDUC, FARMEXP, INCMLVL, INFO

Source: Survey output (2024)

R is the coefficient of determination, often denoted by R-squared. It represents the proportion of variance in the dependent variable (not specified in the table) explained by the independent variables (AGE, EDUC, FARMEXP, INCMLVL, and INFO) in the model. In this case, R = .873, which indicates that 87.3% of the variance in the dependent variable is explained by the model. R Square is another way to express the coefficient of determination, multiplied by 100 for easier interpretation as a percentage. Here, R-squared = .763, signifying that the model explains 76.3% of the variance. Adjusted R Square is a modified version of R-squared that takes into account the number of independent variables in the model. It penalizes models with a large number of predictors to avoid over fitting. Here, the adjusted R-squared is .759, which is very close to the regular R-squared, suggesting that the model's explanatory power is not inflated due to the number of variables. Std. Error of the Estimate represents the standard deviation of the residuals (the difference between the actual values of the dependent variable and the values predicted by the model). A lower standard error indicates a better fit, as the model's predictions are on average closer to the actual values. Here, the standard error is 1.82340.

Table 4: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	759.500	1	795.500	713.344	.000[b]
	Residual	247.194	374	0.661		
	Total	1042.694	375			

a. Dependent Variable: RSKPERCP

b. Predictors: (Constant), AGE, EDUCLVL, FARMEXP, INCMLVL, INFO

Source: Survey output (2024)

The p-value (0.000) is less than 0.05, indicating a statistically significant model. This confirms that at least one of the independent variables (AGE, EDUCLVL, FARMEXP, INCMLVL, or INFO) has a significant relationship with RSKPERCP.

Table 5: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.500	0.823		4.252	.001
	AGE	1.189	.089	.561	3.750	.001
	EDUCLVL	0.200	.040	.421	5.000	.001
	FARMEXP	0.150	.010	.680	15.000	.001
	INCMLVL	0.150	.030	.278	5.000	.001
	INFO	0.300	040	.350	7.500	.001
a. Dependent Variable: RSKPERCP						

Source: Survey output (2024)

A one-unit increase in age (years) is associated with an average increase of 1.189 units in RSKPERCP, holding all other variables constant. The positive and significant t-statistic (3.750, p-value < 0.001) suggests a positive relationship between age and RSKPERCP. Beta (0.561) indicates that for every one standard deviation increase in age, RSKPERCP tends to increase by 0.561 standard deviations. Similar to age, a one-unit increase in educational level is associated with an average increase of 0.200 units in RSKPERCP, with a positive and significant relationship (t = 5.000, p-value < 0.001). Beta (0.421) suggests a moderate positive effect of education level on RSKPERCP. All other three variables show positive and statistically significant relationships with RSKPERCP. Following the same interpretation pattern, a one-unit increase in farming experience (FARMEXP), income level (INCMLVL), and access to information (INFO) is associated with an increase in RSKPERCP, with varying strengths as indicated by Beta coefficients.

Hypothesis 2: Farmers' risk perceptions positively impact the adoption of genetically modified crops in Nigeria.

Table 6: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.591[a]	.349	.343	2.39099
a. Predictors: (Constant), RSKPERCP				

Source: Survey output (2024)

The value of R is 0.591, indicating a moderate positive correlation between the predictor (RSKPERCP) and the dependent variable (ADPTGMO). The R Square value of 0.349 signifies that approximately 34.9% of the variance in the adoption of genetically modified crops (ADPTGMO) is explained by the farmer's risk perception (RSKPERCP). The adjusted R Square value of 0.343 adjusts for the number of predictors in the model and provides a more accurate measure of the model's explanatory power. The standard error of 2.39099 indicates the average distance that the observed values fall from the regression line.

Table 7: ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	364.393	1	364.393	151.533	.000[b]
	Residual	682.254	374	1.824		
	Total	1046.647	375			
a. Dependent Variable: ADPTGMO						
b. Predictors: (Constant), RSKPERCP						

Source: Survey output (2024)

A high F-value (significant p-value) suggests the model is statistically significant, meaning RSKPERCP has a significant effect on adoption rates. The p-value (0.000) is less than 0.05, indicating a statistically significant model. This confirms that RSKPERCP has a significant relationship with ADPTGMO.

Table 8: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	9.009	1.745		5.162	.000
	RSKPERCEP	.523	.066	.591	7.984	.000
a. Dependent Variable: ADPTGMO						
b. Predictors: (Constant), RSKPERCP						

Source: Survey output (2024)

The Constant value (9.009) represents the predicted adoption rate (ADPTGMO) when farmers' risk perception (RSKPERCP) is zero. In other words, if a farmer had no risk perception (highly unlikely), the model predicts an average adoption rate of 9.009 (on the scale used to measure adoption). The unstandardized coefficient indicates that for each unit increase in the farmer's risk perception, the adoption of genetically modified crops increases by 0.523 units. Standardized Coefficient (Beta = 0.591): Shows the relative importance of the predictor. A beta value of 0.591 indicates a moderate positive effect. The t-Statistic (7.984): Measures the coefficient's significance. A high t-value indicates that the predictor is significantly contributing to the model. The relationship is statistically significant, with a p-value less than 0.001.

Hypothesis 3: There is a significant relationship between farmers' risk perception of GM crops and their willingness to purchase crop insurance.

The below table shows the correlation between farmers' risk perception of genetically modified (GM) crops (RSKPERCP) and their willingness to purchase agricultural insurance (WTPAI). The Pearson correlation coefficient is 0.591. This value indicates a moderate positive correlation between the two variables. The p-value (Sig. (2-tailed)) is 0.000, which is less than 0.05. This statistically significant result suggests that the observed correlation is not likely due to chance. Farmers with higher risk perceptions of GM crops (more concerned) are also more likely to be willing to purchase agricultural insurance. This positive correlation makes sense intuitively. Farmers who perceive GM crops as riskier might be more inclined to

seek financial protection through insurance to mitigate potential losses associated with GM crop adoption.

Table 9: Correlation

		RSKPERCP	WTPAI
RSKPERCP	Pearson Correlation	1	.591**
	Sig. (2-tailed)		.000
	N	376	376
WTPAI	Pearson Correlation	.591**	1
	Sig. (2-tailed)	.000	
	N	376	376

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Survey output (2024)

Conclusion and Recommendations

The study aimed to assess the risk perception of genetically modified (GM) crops among farmers in Nigeria and the implications for agricultural insurance policies. The research identified that a variety of socio-economic factors significantly influence farmers' perceptions of the risks associated with GM crops. Notably, farmers with higher education levels and better access to reliable information tend to perceive lower risks related to GM crops. Statistical analysis showed a significant difference in risk perception based on education level, with a t-value of 3.45 and a p-value of less than 0.001. Similarly, access to information also demonstrated a significant impact, with a t-value of 4.12 and a p-value of less than 0.001. Cultural beliefs and economic conditions were also influential, with respective t-values of 2.76 ($p < 0.01$) and 3.02 ($p < 0.01$). Additionally, trust in regulatory bodies was found to correlate with lower risk perception, evidenced by a t-value of 3.89 and a p-value of less than 0.001. Farmers' risk perceptions were found to negatively impact the adoption of GM crops. Concerns about potential health and environmental risks, compounded by widespread misinformation and a lack of comprehensive educational initiatives, contribute significantly to hesitancy in adopting GM crops. The statistical analysis supported this finding, with a t-value of -2.95 and a p-value of less than 0.01 indicating a significant negative impact. Misinformation and lack of education were further substantiated as major barriers, with a t-value of -3.21 and a p-value of less than 0.002.

The study also highlighted a significant relationship between farmers' risk perception of GM crops and their willingness to purchase crop insurance. Farmers who perceive higher risks are less likely to invest in crop insurance, affecting their overall risk management strategies. This relationship was statistically significant, with a t-value of -2.88 and a p-value of less than 0.01. Moreover, the existing agricultural insurance policies in Nigeria were found to be inadequately tailored to address the specific concerns related to GMOs, leading to their underutilization. This inadequacy was reflected in the statistics, with a t-value of -3.15 and a p-value of less than 0.002. The regulatory framework for GM crops in Nigeria, established under the National Biosafety Management Agency (NBMA) Act of 2015, has faced significant challenges in implementation, including inadequate enforcement and limited public engagement. This has contributed to persistent public skepticism and misinformation about GMOs, further exacerbating slow adoption rates. The study's analysis showed a t-value of -2.67 and a p-value of less than 0.01 for regulatory challenges, and a t-value of -3.45 with a p-value of less than 0.001 for public skepticism and misinformation.

Therefore, the study concludes that the risk perception of genetically modified crops among Nigerian farmers is a significant barrier to their adoption. Socio-economic factors, cultural beliefs, and misinformation heavily influence these perceptions. Additionally, the existing agricultural insurance policies are not sufficiently addressing the specific risks associated with GM crops, leading to their underutilization. The regulatory environment, while established, requires more robust enforcement and public engagement to build trust and dispel myths surrounding GMOs. Effective communication and education are critical to altering the negative perceptions and encouraging the adoption of GM crops, which have the potential to significantly enhance agricultural productivity and sustainability in Nigeria. The following recommendations are made:

1. Develop and implement comprehensive educational programs to provide accurate information about GM crops. These programs should target farmers, policymakers, and the general public to dispel myths and misinformation.
2. Utilize various media platforms for balanced and factual reporting on the benefits and risks of GM crops.
3. Design and promote agricultural insurance products that specifically address the perceived risks associated with GM crops. These products should offer financial protection against potential failures and uncertainties unique to GMOs.
4. Incorporate educational components within insurance schemes to educate farmers about the benefits and safety of GM crops.
5. Enhance the enforcement of the National Biosafety Management Agency (NBMA) Act of 2015 and ensure consistent regulatory oversight to build farmer confidence in the safety and support of GM technologies.
6. Increase public engagement and transparency in regulatory processes to foster trust among farmers and other stakeholders.
7. Provide financial incentives and support to smallholder farmers to encourage the adoption of GM crops. This could include subsidies, grants, or low-interest loans specifically for farmers willing to adopt GM technologies.
8. Address economic barriers by improving access to markets and ensuring that GM crops are economically viable for farmers.

References

Adenle, A. A. (2011). Response to issues on GM agriculture in Africa: Are transgenic crops safe? *BMC Research Notes, 4*(1), 388.

Adenle, A. A. (2014). Stakeholders' perceptions of GM technology in West Africa: Assessing the responses of policymakers and scientists in Ghana and Nigeria. *Journal of Agricultural and Environmental Ethics, 27*(2), 241–263.

Adenle, A. A., Morris, E. J., & Parayil, G. (2013). Status of development, regulation and adoption of GM agriculture in Africa: Views and positions of stakeholder groups. *Food Policy, 43*, 159–166.

Akinola, B. D. (2014). Determinants of farmers' adoption of agricultural insurance: The case of poultry farmers in Abeokuta Metropolis of Ogun State, Nigeria. *British Journal of Poultry Sciences, 3*(2), 36-41.

Barnett, B. J., & Mahul, O. (2007). Weather index insurance for agriculture and rural areas in lower-income countries. *American Journal of Agricultural Economics, 89*(5), 1241–1247.

Basso, B., & Antle, J. (2020). Digital agriculture to design sustainable agricultural systems. *Nature Sustainability, 3*(4), 254–256.

Brookes, G., & Barfoot, P. (2020). GM crops: Global socio-economic and environmental impacts 1996–2018. *PG Economics Ltd.*

Brookes, G., & Barfoot, P. (2022). Environmental impacts of genetically modified (GM) crop use 1996–2020: Impacts on pesticide use and carbon emissions. *GM Crops & Food, 13*(1), 262–289.

Carter, M., de Janvry, A., Sadoulet, E., & Sarris, A. (2017). Index insurance for developing country agriculture: A reassessment. *Annual Review of Resource Economics, 9*(1), 421-438.

Dosman, D. M., Adamowicz, W. L., & Hrudey, S. E. (2001). Socioeconomic determinants of health- and food safety-related risk perceptions. *Risk Analysis, 21*(2), 307–317. https://doi.org/10.1111/0272-4332.212113

Ellstrand, N. C. (2018). "Born to run"? Not necessarily: Species and trait bias in persistent free-living transgenic plants. *Frontiers in Bioengineering and Biotechnology, 6*, 88.

Ezezika, O. C., Mabeya, J., Daar, A. S., & Singer, P. A. (2012). Factors influencing agbiotech adoption and development in sub-Saharan Africa. *Nature Biotechnology, 30*(1), 38–40. https://doi.org/10.1038/nbt.2088

Frewer, L. J., van der Lans, I. A., Fischer, A. R., Reinders, M. J., Menozzi, D., Zhang, X., & Zimmermann, K. L. (2013). Public perceptions of agri-food applications of genetic modification–A systematic review and meta-analysis. *Trends in Food Science & Technology, 30*(2), 142–152. https://doi.org/10.1016/j.tifs.2013.01.003

Gaskell, G., Allum, N., Wagner, W., Kronberger, N., Torgersen, H., Hampel, J., & Bardes, J. (2004). GM foods and the misperception of risk perception. *Risk Analysis, 24*(2), 185–194.

Gould, F., Brown, Z. S., & Kuzma, J. (2018). Wicked evolution: Can we address the sociobiological dilemma of pesticide resistance? *Science, 360*(6390), 728–732. https://doi.org/10.1126/science.aar3780

International Institute of Tropical Agriculture (IITA). (2019). Nigeria approves Bt cowpea for cultivation. Retrieved from https://www.iita.org/cropsnew/cowpea/#:~:text=IITA's%20research%20and%20impact&text=Following%20more%20than%20two%20decades,cowpea%20to%20farmers%20in%20Nigeria

International Service for the Acquisition of Agri-biotech Applications (ISAAA). (2020). *Global status of commercialized biotech/GM crops in 2019: Biotech crops drive socio-economic development and sustainable environment in the new frontier* (ISAAA Brief No. 55). Retrieved from https://www.isaaa.org/resources/publications/briefs/55/

James, C. (2018). *Global status of commercialized biotech/GM crops: 2018* (ISAAA Brief No. 54). ISAAA. Retrieved from https://www.isaaa.org/resources/publications/briefs/54/

Kaur, S., Singh, H., Roy, D., & Singh, H. (2024). Prospects of crop insurance for sustenance of farmers' livelihood during GM cotton crop failure in Indian Punjab. *Journal of Agribusiness in Developing and Emerging Economies*.

Kikulwe, E. M., Birol, E., Wesseler, J., & Falck-Zepeda, J. (2011). A latent class approach to investigating demand for genetically modified banana in Uganda. *Agricultural Economics, 42*(5), 547–560.

Mahul, O., & Stutley, C. J. (2010). *Government support to agricultural insurance: Challenges and options for developing countries*. World Bank Publications. Retrieved from http://documents.worldbank.org/curated/en/911381468150325904/Government-support-to-agricultural-insurance-challenging-and-options-for-developing-countries-overview

Morris, J., & Brewin, P. (2014). The impact of seasonal flooding on agriculture: The spring 2012 floods in Somerset, England. *Journal of Flood Risk Management, 7*(2), 128-140.

Moschini, G. (2008). Biotechnology and the development of food markets: Retrospect and prospects. *European Review of Agricultural Economics, 35*(3), 331–355.

Naseem, A., Omamo, S. W., & Spielman, D. J. (2006). The private sector in agricultural R&D: Policies and institutions to foster its growth in developing countries. *International Service for National Agricultural Research* (ISNAR Discussion Paper 6). Retrieved from https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=09e59c041847f304435d0d093741b409838fbd3a

National Academy of Sciences. (2016). *Genetically engineered crops: Experiences and prospects*. National Academies Press.

National Biosafety Management Agency (NBMA). (2015). *National Biosafety Management Agency Act, 2015*. Federal Government of Nigeria. Retrieved from https://nbma.gov.ng/nbma-act/

National Biotechnology Development Agency (NABDA). (2018). *National Biotechnology Development Agency Annual Report 2018*. National Biotechnology Development Agency. Retrieved from https://nabda.gov.ng/

National Bureau of Statistics (NBS). (2021). *Nigerian gross domestic product report Q4 2021*. National Bureau of Statistics. Retrieved from https://nigerianstat.gov.ng/elibrary/read/1241137

National Bureau of Statistics (NBS). (2023). *Nigerian gross domestic product report Q1 2023*. National Bureau of Statistics. Retrieved from https://nigerianstat.gov.ng/download/1241325#:~:text=Nigeria's%20Gross%20Domestic%20Product%20(GDP,the%20fourth%20quarter%20of%202022

Nicolia, A., Manzo, A., Veronesi, F., & Rosellini, D. (2014). An overview of the last 10 years of genetically engineered crop safety research. *Critical Reviews in Biotechnology, 34*(1), 77–88. https://doi.org/10.3109/07388551.2013.823595

Nigerian Agricultural Insurance Corporation (NAIC). (2020). *Nigerian Agricultural Insurance Corporation Annual Report 2020*. Nigerian Agricultural Insurance Corporation. Retrieved from https://naic.gov.ng/

Olubiyo, S. O., Hill, G. P., & Webster, J. P. G. (2009). Econometric analysis of the impact of agricultural insurance on farming systems in the middle belt, Nigeria. *African Journal of Food, Agriculture, Nutrition and Development, 9*(6), 1406–1417. https://doi.org/10.4314/ajfand.v9i6.46266

Qaim, M. (2009). The economics of genetically modified crops. *Annual Review of Resource Economics, 1*(1), 665–693.

Qaim, M. (2020). Role of new plant breeding technologies for food security and sustainable agricultural development. *Applied Economic Perspectives and Policy, 42*(2), 129–150. https://doi.org/10.1002/aepp.13044

Siegrist, M. (2000). The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Analysis, 20*(2), 195–204. https://doi.org/10.1111/0272-4332.202020

Skees, J. R., & Barnett, B. J. (2006). Enhancing microfinance using index-based risk-transfer products. *Agricultural Finance Review, 66*(2), 235–250. https://doi.org/10.1108/00214660680001189

Skees, J. R., Hazell, P., & Miranda, M. (1999). *New approaches to crop yield insurance in developing countries*. International Food Policy Research Institute.

Slovic, P. (1987). Perception of risk. *Science, 236*(4799), 280–285. https://doi.org/10.1126/science.3563507

Slovic, P. (2000). *The perception of risk*. Earthscan Publications.

Smith, V. H., & Glauber, J. W. (2012). Agricultural insurance in developed countries: Where have we been and where are we going? *Applied Economic Perspectives and Policy, 34*(3), 363–390.

Xie, S., Zhang, J., Li, X., Xia, X., & Chen, Z. (2024). The effect of agricultural insurance participation on rural households' economic resilience to natural disasters: Evidence from China. *Journal of Cleaner Production, 434*, 140123.

Zilberman, D., Graff, G., Hochman, G., & Kaplan, S. (2015). The political economy of biotechnology. *German Journal of Agricultural Economics, 64*(4). https://doi.org/10.22004/ag.econ.27018