

Nhận thức và quản lý rủi ro của nông dân trong nông nghiệp: Tổng quan thực nghiệm từ các nước đang phát triển

TÓM TẮT

Dựa trên khung phân loại tám nhóm rủi ro nông nghiệp do UNESCO đề xuất, nghiên cứu này tiến hành tổng hợp có hệ thống các bằng chứng thực nghiệm từ nhiều quốc gia đang phát triển nhằm làm sáng tỏ nhận thức của nông dân về rủi ro và các chiến lược ứng phó trong quá trình sản xuất nông nghiệp. Kết quả tổng hợp cho thấy rủi ro sản xuất, rủi ro thị trường và rủi ro khí hậu được xem là những mối đe dọa nghiêm trọng nhất; tuy nhiên, mức độ nhận thức và phản ứng của nông dân có sự khác biệt đáng kể tùy thuộc vào điều kiện kinh tế – xã hội. Các yếu tố như quy mô đất đai, trình độ học vấn, kinh nghiệm sản xuất và khả năng tiếp cận tín dụng đóng vai trò quyết định trong việc định hình hành vi quản lý rủi ro. Nghiên cứu này không chỉ cung cấp bức tranh toàn diện về nhận thức rủi ro của nông dân trong bối cảnh các nước đang phát triển, mà còn làm rõ mối quan hệ giữa đặc điểm kinh tế – xã hội và hành vi quản lý rủi ro, các hướng tiếp cận tích hợp nhằm xây dựng khung chính sách quản lý rủi ro nông nghiệp phù hợp và bền vững.

Từ khóa: *Nông hộ nhỏ; nhận thức rủi ro; né tránh rủi ro; rủi ro khí hậu; quản lý rủi ro nông nghiệp.*

Farmers' Risk Perception and Management in Agriculture: An Empirical Review from Developing Countries

ABSTRACT

Using UNESCO's framework of eight agricultural risk categories, this study synthesizes empirical evidence from developing countries to clarify how farmers perceive and respond to risks in agricultural production. The synthesis reveals that production, market, and climate-related risks are perceived as the most severe threats; however, farmers' awareness and responses vary substantially across socio-economic contexts. Factors such as landholding size, education, farming experience, and access to credit play decisive roles in shaping farmers' risk management behavior. This study not only provides a comprehensive picture of farmers' risk perception in developing countries but also elucidates the relationship between socio-economic characteristics and risk management practices, offering integrated insights to inform the design of sustainable and context-specific agricultural risk management policies.

Keywords: *smallholder farmers; risk perception; risk management; agricultural risk management.*

1. INTRODUCTION

Agriculture remains a cornerstone of the global economy, playing a vital role in food security and sustainable development, contributing approximately 4% of global GDP, and in some developing countries, this figure may exceed 25% (World Bank).¹ In recent years, particularly since 2019, agricultural production has increasingly faced multifaceted and interconnected risks due to climate change, market volatility, rising input costs, and increasing integration into global value chains. Extreme weather events, fluctuating product prices, and uncertainty in accessing inputs have increased both the frequency and severity of risks faced by farmers, especially in developing countries. These evolving challenges make understanding risk perception directly beneficial to farmers: helping them identify gaps in traditional self-response strategies, thereby proactively accessing technical and financial support resources tailored to their current circumstances, more urgent than ever. In the context of increasingly severe climate change and rural livelihoods still dependent on agriculture, farmers' awareness and response to risks have become an urgent research priority, attracting attention at both international and national levels. The concept of "risk" in agriculture has been approached from various theoretical perspectives. Knight, distinguished between risk and uncertainty, arguing that risk involves quantifiable probabilities, whereas uncertainty cannot be measured.² Holton, viewed it as the combination of uncertainty and exposure to loss.³ Risk refers to the probability of loss, damage, or uncertainty that adversely affects individuals (Bui Thi Gia).⁴ Hubbard, conceptualized risk as measurable variability in expected outcomes.⁵

And according to ISO 31000:2018, risk is defined as "the effect of uncertainty on objectives," including potentially positive effects if properly managed.

In agricultural production, risk management decisions are integral to farmers' economic behavior, particularly in developing countries where consumption and production are closely interlinked. Climate change has amplified rural vulnerability by reducing yields, increasing production costs, and heightening the risk of crop failure and income instability. Hence, farmers' risk perception is central to their production choices, technology adoption, and management strategies (Duong et al.; Jankelova et al.).⁶ Empirical evidence across countries shows that farmers commonly face production and market risks such as natural disasters, pests and diseases, and price volatility. For instance, Jankelova, Masar, and Moricova found that Slovak agricultural households and enterprises perceive price and income fluctuations as their most serious risks,⁷ while Ahmad, Afzal, and Rauf reported that wheat and maize farmers in Pakistan and Kenya are most concerned about low yields, high input costs, and harsh weather conditions.⁸ In Indonesia, Imelda et al. revealed that rubber farmers identified pests, abnormal weather, and price fluctuations as the most threatening risks.⁹ In Vietnam, recent studies have also confirmed that production and market risks are the two most prominent categories of risks faced by smallholder farmers. For instance, Tran Hoai Nam and Do Minh Hoang demonstrated that natural disasters, pest outbreaks, and fluctuations in agricultural product prices directly affect the production efficiency of vegetable farming in

Lam Dong province.¹⁰ These findings reflect the broader characteristics of Vietnamese agriculture, where the majority of farmers operate on a small scale, remain highly dependent on natural conditions, and have limited access to market information. Farmers' risk awareness plays a central role in coordinating their production decisions, crop selection, technology adoption, and risk management strategy choices, rather than relying solely on automated and unsustainable solutions. Evidence suggests that farmers do not react solely to customer risks; instead, their behavior is largely influenced by their perceived risk profiles, socioeconomic characteristics, and local context. From a farmer's perspective, understanding risk provides a better insight into the types of risks considered most significant and the strategies commonly used to cope with uncertainty. Compared to existing review studies on agricultural risk, this paper offers several novel contributions. First, instead of merely summarizing empirical findings, this review employs a thematic synthesis approach to systematically categorize farmers' risk perceptions and risk management strategies across different production and market contexts. Second, this review clearly links risk perceptions to farmers' behavioral responses and policy implications, thereby expanding upon existing reviews that primarily focus on descriptive summaries. Third, by focusing on recent empirical evidence from developing and transitional economies, this review provides up-to-date insights highly relevant to agricultural risk management in the context of climate change and increasingly volatile markets. Therefore, synthesizing international empirical evidence in conjunction with Vietnam's specific agricultural context is essential for developing appropriate agricultural risk management policies, thereby enhancing farmers' resilience and promoting sustainable rural development.

Review methodology

This study adopts a structured narrative review approach to synthesize existing empirical and review studies on farmers' risk perception and agricultural risk management. Relevant literature was collected from peer-reviewed journals and policy reports published between 2016 and 2025, using key terms related to risk perception, climate risk, market risk, and agricultural decision-making. Studies were selected based on their relevance to farm-level risk perception, methodological transparency, and empirical contribution. The reviewed literature was

systematically categorized according to types of risks, analytical methods, and key findings. Rather than summarizing individual studies separately, this review emphasizes comparative analysis to identify consistent patterns, divergences, and research gaps in the literature.

2. OVERVIEW OF AGRICULTURAL RISKS

Following the World Bank's "Rapid Agricultural Supply Chain Risk Assessment Framework" (2010), agricultural risks can be classified into eight key categories: weather, natural disasters, biological and environmental, market, logistics and infrastructure, management and operational, policy and institutional, and political risks.¹¹

2.1. Weather risk

Weather risk refers to the likelihood of adverse phenomena such as heavy rainfall, strong winds, hail, or abnormal temperature fluctuations that negatively affect agricultural production, human livelihoods, and the environment. Even non-extreme weather events such as excessive or insufficient rainfall, or unusually high or low temperatures can disrupt agricultural supply chains within a single cropping season or production cycle. Insufficient rainfall leads to soil dryness, reduced moisture and nutrient levels, stunted crop growth, or mass plant mortality, while livestock suffer from water shortages and a lack of green fodder. Conversely, excessive rainfall or flooding can cause root rot, soil erosion, and nutrient leaching, increase pest and disease incidence, and damage agricultural infrastructure, ultimately reducing productivity. Abnormal temperature variations can also disrupt plant growth, causing leaf burn, reduced photosynthesis, and the death of seedlings, as well as affecting flowering and fruiting processes. Phenomena such as hail, strong winds, or prolonged high humidity not only diminish yields but also reduce product quality and impede the transportation of agricultural goods. Localized weather anomalies may lead to declines in both agricultural output and quality, triggering downstream effects on input demand, support services, and farmers' repayment capacity. These disruptions can further affect buyers, processors, and supply chain logistics, including transportation, communication, and energy provision. However, in many cases, such as localized droughts, losses are borne primarily by farmers, while purchasing and processing enterprises in unaffected areas experience little to no impact. For farmers, weather risk remains the

most difficult to manage, as it depends entirely on natural conditions. Even minor fluctuations in weather can lead to substantial economic losses, particularly for smallholders who lack irrigation systems or modern storage facilities.

2.2. Natural disaster risk

Natural disaster risk refers to losses or disruptions caused by extreme natural phenomena such as floods, severe droughts, storms, earthquakes, or volcanic eruptions, which directly affect land, infrastructure, and agricultural production capacity. Natural disasters often have widespread and long-lasting consequences that extend across multiple cropping seasons. Floods inundate farmlands, wash away crops and livestock, and destroy critical infrastructure such as irrigation systems and animal shelters. Severe droughts lead to water scarcity, soil degradation, and crop wilting, while livestock suffer from a shortage of water and feed. Storms can uproot trees, damage greenhouses and irrigation systems, and create favorable conditions for subsequent pest and disease outbreaks. Earthquakes and volcanic eruptions may completely devastate physical infrastructure, disrupt production processes, and contaminate the natural environment. These risks not only reduce productivity and cause substantial material damage but also disrupt supply chains by interrupting the flow of goods, services, and energy. In the long term, natural disasters erode the stability of production systems, weaken market linkages, and undermine the sustainable livelihoods of farming communities.

2.3. Biological and environmental risk

Biological and environmental risks refer to the potential adverse impacts arising from pest infestations, livestock diseases, food contamination, or resource degradation. Crop pests reduce yields and quality while increasing the cost of prevention and control. Livestock diseases, such as avian influenza, foot-and-mouth disease, or African swine fever can cause mass mortality, severely disrupting meat supply and affecting farmers' incomes. Food contamination resulting from excessive use of chemicals, pesticides, or antibiotics, or from unsafe production environments, erodes consumer trust and damages the reputation and export potential of agricultural products. In addition, the degradation of natural resources such as soil, water, and biodiversity undermines long-term agricultural productivity and increases the cost of land restoration. Over time, these factors

negatively influence both yield stability and product quality, threatening the sustainability of agricultural systems.

2.4. Market risk

Market risk refers to the likelihood of economic loss resulting from fluctuations in supply and demand, price volatility of inputs and outputs, stringent quality and food safety standards, or reputational risks within the supply chain. When supply exceeds demand, falling agricultural prices lead to farmer losses; conversely, when demand surges unexpectedly while supply remains limited, market imbalances occur, creating instability in production and consumption. Rising input costs, such as fertilizers, pesticides, animal feed, and fuel further inflate production expenses, while unstable output prices reduce profit margins. Moreover, increasingly strict international requirements regarding traceability, quality, and food safety compel producers to adopt modern technologies and production standards. Failure to comply can result in market exclusion, economic loss, and missed export opportunities. Reputational risks, such as commercial fraud or non-compliance with product standards—can erode partner confidence and inflict severe damage on agricultural brands, further exacerbating market vulnerability.

2.5. Logistics and infrastructure risk

Logistics and infrastructure risks arise when transportation, storage, distribution, or energy supply systems are disrupted due to natural disasters, technical failures, labor strikes, or rising logistics costs. Such disruptions directly affect the circulation of goods, the preservation of agricultural products, and product quality. For perishable commodities, transportation delays can result in spoilage and substantial financial losses. Power outages, fuel shortages, or damage to infrastructure—such as roads, bridges, and cold storage facilities—significantly increase operating costs and reduce the competitiveness of agricultural products in both domestic and international markets.

2.6. Management and operational risk

Management and operational risks originate from human and organizational factors, including poor decision-making in investment, planning, and technology, or insufficient flexibility in process and market adjustments. For example, selecting unsuitable crop varieties, overusing fertilizers, mismanaging cropping schedules, or lacking

effective labor management can reduce yields, increase costs, and cause supply–demand imbalances. Technical errors in crop care, storage, or post-harvest handling also degrade product quality. Moreover, a lack of adaptive capacity to market fluctuations can lead producers to miss sales opportunities and, in some cases, trigger cascading losses throughout the entire agricultural supply chain.

2.7. Policy and institutional risk

Policy and institutional risk arises from instability, inconsistency, or inefficiency within policy, legal, and governance frameworks-encompassing monetary, tax, trade, and land policies, as well as the administrative capacity of state institutions. Such volatility directly affects the investment environment, resource allocation efficiency, and the sustainable development of the agricultural sector. These risks influence the behavior and decision-making of stakeholders across agricultural value chains by altering costs, profitability, and production planning. Fluctuations in interest rates, taxation, or trade regulations increase borrowing costs, reduce predictability, and weaken the competitiveness of farmers and agribusinesses. Inconsistent land policies, weak governance, and corruption further distort resource distribution, cause fiscal inefficiencies, and erode investor confidence. Limited institutional capacity-manifested in delayed policymaking, poor coordination, and ineffective implementation-undermines the sector's ability to respond to market shocks, natural disasters, and global integration pressures. Overall, policy and institutional risks may propagate through the entire agricultural value chain, disrupting the flow of goods, services, and finance, thereby reducing productivity, hindering trade, and posing long-term threats to sustainable agricultural growth.

2.8. Political risk

Political risk refers to potential losses arising from socio-political instability, including conflict, war, nationalization, or disruptions in international trade. Conflicts and wars damage infrastructure, disrupt production, and create labor shortages that constrain agricultural input supply. Excessive state control or nationalization undermines investor confidence and discourages capital inflows, while sanctions or trade barriers hinder exports, amplify price volatility, and threaten both food security and macroeconomic stability.

In essence, the eight categories of agricultural risk are interrelated and mutually reinforcing within agricultural supply chains. Accurate identification, classification, and assessment of these risks form the foundation for developing effective agricultural risk management strategies and advancing sustainable agricultural development.

3. LITERATURE REVIEW OF EMPIRICAL STUDIES ON FARMERS' RISK PERCEPTION AND MANAGEMENT IN AGRICULTURE

International studies have shown that farmers worldwide face multiple risks that directly affect productivity, income, and decision-making related to production and risk management strategies. Farmers' risk perception is shaped by various factors, including geographic location, socio-economic conditions, perceived severity of risks, and available coping capacity. Empirical evidence across countries indicates considerable variation in how farmers perceive and respond to risks in both magnitude and strategy. **Studies in Pakistan, Indonesia, and Ghana all agree that educational attainment and farming experience play a decisive role in shaping risk-avoidance behavior. Higher-educated farmers tend to be more cautious and employ more systematic risk management practices.** In Sub-Saharan Africa, particularly in Ethiopia, several studies (Legesse & Drake; Gebreegziabher & Tadesse; Bishu et al.) emphasize the role of household characteristics, human capital, infrastructure, resource access, and environmental conditions in shaping farmers' perceptions of risk.¹²⁻¹⁴ Common coping strategies include production diversification, use of veterinary services, and financial management. **There are clear comparisons between household groups. While smallholder farmers in Ethiopia and Vietnam often adopt spontaneous measures such as crop restructuring based on experience, large-scale agricultural enterprises (such as those in Slovakia) prioritize specialization and the use of sophisticated financial management tools.** In South Africa, Kisaka Lwayo and Ajuruchukwu found that smallholders perceive production, market, and financial risks as most critical, typically managing them through traditional means such as crop diversification, savings, and reliance on social networks.¹⁵ Similarly, Bishu et al., in a study of livestock farmers in the Tigray region of northern Ethiopia, identified labor shortages, high feed costs, and low agricultural income as major risks, with prevalent

management strategies including veterinary care, parasite control, and credit use.¹⁴

In the study “Smallholder Farmers’ Risk Perceptions and Risk Management Responses: Evidence from the Semi-Arid Region of Ghana by Asravor”, a survey of 324 maize, cassava, and rice farmers in northern Ghana examined smallholders’ perceptions and risk management behavior.¹⁶ Using primary data collected through structured questionnaires, the author applied a Probit model to identify determinants of risk perception and response behavior, complemented by descriptive statistics to characterize households, risk types, and management measures. The results indicated that age, herd size, income level, and engagement in non-farm activities significantly affect how farmers recognize and respond to risks. Most farmers in the region operate on a small scale, have limited education, and primarily practice subsistence farming. They adopt a mix of management strategies, most notably production diversification and financial measures such as savings, debt reduction, or off-farm employment to stabilize income. Among these, diversification emerges as the key strategy to mitigate production and human-related risks. Farmers’ perceptions and risk management behaviors not only influence individual livelihoods but also indirectly affect agribusinesses and regional value chains, as fluctuations in yield and quality complicate procurement, processing, and distribution. Accordingly, Asravor recommended policies to enhance farmers’ knowledge, financial access, and market participation, while strengthening sustainable linkages between farmers and agribusinesses. Such interventions are vital to stabilize rural livelihoods and promote sustainable agricultural development amid growing natural and market uncertainties.¹⁶

In the study “Analysis of Wheat Farmers’ Risk Perceptions and Attitudes: Evidence from Punjab, Pakistan”, Dilshad Ahmad, Muhammad Afzal, and Abdur Rauf examined the perceptions and attitudes toward risk among 402 wheat farmers across six districts of Punjab Province, representing high-, medium-, and low-yielding regions.⁸ Data were collected through structured interviews in which respondents assessed the severity and frequency of agricultural risks, including weather, natural disasters, market, and policy-related risks, using a Likert scale ranging from “not important” to “very severe.” Based on this dataset, the authors employed descriptive statistics, factor analysis, and regression models

to explore the relationships between risk perception, risk attitude, and farmers’ demographic and economic characteristics such as age, education, farming experience, land size, income, and access to credit. The results revealed that farmers generally exhibit risk-averse behavior, though the degree of aversion varies across individual and economic attributes. Older and more educated farmers tend to be more cautious, while those with greater farming experience or livestock ownership demonstrate higher risk tolerance. Moreover, larger landholdings, non-farm income, and better access to credit and markets enhance farmers’ capacity to diversify and cope with climate and price-related risks. The authors emphasized the importance of comprehensive policy interventions aimed at strengthening farmers’ risk management capacity, improving access to finance and markets, and promoting skill development programs to enhance adaptability and livelihood stability in the face of increasing agricultural risks.

In the study “Understanding Farmers’ Risk Perception and Attitude: A Case Study of Rubber Farming in West Kalimantan, Indonesia”, Imelda, Jangkung Handoyo Mulyo, Any Suryantini, and Masyhuri conducted a comprehensive analysis of rubber farmers’ perceptions and attitudes toward risk in West Kalimantan, Indonesia, based on a survey of 120 farming households.⁹ The findings revealed five major categories of risks faced by rubber farmers: (1) production risk (pests, abnormal climate variations, and unstable yields); (2) market risk (price volatility in domestic and international rubber markets and rising input costs); (3) financial risk (limited capital and restricted access to credit); (4) human risk (health issues, labor shortages, and policy changes); and (5) environmental risk (natural disasters and land degradation). The authors employed a mixed-methods approach, combining structured questionnaires with in-depth interviews to capture local context and farmers’ actual coping behaviors. Quantitative data were analyzed using descriptive statistics, exploratory factor analysis to classify risk categories, and multiple linear regression to identify determinants of risk perception and attitude. Farmers’ risk perceptions were measured on a five-point Likert scale, reflecting their assessment of the likelihood and impact of each risk type. Results showed substantial heterogeneity in farmers’ risk concerns and aversion, influenced by demographic and economic characteristics such

as age, education, farm size, non-farm income, and access to credit. Risk perception was found to play a critical role in shaping farmers' management behavior. Most respondents preferred on-farm preventive measures, such as crop diversification, intercropping, and technical improvements, rather than relying on formal market-based tools like agricultural insurance or contract farming. This tendency reflects a self-reliant adaptation strategy grounded in experience and available resources, while also highlighting smallholders' limited access to formal risk management mechanisms in the region.

In addition to studies conducted at the household level, the research "Risk Factors in the Agriculture Sector" by Jankelová, Masár, and Moricová examined agricultural risks at the enterprise level.⁷ The authors analyzed key risk factors affecting the operations of 104 agricultural enterprises in Slovakia, including cooperatives, joint-stock companies, limited liability firms, and individual farms. Using a quantitative approach based on structured questionnaires, the study assessed the prevalence and characteristics of various risk types across enterprise forms. The collected data were analyzed using descriptive statistics to determine the frequency and intensity of risks, and comparative analysis was employed to identify differences in risk perception and management behavior among enterprises. Risk perception was measured using a five-point Likert scale reflecting the importance and frequency of each risk's impact on business performance. The findings identified five major categories of risks: (1) price and market risk (fluctuations in input and output prices); (2) production risk (natural disasters, pests, and low yields); (3) financial risk (limited capital and restricted access to credit); (4) institutional and policy risk (unstable regulations and inconsistent policy support); and (5) human and asset-related risk (labor shortages, workplace accidents, and equipment failures). Among these, price and production risks were perceived as the most critical, as they directly and recurrently affect income, profitability, and operational continuity. Enterprises also emphasized institutional and financial risks, particularly policy instability, legal uncertainty, and limited access to finance, alongside human and asset-related risks associated with

Ho Thanh Tam measured farmers' risk perceptions and examined the impacts of various risk factors on rice production efficiency in Long Phu and Tran De districts of Soc Trang Province,

infrastructure damage and equipment breakdowns. In response, firms adopted a variety of risk management measures to mitigate adverse impacts and maintain operational stability. These included flexible production planning, income diversification, financial and cash-flow management tools, workforce training, and enhanced maintenance of physical assets. However, the study noted that the overall effectiveness of risk management remains closely tied to state policy support, particularly in market stabilization, financial assistance, and institutional transparency. The authors concluded that a profound understanding of risk and adaptive management capacity are critical determinants of agricultural enterprises' resilience in volatile production environments, thereby contributing to the sustainable development of the agricultural sector.

Similarly, Tran Hoai Nam and Do Minh Hoang, in their study "Measuring Risk in Vegetable Production among Farming Households in Don Duong District, Lam Dong Province", investigated farmers' risk perceptions and identified major risk categories in vegetable farming.¹⁰ Based on a structured survey of 160 households and employing a Likert scale to assess the severity and frequency of risks, the study applied descriptive and comparative statistical analyses. The results revealed three dominant risk groups: production risk, market risk, and human risk. Among these, production risk, comprising natural disasters, pest outbreaks, and issues related to seed, fertilizer, and pesticide quality, was perceived as the most severe. Market risk was also prominent, driven by price fluctuations, dependence on middlemen, and supply-demand imbalances, while human risk involved limited technical skills, health issues, and managerial capacity. Although institutional and financial risks were present, their impact was relatively modest due to ineffective policy support. Most farmers relied on experiential coping strategies such as adjusting cultivated areas, changing crop structures, or reducing input costs; however, these measures were often unsustainable. The authors emphasized the need for enhanced technical and financial support, along with stronger farmer-enterprise partnerships, to improve adaptive capacity and ensure production stability.

using survey data from 125 farming households.¹⁷ Data were collected through structured questionnaires and analyzed using descriptive statistics and multiple linear regression. The

findings revealed that weather-related risks were perceived as the most severe, particularly heavy rainfall, drought, and flooding, which caused direct yield losses and increased production costs. Other significant risks included pest infestations, seed quality issues, input price fluctuations, and inconsistent farming techniques. Furthermore, production experience, farm size, education, and access to market information were found to enhance farmers' ability to recognize and cope with risks. The study recommended promoting agricultural technology transfer, developing weather warning systems and crop insurance, implementing financial support policies, and strengthening market linkages to improve adaptive capacity and stabilize rice production in Soc Trang Province.

Similarly, Nguyen Tuan Kiet and Nguyen Tan Phat assessed farmers' risk perceptions in agricultural production in Can Tho City through direct interviews and structured questionnaires with 80 farming households using a Likert scale.¹⁸ Descriptive statistics, including mean, standard deviation, frequency, and range, were used to reflect the current state of risk perception and coping strategies. The results showed that farmers primarily identified production risks and financial risks as the most significant challenges. Production risks stemmed from abnormal weather conditions, pest and disease outbreaks, poor seed quality, and rising input costs, while financial risks were mainly associated with limited capital, credit inaccessibility, and high production expenses. Most farmers adopted spontaneous coping measures, such as adjusting crop structures, reducing costs, or downsizing production, but these strategies proved unsustainable due to insufficient financial, technical, and informational support. The authors emphasized the need for enhanced credit policies, technical transfer programs, and stronger farmer - enterprise linkages to improve risk management capacity and ensure sustainable livelihoods for farming households in Can Tho.

Van Bac Ho's study on risk perception and management strategies of fruit farmers in Son La province was conducted through a direct survey method using multi-stage sampling, collecting data from 172 farmer households through direct interviews using a semi-structured questionnaire.¹⁹ To measure perception, the study used a 5-point Likert scale, asking farmers to assess the severity of risk sources and the importance of management strategies. Regarding

the analysis method, the author applied Principal Component Analysis (PCA) to group variables and a multiple linear regression model to identify influencing factors. The research results identified 14 risk sources, divided into 4 groups: production risk, market risk, human risk, and financial risk. Among these, production risk, especially seed quality, adverse weather conditions, and pests and diseases, was assessed as the most serious. Risk management strategies were also grouped into four categories: diversification, product quality improvement, human resource management, and technical consulting, with quality control, disease prevention, and product preservation being the most important measures. Regression analysis showed that socio-economic factors such as ethnicity, primary occupation, land size, access to credit, and agricultural extension services significantly influenced farmers' risk perception and management strategy choices, thereby highlighting the central role of risk perception in shaping production behavior and risk response in the context of agriculture in developing countries.

The study "Risk Perception, Adaptation Strategies, and Agricultural Sustainability" analyzes the relationship between farmers' risk perception, adaptation strategies, and agricultural production sustainability in the context of environmental and economic change.²⁰ Risk perception is measured using a multi-level Likert scale, reflecting farmers' subjective assessment of key risk groups such as natural-climate risks, market risks, production risks, and policy risks. Methodologically, the authors used micro-scale farmer survey data combined with a multivariate econometric model, primarily a Logit/Probit regression model and a mediating structural model, to test the role of risk perception in influencing the selection of adaptation strategies. The research results show that risk perception is significantly influenced by factors such as the household head's educational level, production experience, size of cultivated land, level of access to information, policy support, and local environmental conditions. Notably, high risk perception increases the likelihood of adopting proactive adaptation strategies (crop diversification, technical improvements, sustainable input use), thereby contributing to enhanced agricultural sustainability, while low risk perception often leads to passive behavior and increases the vulnerability of the household agricultural production system.

Xinyu Li's study, "A Study on the Impact of Poverty Vulnerability on Farmers' Livelihood Choices from the Perspective of Risk Perception: Evidence from the Yellow River Basin," measured farmers' risk perceptions across three main dimensions: production risk (natural disasters, diseases), market risk (price fluctuations, supply and demand), and policy risk (policy adjustments and implementation), using a 5-point Likert scale to assess subjective perception.²¹ The research methodology employed combined quantitative surveys with 3,235 questionnaires and econometric models, specifically the Expected Poverty Probability Model (VEP) to measure vulnerability, a multivariate Logistic Regression model to analyze livelihood choices, and a stepwise

regression method to examine the mediating effects of risk perception. Factors influencing risk and livelihoods include intrinsic characteristics such as educational attainment, household size, land resources, social capital, and extrinsic factors such as fragile ecological environments, frequent natural disasters, and social security systems. The study results show that vulnerability due to poverty significantly impacts livelihood diversification; households with higher vulnerability tend to choose purely agricultural livelihood strategies to avoid risk. In particular, perceptions of production risk and policy risk play a crucial mediating role in this relationship, while market risk, although most strongly perceived by farmers, does not have a significant mediating impact.

4. OMPARATIVE SUMMARY TABLE:

Author (Year)	Country	Data & Method	Type of Risk	Key Findings
Tran Hoai Nam & Do Minh Hoang (2016)	Vietnam (Lam Dong)	Survey of 160 households; Likert scale, descriptive statistics, comparison.	Production, markets, people.	Production risks (natural disasters, epidemics) are the most serious. Strategies based on experience are often unsustainable.
Jankelová et al. (2017)	Slovakia	Survey of 104 businesses; descriptive statistics, comparative analysis.	Prices/Markets, production, finance, institutions, people.	Price and production risks are the most important. Effective risk management is closely linked to government policy support.
Ho Thanh Tam (2017)	Vietnam (Soc Trang)	Survey of 125 households; descriptive statistics and multiple linear regression analysis were used.	Weather (rain, drought, floods), pests and diseases, prices, and techniques.	Weather risks have the most direct impact on productivity. Education and access to information help improve adaptability.
Asravor (2018)	Ghana	Survey of 324 farmers; Probit model, descriptive statistics.	Production, people, finance.	Age and income influence perceptions. Diversification is a key risk mitigation strategy.
Ahmad et al. (2019)	Pakistan	Survey of 402 farmers; Likert scale, factor analysis, regression.	Weather, natural disasters, market conditions, policies.	Farmers tend to avoid risk. Education and experience help increase adaptability and diversification.
Nguyen Tuan Kiet & Nguyen	Vietnam (Can Tho)	Survey of 80 households; direct interviews, Likert	Production, finance.	Financial risks (capital, interest rates) are a major challenge. Farmers lack

Tan Phat (2019)		scale, and descriptive statistics.		technical support and official information.
Van Bac Ho (2022)	Vietnam	Survey of 172 households (Son La); multi-stage sampling, 5-level Likert, PCA, multiple regression.	Production, markets, people, finance.	Production risks (seeds, weather, pests) are the most serious. Ethnicity and credit status influence perceptions.
Jiang, Wang & Huang (2023)	China	Household survey data; risk perception measured using Likert-scale indicators; Logit/Probit regression and mediation models	Natural–climate risk, market risk, production risk, policy risk	Higher levels of risk perception significantly increase farmers’ adoption of proactive adaptation strategies (e.g., crop diversification and technical improvement), thereby enhancing agricultural sustainability; risk perception is strongly influenced by education, farming experience, land size, access to information, and policy support.
Imelda et al. (2023)	Indonesia	Survey of 120 households; mixed methodology, EFA, linear regression.	Production, markets, finance, people, environment.	Farmers prioritize preventative measures on the farm (intercropping, techniques) over formal insurance.
Xinyu Li (2025)	China	Survey of 3,235 households; VEP model, multiple logistic regression, stepwise regression.	Production, market, policy.	Poverty reduces livelihood diversification. Perception of production/policy risks plays a mediating role.

5. FINDINGS AND DISCUSSIONS

A synthesis of empirical studies reveals that agricultural production is inherently exposed to a wide range of multidimensional and complex risks, among which production, market, and climatic risks are the most prominent. These risks have intensified in recent years, largely due to the combined effects of climate change, trade liberalization, tightened regulations on agricultural inputs, and transboundary diseases. This pattern has been observed across various countries, such as Slovakia, Ghana, Pakistan, and Vietnam, where underdeveloped infrastructure, limited information, and restricted access to credit and insurance amplify the vulnerability of smallholder farmers. A notable finding across the literature is the variation in risk perception and coping behavior among countries, reflecting diverse socio-economic and institutional contexts. In Ethiopia and Ghana, farmers commonly adopt strategies such as production diversification and veterinary service utilization

to mitigate climatic and livestock-related risks. Conversely, in Slovakia, market-based instruments and institutional supports play a central role, supported by stable agricultural policies and high levels of market integration. In Pakistan and Vietnam, factors such as education, land size, farming experience, and non-farm income significantly influence both risk perception and the selection of coping strategies. Across contexts, demographic and household resource characteristics are found to be decisive in shaping farmers’ behavioral responses to risk. Variables such as age, income structure, access to credit, and financial reserves explain the heterogeneity in risk aversion and acceptance, as well as farmers’ preference between on-farm preventive measures (e.g., crop diversification, intercropping, and technical innovation) and market-based risk management tools (e.g., agricultural insurance, contract farming). Among these, production diversification is widely recognized as the most practical and effective

strategy for smallholders, whereas specialization tends to benefit larger agribusiness enterprises seeking to optimize productivity and cost efficiency. Financial instruments such as savings, loans, and non-farm income generation are also used to buffer risks, though their effectiveness remains constrained by high insurance premiums and limited coverage.

In the Vietnamese context, these findings hold profound practical implications. Small-scale farmers often face severe market risks, particularly price volatility and dependency on intermediaries. In fragmented production areas, production risks are exacerbated by dependence on natural water sources, rising input costs, and inadequate access to timely market and meteorological information. Consequently, policy priorities should focus on: (i) strengthening agricultural extension services and technical training; (ii) expanding access to market and climate forecast information; (iii) improving the legal enforceability of agricultural contracts; and (iv) designing flexible risk management policies tailored to the socio-economic and agro-ecological characteristics of farming households.

Overall, the synthesis underscores the necessity of developing an integrated analytical framework that links farmers' risk perceptions, socioeconomic characteristics, and coping strategies. Such a framework not only elucidates the diversity of risk management behavior among farmers but also provides a robust scientific basis for policymaking aimed at enhancing adaptive capacity and promoting sustainable agricultural development in the face of escalating global economic and climatic uncertainties.

6. CONCLUSION

Empirical evidence reveals three key insights. First, farmers' risk perceptions are strongly shaped by their socioeconomic characteristics, including landholding size, education level, and income composition, reflecting differences in their capacity to assess and respond to uncertainty. Second, production diversification

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remains the most prevalent and effective risk management strategy among smallholder farmers, whereas large-scale agricultural enterprises tend to adopt specialization to maximize productivity and cost efficiency. Third, financial instruments such as agricultural insurance and preferential credit have not yet achieved their intended effectiveness, constrained by high costs, complex administrative procedures, and limited accessibility, particularly in rural regions. From a theoretical perspective, this study contributes to a more nuanced understanding of the multidimensional nature of agricultural risk, emphasizing the critical role of socioeconomic factors in shaping farmers' perceptions and management behaviors. From a practical perspective, the findings underscore the need for a comprehensive, flexible, and context-sensitive portfolio of risk management strategies, tailored to different household types and regional agro-ecological conditions. In the context of intensifying climate change and expanding market integration, strengthening farmers' adaptive capacity requires an integrated approach that combines technological innovation, institutional reinforcement, and community-based initiatives. By bridging the nexus between risk perception and management behavior, this study provides an essential scientific foundation for agricultural policymaking aimed at advancing sustainability, livelihood stability, and resilience in rural communities amid escalating global uncertainties.

Despite its contributions, this review has some limitations. First, the analysis is based on secondary studies, which may not fully capture the dynamic changes in farmers' risk perceptions over time. Second, most of the studies reviewed focus on the context of a single country, limiting comparisons between countries. Future research could integrate quantitative and qualitative methods and examine risk perceptions along the agricultural value chain in the context of climate change and market volatility.

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