

**ENHANCING RESILIENCE IN VIETNAMESE AGRICULTURE THROUGH
DISASTER RISK MANAGEMENT****Tran Thi Anh Nguyet**PH.D. Program for Infrastructure Planning and Engineering,
College of Construction and Development, Feng Chia University, Taichung 40724, Taiwan**ABSTRACT**

Natural disasters have become increasingly complex, causing severe losses to Vietnam's agricultural production, directly affecting food security, rural livelihoods and the national sustainable development process. As one of the countries most vulnerable to climate change, Vietnam faces multiple types of disasters, including typhoons, floods, droughts, salinity intrusion and landslides. Consequently, disaster risk management in agriculture is not only an urgent issue but also a long-term strategic requirement to minimize damages, enhance resilience and ensure sustainable development. This study examines the challenges posed by natural disasters to Vietnam's agricultural sector and evaluates the effectiveness of current disaster response measures. Drawing on a combination of policy analysis, secondary data on agricultural losses and case studies of local adaptation practices, the research provides a comprehensive assessment of disaster impacts on agricultural production systems. In addition, the study reviews national strategies and institutional frameworks for disaster risk reduction and climate change adaptation, with a focus on their implementation at the community and farm levels. Findings reveal that while Vietnam has established legal and policy frameworks to address disaster risks, significant gaps remain in local implementation, resource allocation and community engagement. Smallholder farmers are particularly vulnerable due to limited access to technology, finance and early warning information. The study also highlights emerging best practices such as integrated water resource management, crop diversification and community-based adaptation initiatives that can enhance agricultural resilience.

The paper contributes to the literature by linking disaster risk management with sustainable agricultural development, offering both theoretical and practical implications. For scholars, it enriches the understanding of how disaster risk governance interacts with agricultural systems under climate stress. For policymakers and practitioners, it provides evidence-based recommendations to strengthen disaster preparedness, improve adaptive capacity and align agricultural development with the broader goals of sustainable development and climate change adaptation. Integrated disaster risk governance is essential for sustainable agriculture.

Keywords:

Natural disasters; sustainable agriculture; risk management; climate change; Vietnam.

I. INTRODUCTION

In the era of globalization and amid the growing impacts of climate change, natural disasters have become one of the most urgent challenges to Vietnam's socio-economic development. With a coastline stretching more than 3,200 kilometers, diverse topographical conditions, and a tropical monsoon climate, Vietnam is especially susceptible to extreme weather events and fluctuations in climate. (The World Bank, 2022)). Each year, Vietnam is struck by numerous typhoons and tropical depressions that cause extensive agricultural losses valued in trillions of Vietnamese Dong. These disasters not only undermine food security but also endanger the livelihoods of millions of rural households whose incomes depend heavily on farming.

Agriculture continues to serve as a cornerstone of the national economy, contributing approximately 12% to Vietnam's GDP while employing nearly 40% of the labor force (Pham, T. 2024). Yet, paradoxically, this sector is also the most severely affected by climate-induced hazards. In the Central region, recurrent floods wash away rice harvests; in the Mekong Delta, droughts and saltwater intrusion render hundreds of thousands of hectares of farmland unproductive; while in the Northern mountainous provinces, landslides cause not only human casualties but also significant damage to agricultural infrastructure. The immediate consequences of these disasters include reduced yields and declining household incomes, while their long-term impacts extend to eroded resilience, diminished adaptive capacity and setbacks in sustainable development trajectories.

Given this context, disaster risk management in agriculture should be conceptualized not merely as an emergency or reactive response but as an integral component of long-term development planning. A proactive strategy requires the systematic integration of science and technology, rational land-use and production planning, climate-resilient infrastructure investment and enhanced community-based participation. Such measures are essential to minimize economic and human losses while simultaneously strengthening adaptive resilience. Moreover, disaster risk management in agriculture must be closely aligned with Vietnam's broader agenda of promoting green growth, sustainability and climate-resilient agricultural transformation.

Against this backdrop, academic inquiry into disaster risk management strategies for agriculture in Vietnam is both timely and imperative. This paper seeks to answer how disaster risk management can enhance resilience in Vietnamese agriculture, identify existing gaps and limitations and propose strategic directions for enhancing resilience within the agricultural sector. By advancing solutions that integrate environmental sustainability, economic stability and social equity, the paper aims to contribute to Vietnam's pursuit of its national sustainable development goals and to strengthen the livelihoods of rural communities in the face of escalating climate risks.

II. THEORETICAL FRAMEWORK

Building on the theoretical foundations of disaster risk management and its significance in bolstering agriculture sector resilience, the following section examines the Vietnamese setting to evaluate the practical application of these principles.

2.1. Natural Disasters and Their Impacts

According to the Disaster Management Center (2017), "A natural disaster is a natural process or phenomenon that can cause death, injury or other health impacts; lead to damage to property, livelihoods and services; disrupt socio-economic activities; or cause environmental destruction." Natural disasters include typhoons, tropical depressions, floods, flash floods, inundation, heavy rainfall, tornadoes, lightning, landslides, storm surges, earthquakes, tsunamis, droughts, heatwaves, extreme cold, hail, land subsidence and saltwater intrusion.

More specifically, DMC provides detailed definitions for each type of disaster. For instance, "A typhoon is a tropical cyclone with maximum sustained winds of level 8 or higher, possibly accompanied by gusts. A typhoon with maximum winds of level 10–11 is considered a strong typhoon, level 12–15 is a very strong typhoon and level 16 or above is a super typhoon." A flood is defined as "a phenomenon in which river water levels rise significantly for a certain period before receding." In Vietnam, typhoons and floods are the most common disasters; therefore, this study focuses on their definitions. Definitions of other disasters can be found on the official website of the Disaster Management Center (2017).

Additionally, for statistical purposes, the Centre for Research on the Epidemiology of Disasters (CRED) defines a natural disaster based on its impacts as an event that meets at least one of the following four criteria: (i) 10 or more people reported killed, (ii) 100 or more people reported affected, (iii) declaration of a state of emergency or (iv) a call for international assistance. This definition has been widely used in international disaster research, such as Stromberg (2007), Noy (2009), Noy and Nualsri (2007).

When natural disasters occur, they inevitably affect socio-economic activities. According to Pelling et al. (2002), disaster impacts can be divided into two categories: direct impacts and indirect impacts. Direct impacts refer to the immediate consequences of a disaster, represented by indicators such as the number of fatalities, number of people affected, value of damaged assets, destroyed houses and other immediate damages. Typical studies focusing on direct impacts include Cavallo et al. (2010) and Hallegatte (2008). Indirect impacts, on the other hand, refer to the subsequent economic effects that occur after the disaster event. These are often measured through variables such as GDP, prices, trade, labor, employment, exchange rates and other economic indicators. Cavallo and Noy (2011) further divide indirect impacts into short-term and long-term effects.

According to the FAO (2023), the frequency of natural disasters worldwide has been increasing significantly, leading to escalating economic damages. These statistics not only highlight the growing recurrence and scale of natural disasters but also reaffirm the urgency of studying their impacts on socio-economic development.

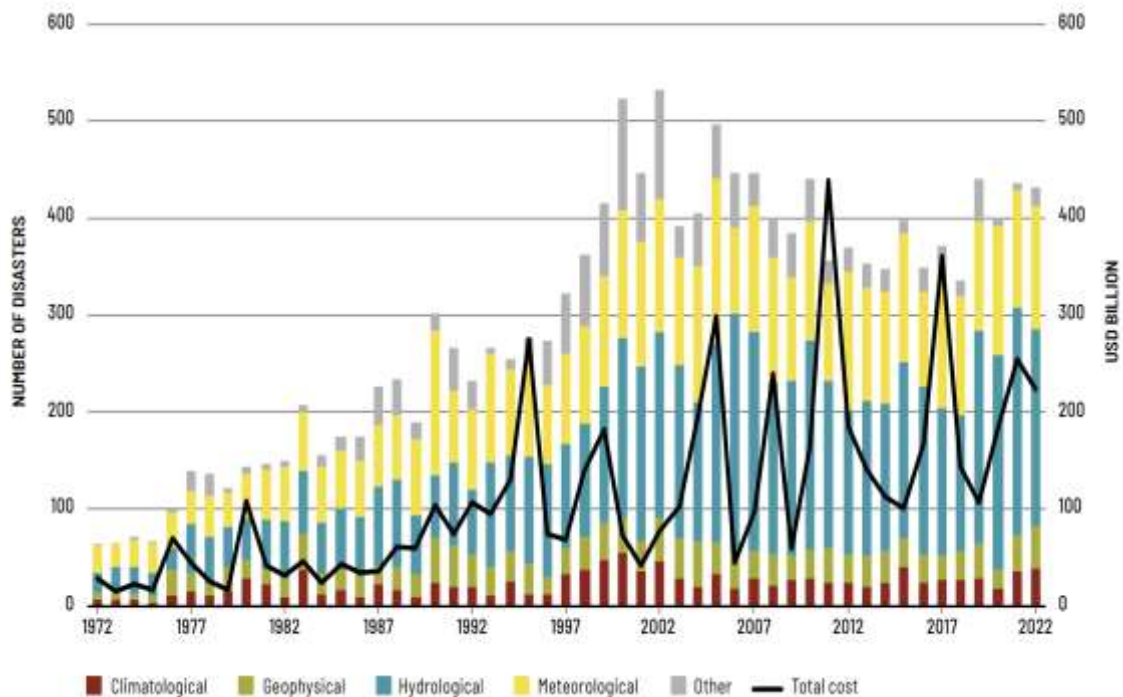


Figure 1: Number of natural disasters by EM-DAT classification and total economic damage (1972–2022)
(Source: FAO, 2023)

Based on EM-DAT statistics for the period 1972–2022, it is evident that the number of natural disasters worldwide has shown a marked upward trend in both frequency and economic damage. In the early years (1972–1985), the number of disasters remained relatively low, below 100 events per year. However, the figure rose sharply thereafter, peaking at over 400 events annually in the late 1990s and early 2000s. Since 2000, the annual number of disasters has stabilized at a high level, fluctuating between 300 and 400 events, reflecting the trend of disasters becoming more frequent and severe.

In terms of composition, meteorological disasters (such as typhoons and tropical depressions) and hydrological disasters (such as floods, flash floods and inundations) account for the largest share and have increased significantly, especially since the 1990s. Climatic disasters such as droughts and heatwaves, though less numerous, have also steadily increased, linked to the growing impacts of climate change. In contrast, geological disasters (earthquakes, volcanic eruptions) have remained more stable and less variable, as they are inherently less influenced by climate factors.

From an economic perspective, disaster-related losses have fluctuated sharply year by year, with some periods exceeding USD 400–500 billion, particularly in years with large-scale catastrophic events such as super typhoons, tsunamis or severe earthquakes. Compared with the 1970s–1980s, the scale of economic losses has risen dramatically in the past two decades, reflecting not only the increased number of disasters but also the growing concentration of populations, infrastructure and socio-economic assets in vulnerable areas.

This reality highlights that natural disasters are becoming an increasingly serious threat to sustainable development, requiring countries to place greater emphasis on investing in early warning systems, developing resilient infrastructure and establishing financial and insurance mechanisms to mitigate both the direct and indirect impacts of disasters on socio-economic development.

2.2. Disaster Risk Management in Agriculture

Disaster Risk Management (DRM) is understood as a systematic process aimed at identifying, assessing and reducing disaster risks that may negatively impact people, assets and the environment. According to the United Nations (2015), DRM encompasses preventive, mitigation, response and recovery measures designed to minimize losses and enhance community resilience.

In the agricultural sector, DRM refers to the integrated application of policies, strategies, technologies and management practices to reduce the impact of disasters on agricultural production, including crops, livestock, fisheries and rural infrastructure. Disaster risk management in agriculture does not solely focus on emergency response once disasters occur but also emphasizes prevention and adaptation through:

- Risk assessment: Identifying vulnerable areas, seasons and production systems exposed to disasters such as storms, droughts and saltwater intrusion.
- Risk reduction: Applying drought-resistant crop varieties, upgrading irrigation systems, planting coastal mangrove forests and establishing early warning systems.
- Crisis management and emergency response: Supporting farmers in relocating livestock, protecting crops before storms and floods and providing post-disaster relief.
- Recovery and reconstruction: Restoring infrastructure, providing credit support and agricultural insurance and restructuring production toward greater sustainability.

Thus, DRM in agriculture is a comprehensive cycle that combines long-term preventive measures with emergency responses, with the overarching goal of safeguarding agricultural production and securing rural livelihoods.

2.3. The Relationship Between Disaster Risk Management and Sustainable Agricultural Development

Sustainable agriculture is defined as a system that meets current food and livelihood needs without compromising the ability of future generations to meet their own needs (FAO,2014). A sustainable agricultural system must ensure three pillars: economic, social and environmental. Disaster risk management is closely linked to each of these pillars.

- Economic aspect: Disasters often cause severe crop losses, reducing productivity and farmers' incomes. Without effective risk management measures, people may fall into a cycle of poverty, making reproduction and reinvestment difficult. Conversely, good risk management helps minimize economic losses, stabilize agricultural markets and maintain national food security.
- Social aspect: Rural areas in Vietnam are home to more than 60% of the population, with livelihoods largely dependent on agriculture (General Statistics Office of Vietnam [GSO], 2023). Disasters not only destroy production infrastructure but also directly affect people's livelihoods, health and education. Risk management measures such as agricultural insurance, community training and cooperative development help strengthen social cohesion, enhance autonomy and improve community resilience.
- Environmental aspect: Disaster risk management is inherently tied to protecting and improving ecosystems. For example, planting upstream forests helps reduce landslides, restoring coastal mangroves protects against waves or adopting Climate-Smart Agriculture (CSA) reduces greenhouse gas emissions. These measures both mitigate disaster risks and contribute to environmental protection and climate change adaptation.

From this relationship, it suggests that disaster risk management is an integral component of sustainable agricultural development strategies. Neglecting risk management will leave agriculture perpetually vulnerable, hinder stable production and make it difficult to achieve long-term development goals.

2.4. The Role of Advanced Technology in Disaster Risk Management

Globally, advanced technologies such as the Internet of Things (IoT), satellite data, artificial intelligence (AI) and real-time data analytics are being widely applied to monitor, forecast and provide early warnings of natural disasters. These systems collect and process data on weather, geology, water levels and other environmental factors, thereby delivering accurate forecasts and timely warnings to minimize damages. In Vietnam, the application of technology in disaster risk management has made significant progress. Early warning systems for floods, storms and landslides are being developed based on sensor technology, satellite data and advanced weather forecasting models. These technologies enable authorities to continuously monitor weather and environmental conditions, thereby issuing early warnings and timely response measures to safeguard people's lives and property.

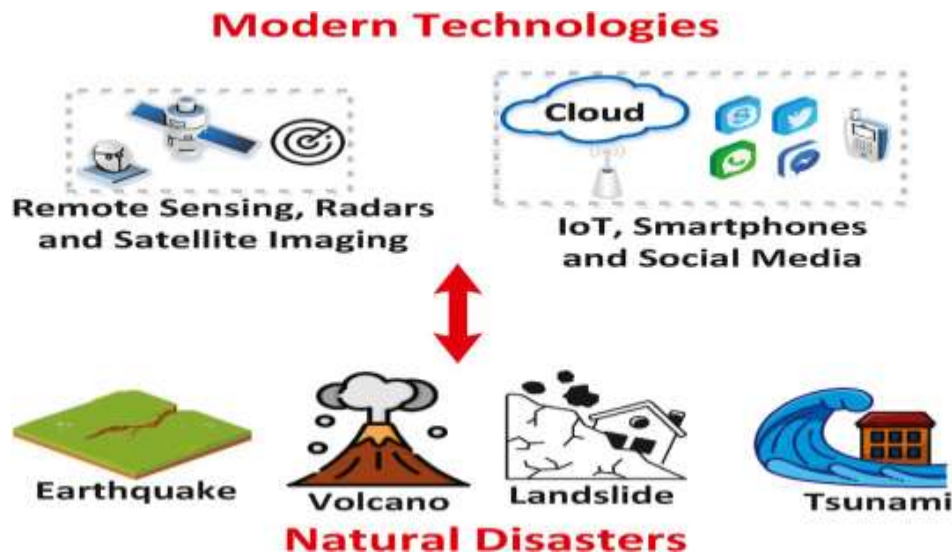


Figure 2. The Role of Advanced Technology in Disaster Risk Management
(Source: Krichen, M., Abdalzafer, M. S., Elwekeil, M., & Fouda, M. M., 2024)

III. NATURAL DISASTERS AND THEIR IMPACTS ON AGRICULTURE IN VIETNAM

3.1. Current Situation of Natural Disasters in Vietnam

Located in the tropical monsoon region, with three-fourths of its territory consisting of mountains and highlands, a dense system of rivers and streams, over 3,200 km of coastline and extensive maritime zones, Vietnam is among the countries most frequently exposed to multiple types of natural disasters, especially floods, typhoons, heatwaves, droughts, saltwater intrusion and landslides (Ministry of Agriculture and Rural Development (MARD), 2022). In recent years, abnormal weather patterns caused mainly by climate change, combined with unsustainable socio-economic development within the country, upstream impacts from neighboring nations sharing transboundary rivers and increasing population pressures, have made natural disasters more extreme and unpredictable in both intensity and recurrence. Severe storms, super typhoons, historic floods, droughts and salinity intrusion have caused devastating losses of lives and property, posing major challenges to disaster prevention and control.

Vietnam is ranked among the five countries most severely affected by natural disasters and climate change. On average, disasters claim about 240 lives annually and cause economic losses of nearly VND 30,000 billion (approximately USD 1.2 billion, using an exchange rate of 1 USD = 25,000 VND) (Khanh Linh, 2025). The main types of disasters include typhoons, tropical depressions, localized heavy rains, flash floods, landslides, droughts and saltwater intrusion. According to the 2023 Annual Disaster Prevention Report of the General Department of Disaster Prevention and Control, natural disasters killed and left 169 people missing and caused an estimated VND 10,000 billion (\approx USD 400 million) in economic damage in 2023.

In 2024, Vietnam recorded 1,340 disaster events, covering 21 out of 22 types of disasters. The most devastating was Typhoon No. 3 (Yagi), the strongest storm in 30 years in the East Sea and in 70 years on land. Its circulation triggered heavy rains across Northern Vietnam and Thanh Hoa, leading to large-scale flooding with most rivers exceeding alarm level 3, with historic floods recorded on seven river systems and widespread landslides, flash floods and mudflows in almost all northern mountainous and midland provinces, particularly Lao Cai, Yen Bai and Cao Bang.

Typhoon No. 3 and subsequent floods claimed 345 lives, which was twice the total number of disaster-related fatalities in 2023. The total economic damage was nearly VND 83,746 billion (\approx USD 3.35 billion), about nine times higher than the total losses from disasters in 2023. Preliminary statistics indicate that disasters in 2024 killed or left 514 people missing, three times higher than in 2023 and 2.4 times higher than the 10-year average from 2014 to 2023, with 2,207 people injured. The total estimated economic loss reached VND 88,748 billion (\approx USD 3.55 billion), 9.52 times greater than in 2023 and 4.19 times the 10-year average (Do, T. T. H., 2025).

3.2. Impacts of Natural Disasters on Agriculture in Vietnam

Agriculture in Vietnam is one of the sectors most directly and severely affected by natural disasters, as production heavily relies on natural conditions, water resources, soil quality and climate. Over the years, various types of disasters, including storms, floods, droughts, saltwater intrusion and landslides, have caused substantial losses in agricultural production, reducing productivity and affecting food security and the livelihoods of millions of farming households.

Crop production losses are among the most significant impacts. Natural disasters frequently destroy cultivated areas, resulting in crop failure or substantial yield reductions. According to the Statistical Office (2023), in 2024 alone, natural disasters damaged 302,400 hectares of rice and 111,400 hectares of other crops. In the Mekong Delta, saltwater intrusion has become increasingly severe. During the 2023–2024 dry season, saltwater intrusion and drought caused a reduction in yield for 1,189 hectares of rice, complete loss of 43 hectares and affected nearly 74,000 households lacking access to clean water. In contrast, in the northern and central regions, storms and floods regularly lead to widespread waterlogging, causing total crop losses in affected areas.

Livestock production is also heavily impacted. Large-scale disasters such as storms and flash floods often result in mass deaths of livestock and poultry, disrupt feed supply and facilitate the spread of diseases. In 2024, natural disasters caused the deaths of 5.4 million livestock and poultry (GSO, 2023). Prolonged droughts further limit access to drinking water and green fodder, affecting overall livestock productivity.

Aquaculture and fisheries face similar vulnerabilities. Coastal storms frequently damage fish cages and shrimp farms, while floods and landslides alter aquatic habitats, causing widespread mortality among aquatic species. Storm No. 3 (Yagi) in 2024 caused severe damage to aquaculture production, resulting in shortages of raw materials for seafood processing and export. Many shipments were delayed, leading to storage issues and potential declines in product quality, thereby increasing financial risks for businesses (Chuong Phuong, 2024).

Agricultural infrastructure is also at high risk. Irrigation systems, dikes, canals and pumping stations, which are crucial for maintaining agricultural production, are frequently damaged by storms and floods. Storm No. 3 (Yagi) in 2024 severely damaged thousands of kilometers of canals, 200 pumping stations and major irrigation works in Northern and North Central Vietnam, disrupting agricultural activities for extended periods (Do, T. T. H., 2025). Damage to infrastructure not only results in direct losses but also increases restoration costs and affects the capacity of farmers to resume production.

Rural livelihoods and social well-being are deeply affected. Natural disasters impact income, livelihoods and social security in rural areas. Approximately 70 percent of Vietnam's population lives in rural areas, largely depending on agriculture (The World Bank, 2022). When disasters strike, farmers often lose their main source of income, leading to increased poverty and debt. In regions frequently affected by saltwater intrusion, such as Ben Tre, Soc Trang and Tra Vinh, many households have abandoned farming and migrated to urban areas to seek employment, creating new social and labor challenges.

Food security and sustainable development are also threatened. Continuous agricultural losses reduce national food production, diminishing both domestic supply and export potential. Vietnam loses hundreds of thousands of hectares of rice annually due to storms, floods, droughts and saltwater intrusion. Rice, being a staple food and a key export commodity, is particularly vulnerable. According to FAO (2023), without effective adaptation measures, rice productivity in the Mekong Delta could decline by 7 to 12 percent by 2030 due to the combined effects of drought and saltwater intrusion. These challenges pose significant risks to national food security under increasingly severe climate change conditions.

Overall, natural disasters exert profound and multidimensional impacts on Vietnamese agriculture, extending beyond direct losses to crops, livestock, and fisheries to affect infrastructure, rural livelihoods, and national food security. Their cumulative consequences provide considerable concerns by compromising production stability, livelihood resilience, and the integrity of agricultural ecosystems. Consequently, there is an urgent need to strengthen disaster risk management, invest in resilient infrastructure, implement early warning systems, and restructure agricultural production to enhance climate adaptation. The findings highlight that bolstering disaster risk management is a crucial strategy for advancing Sustainable Development Goal 2 (Zero Hunger) and Goal 13 (Climate Action), particularly by improving adaptive capacity and ensuring sustainable agricultural development in Vietnam.

IV. CURRENT SITUATION OF DISASTER RISK MANAGEMENT IN VIETNAMESE
AGRICULTURE**4.1. Achievements**

Over the past decade, Vietnam has made significant efforts and achieved important results in disaster risk management (DRM) linked to agricultural development. These achievements are reflected in several aspects:

4.1.1. Improving the Legal Framework and Policies

One notable achievement is the gradual establishment and improvement of laws and policies related to DRM. The Law on Disaster Prevention and Control of 2013 together with Decree 160/2018/ND-CP, has provided a crucial foundation, clearly defining the responsibilities of ministries, local authorities organizations and individuals in disaster prevention, response and recovery. In addition, the Government and the Ministry of Agriculture and Rural Development (MARD) have issued numerous strategies and action plans aimed at minimizing the impacts of natural disasters on agricultural production.

In particular, the National Target Program for Disaster Prevention and Control for the period 2021–2025 provides specific guidance for investing in disaster prevention infrastructure, enhancing forecasting capacity and supporting sustainable livelihoods for farmers. Thanks to a more complete legal framework and policies, DRM in agriculture in Vietnam is implemented more consistently and comprehensively than in the past.

4.1.2. Enhancing Forecasting and Early Warning Capacity

Vietnam has gradually modernized its disaster forecasting and warning systems. The Ministry of Natural Resources and Environment has collaborated with many international organizations to develop real-time warning systems for flash floods, landslides and saltwater intrusion. These technologies improve the accuracy and timeliness of forecasts, allowing local authorities to respond more proactively and protect agricultural production. Recently, the application of digital technologies in DRM has made significant progress. Warning systems based on sensors, satellite data, artificial intelligence (AI) and advanced climate forecasting models are being tested and applied. Some localities have implemented systems to send disaster warnings to residents via SMS, mobile applications and smart speaker systems, enabling farmers to quickly access information and take timely action.

4.1.3. Rational Agricultural Planning and Land Use

In response to climate change challenges, Vietnam has made important adjustments in agricultural planning. In the Mekong Delta, the country's main rice-producing region, some areas previously used for single-crop rice have been converted to aquaculture or salt-tolerant fruit trees. The rice–shrimp rotation model has proven effective in adapting to salinity intrusion, maintaining production and securing farmers' income.

In Central Vietnam, reservoirs, pumping stations and canals have been upgraded to regulate water resources and reduce losses caused by floods and droughts. In the northern mountainous regions, protective and watershed forest projects have helped prevent landslides and protect arable land. These efforts demonstrate a clear shift from traditional production thinking to risk-adaptive planning.

4.1.4. Investment in Disaster Prevention Infrastructure

Many key disaster prevention projects have been built or renovated, including dikes, reservoirs, erosion control structures, saltwater control gates and irrigation canals. These works not only protect residents and socio-economic infrastructure but also ensure the safety of agricultural production.

Some coastal provinces, such as Quang Nam, Quang Ngai and Thanh Hoa, have invested in multifunctional storm shelters for communities, which can also serve as schools or health stations when no disaster occurs. This is considered a successful model, meeting practical community needs while enhancing resilience against disasters.

4.1.5. Raising Community Awareness and Response Capacity

In recent years, awareness-raising and education on DRM have been conducted more regularly and extensively. Numerous training programs, evacuation drills and rescue exercises have been organized in areas frequently affected by storms, floods and droughts. As a result, preventive awareness among residents has gradually improved and many farming households proactively adopt measures to protect crops before disasters occur.

Community-based models, such as “Self-Managed Disaster Prevention Teams” and “Farmer Climate Adaptation Clubs,” have been established in many localities, helping to build local warning and response networks. These initiatives demonstrate a shift from a reactive mindset to proactive risk management in rural communities.

4.1.6. Initial Effectiveness in Reducing Losses

Thanks to these efforts, losses caused by natural disasters in agriculture have tended to decrease compared to previous periods. According to the 2023 Annual Disaster Prevention Report of the General Department of Disaster Prevention and Control, many crop seasons in key areas were protected by early warning systems and risk-

adaptive planning. Structural solutions such as reservoirs, dikes and saltwater control gates have proven effective in protecting cultivated areas and irrigation sources.

Moreover, post-disaster livelihood support programs help farmers quickly restore production, minimizing long-term impacts on livelihoods. These achievements provide a solid foundation for building safe, climate-adaptive agriculture and reducing disaster risks.

4.2. Limitations and Challenges in Disaster Risk Management in Vietnamese Agriculture

Although disaster risk management in Vietnamese agriculture has achieved significant progress, there are still many limitations and challenges that need to be addressed.

Firstly, the disaster forecasting and warning system is not yet fully synchronized and highly accurate. Modern technologies such as satellite data and advanced meteorological-hydrological forecasting models have been applied, but the coverage and timeliness of warnings remain limited, especially in remote, mountainous and hard-to-reach areas, which often suffer severe losses from flash floods and landslides. Many farmers still do not have timely access to early warning information, resulting in reactive rather than proactive responses.

Secondly, investment resources for disaster prevention and risk reduction are still limited. Many localities lack sufficient funding to build and maintain dikes, reservoirs, pumping stations or modern irrigation works. Agricultural and rural infrastructure, especially in the Mekong Delta and the central coastal regions, is still weak and vulnerable to climate change, saltwater intrusion and strong storms.

Thirdly, management capacity and coordination across administrative levels and sectors are not yet effective. DRM requires close cooperation from central to local authorities, including meteorological, agricultural, natural resources and environment agencies and local governments. However, overlapping functions and a lack of unified direction still exist, resulting in suboptimal effectiveness of disaster prevention measures.

Fourthly, community awareness and farmers' adaptive capacity remain limited. Most smallholder households lack the conditions to implement climate-adaptive production models, such as crop-livestock restructuring, climate-smart agriculture (CSA) or water-saving cultivation practices. Moreover, agricultural insurance, an important tool for risk sharing, is still not widely available, leaving most of the loss burden on farmers.

Fifthly, the increasingly severe impacts of global climate change pose a major challenge. The frequency and intensity of storms, floods, droughts and saltwater intrusion are increasing, exceeding the resilience capacity of many traditional agricultural production systems. Key agricultural regions, such as the Mekong Delta, the country's largest rice-producing area, face the risk of reduced production due to rising sea levels and increasingly severe salinity intrusion.

Overall, DRM in Vietnamese agriculture is currently facing multiple limitations and challenges in terms of technology, resources, governance and community adaptive capacity. Addressing these issues requires comprehensive, long-term and sustainable solutions, combining infrastructure investment, enhanced forecasting capacity, strengthened management and active participation of local communities.

V. SOLUTIONS TO IMPROVE THE EFFECTIVENESS OF DISASTER RISK MANAGEMENT IN VIETNAMESE AGRICULTURE

To reduce losses and enhance disaster response capacity in the agricultural sector, Vietnam needs to adopt a set of strategic solutions organized around four key themes: technological innovation, institutional strengthening, community empowerment, and financial resilience.

Technological Innovation

Vietnam should modernize its disaster forecasting and early warning systems by investing in advanced meteorological and hydrological technologies. Integrating satellite data, IoT sensors, artificial intelligence (AI), and high-resolution climate forecasting models will help improve the accuracy and timeliness of warnings. Information should be disseminated rapidly through multiple channels such as SMS, social networks, mobile applications, and community loudspeakers so that farmers in remote areas can access timely alerts and take proactive measures.

At the same time, promoting climate-adaptive agricultural production models is essential. Farmers should adjust crop and livestock structures to suit regional climatic conditions. In drought-prone areas, drought-resistant crops such as maize, sweet potatoes, or cassava can replace rice. In areas affected by salinity, integrated rice and shrimp farming or brackish-water aquaculture can be applied. Broader adoption of Climate-Smart Agriculture practices,

including drip irrigation, greenhouse cultivation, organic farming, and efficient land and water management, should be encouraged.

Institutional Strengthening

Investments in disaster-prevention infrastructure such as irrigation works, reservoirs, dikes, and canals must be sustained and regularly maintained to protect agricultural production from floods, droughts, and saltwater intrusion. In the Mekong Delta, saltwater control and freshwater retention projects are particularly important to support production during the dry season. In addition, building seed and livestock storage facilities and logistics infrastructure can accelerate recovery after disasters.

Enhancing management capacity and intersectoral coordination is equally critical. A unified management mechanism should be established from central to local levels to prevent overlaps and resource dispersion. Training programs for local disaster management officials, especially in disaster-prone communes and districts, should be expanded to improve coordination and preparedness.

Community Empowerment

Communities, especially smallholder farmers, play a frontline role in disaster prevention. Training in disaster preparedness and response skills, from storing seeds and inputs to evacuation, rescue, and production recovery, is essential. Community-based initiatives such as disaster-safe villages should be expanded so that farmers can proactively prevent risks and provide mutual support during emergencies.

Financial Resilience

Agricultural insurance and financial risk management mechanisms are vital to sharing the burden of disaster-related losses. The government should continue improving the legal framework, subsidizing insurance premiums for poor and small-scale farmers, and encouraging insurance providers to tailor products for different regions and types of crops or livestock. Disaster prevention funds and preferential credit schemes should also be developed to assist farmers in restoring production after disasters.

Monitoring and Evaluation Mechanisms

To ensure the effectiveness and sustainability of disaster risk management programs, clear monitoring and evaluation mechanisms should be established. Success can be measured through specific indicators such as reduced agricultural losses, improved early warning coverage, increased insurance participation, enhanced community preparedness, and stronger coordination among agencies. Regular assessment reports and public disclosure of results will promote transparency and continuous improvement in disaster risk management implementation.

VI. CONCLUSION

Natural disasters and climate change pose critical challenges to the sustainable development of Vietnamese agriculture. With diverse geography, a tropical monsoon climate, and over 3,200 kilometers of coastline, Vietnam is highly vulnerable to storms, floods, droughts, saltwater intrusion, and landslides. These hazards increasingly affect human life and economic stability, making disaster risk management a long-term strategic priority linked to food security and rural livelihoods.

Vietnam has made progress through strengthened legal frameworks, national programs, early warning systems, and pilot climate-adaptive agricultural practices such as drought-resistant crops, salinity-tolerant rice, and integrated farming systems. These measures have improved adaptive capacity in the agricultural sector and rural communities. Challenges remain, including uneven warning systems, limited financial resources, low adoption of agricultural insurance, weak intersectoral coordination, and insufficient awareness and preparedness among farmers.

Addressing these challenges requires integrated state, market, and community efforts. Key actions include investing in advanced forecasting technologies, disaster-resilient infrastructure, and climate-smart agricultural models, promoting insurance and financial mechanisms, empowering farmers through training and participatory decision-making, and strengthening coordination at all levels. International cooperation and access to global climate finance will further support resilience. Effective disaster risk management should be seen as both a strategy to reduce losses and an opportunity to transform agriculture toward sustainability. Future studies may employ quantitative resilience modeling or spatial risk mapping to evaluate DRM effectiveness.

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