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Multi-Hazard Preparedness and Food Security: Global and Philippine Perspectives

Picardal Jr EB*

School of Arts and Sciences, Bachelor of Arts in Economics, Biliran Province State University (BiPSU), Naval, Biliran, Philippines

***Corresponding author:** Picardal Jr EB, School of Arts and Sciences, Bachelor of Arts in Economics, Biliran Province State University (BiPSU), Naval, Biliran, Philippines; E-mail: ekyjr26@gmail.com

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Abstract

Multi-hazard events increasingly threaten food systems through disruptions to agricultural production, transportation, storage, markets, livelihoods, and essential public services. These risks are particularly significant in countries and communities exposed to typhoons, floods, droughts, extreme temperatures, and other interconnected hazards. This study examined multi-hazard preparedness and food security through international and Philippine documentary evidence, with Biliran Province serving as a contextual case. It employed qualitative documentary analysis supported by descriptive analysis of secondary quantitative data. The sources included international frameworks and reports, Philippine legislation and government issuances, official statistical publications, and relevant scholarly literature. The analysis focused on disaster risk governance, food-system resilience, agricultural production, food assistance, supply chain continuity, and the emerging contribution of artificial intelligence and digital technologies to preparedness. Findings indicate that international frameworks increasingly recognize the need to strengthen food-system resilience through risk assessment, anticipatory action, coordinated governance, and improved information systems. In the Philippines, Republic Act No. 10121 and Republic Act No. 12287 provide important policy foundations for disaster risk reduction and anticipatory action. The latter specifically enables measures such as prepositioning food supplies and implementing contingency plans to protect agricultural products and food supply systems. Biliran's agricultural statistics, however, show declining palay and corn production between 2024 and 2025, demonstrating the importance of monitoring local production trends alongside broader disaster preparedness measures. The study also identifies opportunities for artificial intelligence and digital technologies in forecasting, early warning, agricultural monitoring, and logistics, while emphasizing the need for reliable data, infrastructure, accountability, and human oversight. The findings suggest that food security should be integrated more explicitly into multi-hazard preparedness, local disaster risk reduction planning, and institutional continuity strategies.

Keywords: Multi-hazard preparedness; Food security; Food-system resilience; Disaster risk reduction; Anticipatory action; Artificial intelligence; Biliran Province

Introduction

Food security is closely connected to environmental stability, agricultural productivity, economic accessibility, institutional preparedness, and the continuity of essential supply systems. Food availability alone does not guarantee food security because households must also possess the economic and physical capacity to obtain food, use it appropriately, and maintain access despite disruptions. The Food and Agriculture Organization of the United Nations identifies four dimensions of food security: availability, access, utilization, and stability [1]. These dimensions provide an important framework for understanding how disasters and other external disturbances affect food systems. Multi hazard events can disrupt these dimensions simultaneously. Typhoons, floods, droughts, extreme temperatures, landslides, and other hazards may damage agricultural land, reduce crop production, interrupt transportation, affect storage facilities, increase food prices, and weaken household livelihoods. Their effects may extend beyond

the immediate disaster period because agricultural losses, damaged infrastructure, disrupted markets, and reduced household income can continue to affect food access and economic stability. Consequently, disaster preparedness must consider not only the protection of lives and property but also the continuity of food production, distribution, and access. The international disaster risk reduction agenda recognizes the importance of preparedness, risk-informed governance, and resilience. The Sendai Framework for Disaster Risk Reduction 2015-2030 emphasizes understanding disaster risk, strengthening disaster risk governance, investing in resilience, and enhancing preparedness for effective response and recovery [2]. These priorities are relevant to food systems because agricultural production and food distribution depend on interconnected environmental, economic, social, and institutional conditions. Resilience is particularly important in this context. Holling explained resilience in relation to the capacity of ecological systems to absorb disturbances while maintaining essential relationships and functions [3]. Folke subsequently discussed resilience as a perspective for understanding the capacity of social-ecological systems to respond to change and disturbance [4]. Applied to food security, resilience involves the ability of agricultural systems, markets, institutions, and households to anticipate, withstand, adapt to, and recover from disruptive events. The Philippines faces recurring hydrometeorological and climate-related hazards that can affect agricultural production and food distribution. National disaster preparedness therefore requires coordination among government agencies, local government units, communities, agricultural institutions, and social protection organizations. Republic Act No. 10121, or the Philippine Disaster Risk Reduction and Management Act of 2010, provides the national legal foundation for a comprehensive disaster risk reduction and management system. More recently, Republic Act No. 12287, or the Declaration of State of Imminent Disaster Act, strengthened the legal basis for anticipatory action before a forecasted disaster occurs. Its provisions include the prepositioning and distribution of food and non-food items and the implementation of contingency plans to mitigate damage to agricultural products and food supply systems. These policy developments demonstrate a growing recognition that disaster preparedness must include measures to protect livelihoods and essential supplies before hazards produce severe consequences. However, the existence of legislation and policy provisions does not automatically establish that all intended activities have been implemented effectively in every locality. Documentary analysis must therefore distinguish between formal policy commitments, documented implementation, and institutional conditions for which sufficient evidence is not publicly available. Biliran Province provides a useful contextual setting for examining these issues. As a provincial economy with agricultural and fisheries activities, its food-system resilience is connected to production conditions, transportation networks, local markets, household income, and disaster preparedness. Official Philippine Statistics Authority data show that palay production declined from 51,246 metric tons in 2024 to 47,562 metric tons in 2025. Corn production also decreased from 580.75 metric tons to 565.50 metric tons during the same period [5]. These figures do not establish the causes of the decline or directly measure household food insecurity. Nevertheless, they demonstrate the importance of examining agricultural production trends as part of a broader assessment of local food system resilience. Technological developments also create opportunities to strengthen preparedness. Artificial intelligence (AI), digital monitoring, geographic information systems, remote sensing, and predictive analytics can support hazard forecasting, agricultural monitoring, early warning, and logistics planning. FAO discusses digital solutions for reducing disaster risks and impacts on agriculture and food security. Similarly, UNDRR, the World Meteorological Organization, the International Telecommunication Union, and the International Federation of Red Cross and Red Crescent Societies examine how AI can contribute to multi-hazard early warning systems. However, technological tools should complement rather than replace institutional judgment, local knowledge, reliable public information, and accountable decision-making. Despite the growing policy and technological attention given to disaster preparedness, an integrated examination of multi-hazard risks, food security, government preparedness, agricultural production, and emerging digital solutions remains important. This study addresses that concern through international and Philippine documentary evidence, using Biliran Province as a contextual case for identifying relevant local policy implications.

Research problems

This study sought to examine multi-hazard preparedness and food security through international and Philippine documentary evidence. Specifically, it addressed the following questions:

1. What major multi-hazard risks and food security vulnerabilities are identified in international literature, government reports, and global preparedness policies, and what strategies are recommended to strengthen food-system resilience?
2. How do Philippine laws, government policies, programs, and available statistical evidence address multi-hazard preparedness, food security, and the continuity of essential food supply systems?
3. What policy gaps, institutional challenges, and preparedness strategies can be identified from international and Philippine documentary evidence, and what lessons can be applied to

strengthen food security and institutional resilience in Biliran Province?

Research objectives

The general objective of this study was to examine multi-hazard preparedness and food security through international and Philippine documentary evidence and identify policy implications for institutional resilience, particularly in Biliran Province.

Specifically, the study aimed to:

1. Analyze international multi-hazard risks, food security vulnerabilities, and preparedness strategies identified in international policies, reports, and scholarly literature.
2. Examine Philippine laws, government policies, programs, and secondary statistical evidence concerning disaster preparedness, food security, and food-supply-system resilience.
3. Identify policy gaps, institutional challenges, and applicable preparedness strategies that can strengthen food security and institutional resilience, particularly in Biliran Province.

Significance of the Study

This study may contribute to disaster risk reduction and food security discussions by bringing together international frameworks, Philippine policies, and available provincial statistical evidence. It provides a documentary basis for understanding how multi-hazard preparedness can be connected to agricultural production, food distribution, household access, and institutional continuity. For policymakers and government agencies, the study may provide insights into the importance of integrating food-system protection into disaster risk reduction policies and preparedness programs. It may also support the identification of policy areas requiring stronger coordination among disaster management, agriculture, social welfare, transportation, and local government institutions. For local government units, particularly those in Biliran Province, the findings may provide a reference for reviewing local disaster risk reduction plans, agricultural preparedness measures, food assistance arrangements, and the continuity of essential supplies. The study does not evaluate the actual performance of individual local government units; rather, it identifies policy considerations based on available documentary evidence. For agricultural stakeholders and communities, the study emphasizes the importance of protecting production capacity, livelihoods, storage, transportation, and market access during emergencies. It also highlights the need to consider vulnerable households whose food access may be affected by income losses and supply disruptions. For educational institutions, the study provides a basis for considering institutional preparedness, continuity of essential services, risk communication, and the use of reliable information systems during emergencies. These considerations are relevant to institutions located in hazard-exposed communities. For researchers, the study may serve as a reference for future investigations on food system resilience, anticipatory action, disaster governance, and the responsible use of AI and digital technologies in preparedness planning.

Scope and delimitations

The study focused on multi-hazard preparedness and food security using international and Philippine documentary evidence. It examined international disaster risk reduction frameworks, food security concepts, scholarly literature, Philippine legislation, government policies, administrative issuances, and available official statistical publications. Biliran Province was used as a contextual case for examining selected agricultural production statistics and identifying possible local policy implications. It was not treated as a field-based empirical research site. The study did not conduct household surveys, interviews, focus group discussions, field observations, or primary data collection. The analysis considered the four dimensions of food security: availability, access, utilization, and stability. It also examined agricultural production, food assistance, supply-chain continuity, institutional preparedness, and the potential contribution of AI and digital technologies. The quantitative component was limited to descriptive analysis of available secondary statistics. Provincial agricultural production figures were not interpreted as direct measures of household food security. Similarly, national poverty statistics were used only as broader socioeconomic context and were not treated as evidence of poverty or food insecurity specifically in Biliran Province. The study was limited by the availability, coverage, and consistency of public documents and statistical records. The presence of a policy provision was not considered proof of implementation. Institutional practices, operational capacities, and technological applications were not classified as established unless supported by documentary evidence.

Review of Related Literature

Multi-Hazard Risks and Food-System Vulnerability

Food systems are exposed to multiple hazards because agricultural production, processing, storage, transportation, and distribution depend on interconnected environmental and socioeconomic conditions. A single hazard may affect several stages of the food system, while multiple or cascading hazards may intensify disruptions. For example, a severe storm may damage crops and roads, interrupt the movement of agricultural products, reduce market availability, and affect household income at the same time. The Sendai Framework for Disaster Risk Reduction 2015-2030 recognizes the importance of understanding disaster risks and

strengthening preparedness across sectors [2]. This approach is relevant to food systems because risks are not limited to direct physical damage. They also include disruptions to production, markets, infrastructure, livelihoods, and essential services. The FAO report on the impact of disasters on agriculture and food security emphasizes the importance of digital solutions in reducing disaster risks and impacts. This reinforces the need to examine agricultural vulnerability through both physical and information-related dimensions. Reliable information on hazards, crops, infrastructure, and supply networks can support more timely preparedness decisions.

Food security and its four dimensions

The FAO (2008) framework identifies four dimensions of food security: availability, access, utilization, and stability.

Food availability concerns the presence of sufficient quantities of food through domestic production, imports, food stocks, and other supply sources. Agricultural production statistics provide one indicator of availability, although they do not capture all sources of food or the amount accessible to individual households.

Food access refers to the ability of individuals and households to obtain food. Access is influenced by income, employment, prices, transportation, market conditions, and social protection. A locality may have agricultural production but still contain households that cannot afford or physically obtain adequate food.

Food utilization concerns the appropriate use of food, including dietary quality, nutritional adequacy, food safety, sanitation, and health conditions. Food availability and access do not necessarily ensure adequate nutrition if households lack access to safe water, sanitation, healthcare, or diverse diets.

Food stability refers to the ability to maintain availability, access, and utilization over time. Disasters can undermine stability by disrupting production, income, transportation, markets, and public services.

These dimensions demonstrate why food security requires a broader analytical approach than agricultural output alone. Disaster preparedness must address both the physical continuity of food systems and the socioeconomic conditions that determine household access.

Resilience theory and food-system continuity

Holling introduced resilience as an important concept in ecological systems analysis, emphasizing the ability of systems to absorb disturbances while maintaining essential functions. This perspective provides a foundation for examining how food systems respond to natural hazards and other disruptions. Folke expanded the discussion of resilience in social-ecological systems. This perspective recognizes that environmental, social, economic, and institutional processes are interconnected. Food systems similarly depend on the interaction of natural resources, agricultural practices, labor, markets, transportation, governance, and household capacities. In this study, resilience is understood as the capacity of food-related systems and institutions to anticipate, withstand, adapt to, and recover from multi-hazard disruptions while maintaining essential functions. This includes protecting agricultural production, maintaining food distribution, supporting vulnerable households, and restoring essential services.

International disaster risk reduction and preparedness

The Sendai Framework identifies four priorities for action: understanding disaster risk, strengthening disaster risk governance, investing in disaster risk reduction for resilience, and enhancing disaster preparedness for effective response and recovery [2]. These priorities are relevant to food security because agricultural and food supply systems require risk-informed planning. Understanding disaster risk involves identifying exposed populations, agricultural areas, transportation routes, storage facilities, and critical infrastructure. Strengthening governance requires coordination among agencies and local institutions. Investment in resilience includes infrastructure, preparedness systems, and protective measures. Effective preparedness requires contingency planning, early warning, and the capacity to respond before and after hazards occur. The framework also supports the integration of disaster risk reduction into development planning. This is important because food-system resilience cannot be achieved through emergency response alone. It requires sustained investment in agricultural capacity, infrastructure, livelihood protection, and institutional coordination.

Philippine disaster risk reduction policies

Republic Act No. 10121 established the Philippine Disaster Risk Reduction and Management Act of 2010. It provides the legal framework for disaster risk reduction and management through institutional coordination, preparedness, response, recovery, and risk reduction activities. The law recognizes the importance of national and local disaster risk reduction and management councils and provides a framework for integrating disaster risk reduction into government planning. Its relevance to food security lies in the need to protect livelihoods, essential services, and community resources from disaster impacts. The Department of Agriculture's Disaster Risk Reduction and Management Program provides an institutional framework for addressing disaster risks affecting the agricultural sector [6]. Agricultural preparedness is important because disruptions to farming, fisheries, and related livelihoods may affect both food availability and household income. The adoption of the 2024 National Disaster Response Plan through Memorandum Circular No. 100, s. 2025, further provides a national response-planning reference [7]. The plan is relevant to

the coordination of emergency response and the continuity of essential services during disasters.

Anticipatory action and the protection of food supplies

Anticipatory action refers to measures undertaken before a forecasted hazard produces its most severe impacts. This approach seeks to reduce potential losses by using forecasts, risk assessments, and available lead time to implement protective measures. Republic Act No. 12287, or the Declaration of State of Imminent Disaster Act, provides a significant legal foundation for anticipatory action in the Philippines. The law allows the declaration of a State of Imminent Disaster based on forecasts and pre-disaster risk assessments. It identifies anticipatory measures such as public information dissemination, mobilization of response teams, evacuation when necessary, and the procurement, prepositioning, and distribution of food and non-food items. Importantly, the law also provides for the implementation of contingency plans to mitigate damage to agricultural products and food supply systems. It further requires local government units to include anticipatory action measures in their programs, plans, and activities under their Local Disaster Risk Reduction and Management Plans and related funding arrangements. The implementing rules and regulations released in September 2026 provide an additional operational policy reference for the implementation of the law. However, the existence of the law and its implementing rules does not by itself establish the level of implementation in every province or municipality. Such implementation must be demonstrated through relevant local plans, budget documents, reports, and operational records.

Food assistance and emergency logistics

Food assistance is an important component of disaster response, particularly for households whose access to food isdisrupted by displacement, livelihood losses, market interruptions, or damage to transportation networks. The Department of Social Welfare and Development's Administrative Order, provides omnibus guidelines on food and non-food items and logistics management for disaster response operations. These guidelines are relevant to the organization, management, and distribution of relief supplies. Emergency food logistics involve more than procuring relief goods. They require appropriate assessment of needs, storage, transportation, inventory management, coordination, and distribution. Delays or weaknesses in any of these processes may affect the timely delivery of assistance. Food assistance should also be considered in relation to the four dimensions of food security. Relief distribution may temporarily improve access and availability, but longer-term food security requires the restoration of livelihoods, markets, agricultural production, and essential services [8].

Agricultural production and local food-system resilience

Agricultural production is an important component of food availability and rural livelihoods. Changes in production, area harvested, and yield can provide useful indicators of agricultural performance. However, production figures must be interpreted carefully because they do not independently establish the availability of food at the household level or the causes of production changes. For Biliran Province, the PSA's full-year 2025 palay and corn statistical release provides comparable production figures for 2024 and 2025. The reported decline in both crops provides a reason to examine agricultural preparedness, production risks, and the continuity of local food systems. The analysis must not assume that the production decline was caused by a particular disaster or climate event unless a source explicitly establishes that relationship. It is more appropriate to treat the figures as descriptive evidence that supports continued monitoring of agricultural performance.

Poverty, household access, and food security

Household access to food is influenced by income, employment, food prices, and the availability of social protection. The PSA's 2023 official poverty statistics reported a national poverty incidence among families of 10.9 percent and a subsistence incidence among families of 2.7 percent [9]. These figures provide national socioeconomic context. They illustrate that some Filipino households have incomes insufficient to meet basic needs, including food requirements. However, national poverty statistics cannot be used to infer the specific poverty or food insecurity situation of Biliran Province without corresponding provincial or municipal evidence. This distinction is important because food security is multidimensional. Agricultural production, household income, food prices, dietary quality, and the stability of access must be considered together.

Artificial intelligence and digital technologies in multi-hazard preparedness and food security

Artificial intelligence and digital technologies are increasingly relevant to disaster preparedness and food-system resilience. Applications may include hazard forecasting, early warning, agricultural monitoring, satellite-image analysis, crop assessment, food price monitoring, and supply-chain planning. FAO discusses digital solutions that can help reduce disaster risks and impacts on agriculture and food security [10]. These applications can support the collection and interpretation of information needed for preparedness planning. UNDRR and its partner organizations examine the potential contribution of AI to multi-hazard early warning systems [11]. AI-enabled approaches may help process large datasets, identify patterns, support forecasting, and improve

the communication of risk information. Their usefulness, however, depends on data quality, institutional capacity, infrastructure, accessibility, and responsible governance. For food systems, potential AI applications include agricultural monitoring, forecasting of crop conditions, identifying possible supply disruptions, analyzing food price trends, and supporting logistics decisions. These applications may help agencies and local institutions anticipate risks and prioritize interventions. Nevertheless, the study does not claim that AI systems are currently operational in Biliran Province or in any specific local institution. The documentary evidence considered here supports discussion of possible applications and policy opportunities, not confirmation of local deployment. Responsible AI use also requires transparency, accountability, fairness, privacy protection, explainability, cybersecurity, and human oversight. AI-generated forecasts and recommendations should be treated as decision-support information rather than unquestionable predictions.

Theoretical Framework

This study was anchored primarily on Resilience Theory and supported by the FAO Food Security Framework, Social-Ecological Systems Theory, and the Sendai Framework for Disaster Risk Reduction.

Resilience theory

Resilience Theory, particularly the work of Holling, provides the central theoretical foundation. It explains how systems absorb disturbances while maintaining essential functions and relationships. Applied to food security, resilience involves the capacity of agricultural systems, food supply chains, households, and institutions to anticipate, withstand, adapt to, and recover from multi-hazard disruptions. This perspective supports the examination of agricultural production, food distribution, emergency logistics, and institutional continuity.

FAO food security framework

The FAO Food Security Framework provides the analytical basis for examining food availability, access, utilization, and stability [1]. These dimensions help identify how multi-hazard events may affect food systems and households. The framework also prevents the study from treating agricultural production as the only indicator of food security. Production data are relevant to availability, but access, utilization, and stability require additional socioeconomic and institutional evidence.

Social-ecological systems theory

Social-Ecological Systems Theory, as discussed by Folke, recognizes the interdependence of ecological, social, economic, and institutional processes. It is relevant because food systems depend on natural resources, agricultural activities, markets, infrastructure, household livelihoods, and governance arrangements. The theory supports an integrated analysis of food-system vulnerability and resilience rather than examining agricultural production or disaster response in isolation.

Sendai framework for disaster risk reduction

The Sendai Framework provides the policy-oriented foundation for examining disaster preparedness and risk governance. Its four priorities guide the analysis of risk understanding, institutional coordination, and investment in resilience, and preparedness for response and recovery [2]. Together, these theoretical and policy foundations support the study's examination of multi-hazard preparedness and food security.

Conceptual Framework

The conceptual framework presents the relationship between multi-hazard risks, food-system vulnerabilities, preparedness measures, and resilience outcomes. The analysis begins with multi-hazard risks, including typhoons, floods, droughts, extreme temperatures, and other hazards that may disrupt agricultural production, transportation, storage, markets, and household livelihoods. These risks are examined in relation to the four dimensions of food security: availability, access, utilization, and stability. The framework then considers preparedness and resilience strategies, including disaster risk governance, anticipatory action, agricultural protection, emergency food logistics, institutional coordination, and the use of digital technologies.

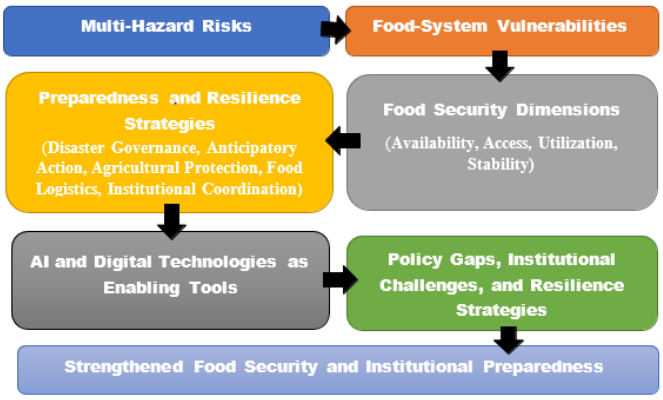


***Figure 1**: Conceptual pathway.*

Artificial intelligence and digital technologies are treated as enabling tools that may support risk identification, early warning, agricultural monitoring, and supply-chain planning. Their contribution depends on the availability of reliable information, institutional capacity, responsible governance, and human oversight. The expected analytical outcome is the identification of

policy gaps, institutional challenges, and strategies that can strengthen food-system resilience and institutional preparedness, particularly in Biliran Province (Figure 1).

The conceptual framework illustrates how multi-hazard risks create vulnerabilities in food systems and threaten the four dimensions of food security: availability, access, utilization, and stability. It emphasizes preparedness and resilience strategies, supported by AI and digital technologies, to identify policy gaps and institutional challenges. Ultimately, these interconnected measures aim to strengthen food security and institutional preparedness against multiple hazards.

Research Methodology

This section presents the procedures used to gather, organize, and analyze documentary and statistical information relevant to the study. It also explains the sources of evidence, document selection, and analytical processes employed to address the research objectives.

Research design

The study employed qualitative documentary analysis supported by descriptive analysis of secondary quantitative data. Documentary analysis was appropriate because the research examined policies, laws, official reports, statistical publications, international frameworks, and scholarly literature rather than collecting primary data from human participants. Bowen describes document analysis as a systematic procedure for reviewing and evaluating printed and electronic documents [12]. In this study, documents were examined to identify policy provisions, institutional responsibilities, preparedness strategies, statistical patterns, and potential gaps related to multi-hazard preparedness and food security. The quantitative component was limited to descriptive analysis of official secondary statistics. It was used to summarize selected agricultural production indicators and relevant socioeconomic information. No inferential statistical analysis or causal modeling was conducted.

Sources of data

The study used publicly available secondary sources from international organizations, Philippine government agencies, official statistical institutions, and scholarly publications. International sources included the Sendai Framework for Disaster Risk Reduction 2015-2030, FAO publications on food security and disaster impacts on agriculture, and the 2026 report on AI and multi-hazard early warning systems. Philippine sources included Republic Act No. 10121, Republic Act No. 12287, its implementing rules and regulations, Memorandum Circular No. 100, s. 2025, Department of Agriculture disaster risk reduction materials, and the Department of Social Welfare and Development's Administrative Order No. 02, s. 2021. Statistical sources included PSA publications on Biliran Province's palay and corn production and national poverty statistics. Relevant scholarly literature on resilience, social-ecological systems, and document analysis was also examined.

Document selection and inclusion criteria

Documents were selected based on their relevance to multi-hazard preparedness, food security, agricultural resilience, disaster governance, emergency logistics, and digital technologies. The documents were selected based on specific inclusion criteria. These included materials addressing disaster risk reduction, food security, agricultural production, emergency response, food supply systems, or digital preparedness; sources issued by recognized government agencies, international organizations, statistical institutions, or scholarly publications; and documents containing information relevant to at least one of the research questions. The publication date, issuing institution, title, and available source information also had to be identifiable. Furthermore, all statistical figures included in the analysis had to be traceable to official publications. Documents with insufficient source information or unclear relevance to the research objectives were excluded from the substantive analysis.

Data collection procedure

The documentary collection process involved identifying relevant international and Philippine documents, locating official publications, reviewing their contents, and extracting information related to the study's analytical categories. The primary documentary materials were organized according to their source, publication date, issuing institution, subject, and relevance to the research questions. For statistical data, the study extracted the relevant figures from official PSA publications. The Biliran palay and corn production comparison used the PSA's detailed full-year 2025 statistical release, which provided comparable figures for 2024 and 2025. Where different PSA publications presented inconsistent values for the same reference period, the more detailed and directly relevant statistical release was prioritized for the comparison. The discrepancy was not treated as evidence of a production change but as a source-verification issue.

Data analysis

The documentary analysis followed five stages.

Stage 1: Document identification. Relevant national legislation, government policies, climate and disaster-related publications, international frameworks, statistical reports, and scholarly literature were identified.

Stage 2: Document verification. The issuing institutions, publication dates, document titles, and source records were

examined to establish the authenticity and relevance of the materials.

Stage 3: Information extraction. Relevant provisions and findings were extracted according to the study's analytical categories: disaster governance, human protection, agricultural production, food availability, household access, food utilization, supply-chain continuity, emergency logistics, institutional preparedness, and digital technologies.

Stage 4: Thematic classification. Extracted information was classified into recurring themes, including multi-hazard vulnerability, food-system resilience, anticipatory action, food assistance, agricultural protection, institutional coordination, and AI-enabled preparedness.

Stage 5: Comparative interpretation. International frameworks and recommendations were compared with Philippine laws, policies, programs, and available statistical evidence. The analysis identified areas of policy alignment, potential gaps, and implications for Biliran Province.

The quantitative analysis used descriptive comparisons of agricultural production values. Percentage change was calculated using:

Percentage change = [(Later-period value − Earlier-period value) / Earlier-period value] × 100

The results were interpreted as descriptive changes in reported production. They were not used to establish causal relationships or to infer household food security.

Analytical distinctions and research integrity

To avoid overstating the evidence, the study distinguished among three categories:

Documented policy provision refers to an official law, regulation, policy, or plan that establishes a responsibility, mechanism, or intended action.

Documented implementation refers to an official report, record, or other reliable source showing that a particular activity was carried out.

Unverified institutional condition refers to a condition or practice for which sufficient documentary evidence was not available in the materials reviewed.

These distinctions were especially important when examining local disaster preparedness, food storage, institutional continuity, and AI applications. The existence of national policies was not treated as proof that every local institution had implemented the required measures.

Ethical considerations

The study relied exclusively on publicly available documents and secondary statistical information. It did not involve human participants, interviews, surveys, focus group discussions, or the collection of personally identifiable information. All documentary sources were attributed to their issuing institutions or authors. Statistical figures were presented with their source and reference period. Interpretations were limited to what the available evidence could support. The study also observed responsible reporting principles by distinguishing official findings from analytical interpretation and by avoiding unsupported claims about local implementation or institutional capacity.

Results and Discussion

This section presents the findings derived from the analysis of international and Philippine documentary sources and official statistical data. It examines multi-hazard risks, food security, agricultural production, disaster preparedness policies, and the role of AI and digital technologies. The findings are discussed in relation to the research objectives, highlighting policy implications and strategies for strengthening food-system resilience, particularly in Biliran Province.

International multi-hazard risks and food-system resilience

The international documentary evidence identifies multi-hazard preparedness as an important component of resilience and sustainable development. The Sendai Framework emphasizes risk understanding, governance, investment in resilience, and preparedness for response and recovery [2]. These priorities are relevant to food systems because agricultural production and food distribution depend on interconnected infrastructure, livelihoods, markets, and environmental conditions. A disruption to one component may affect other parts of the system. Damage to roads, for example, may prevent agricultural products from reaching markets even when production areas remain productive. FAO further emphasizes the role of digital solutions in reducing disaster risks and impacts on agriculture and food security [10]. This supports the importance of reliable data, monitoring, and information systems in preparedness planning. The analysis indicates that international preparedness approaches should not be limited to emergency response. They should also protect production capacity, maintain supply-chain functions, strengthen household access, and support the recovery of essential services.

Philippine disaster risk reduction policies and food-security preparedness

Philippine disaster risk reduction policies provide a legal and institutional foundation for preparedness and response. Republic Act No. 10121 establishes the national disaster risk reduction and management framework. It supports the integration of disaster risk reduction into government planning and institutional coordination.

Republic Act No. 12287 provides a more explicit basis for anticipatory action. It allows government authorities to act before a forecasted hazard produces severe impacts, subject to the conditions and procedures established by law and its implementing rules. The law identifies food-related measures, including the prepositioning and distribution of food and non-food items and the implementation of contingency plans to protect agricultural products and food supply systems. These provisions directly connect disaster preparedness with food security. The release of the law's implementing rules in September 2026 represents a further policy development. Nevertheless, the existence of national legal mechanisms does not establish the extent to which individual local government units have incorporated or implemented them. Local implementation requires supporting evidence, such as approved plans, budget records, operational reports, and documented anticipatory activities. The Department of Agriculture's DRRM Program and the national disaster response planning framework provide additional institutional references for agricultural preparedness and emergency coordination.

Agricultural production and food-system resilience in biliran province

The PSA's detailed full-year 2025 statistical release provides comparable data on palay and corn production in Biliran Province (Table 1).

Table 1: *Palay and Corn Production in Biliran Province, 2024-2025.*

Agricultural indicator	2024	2025	Percentage change
Palay production (metric tons)	51,246.00	47,562.00	-7.19%
Corn production (metric tons)	580.75	565.50	-2.63%
Palay area harvested (hectares)	12,127.00	11,629.00	-4.11%
Corn area harvested (hectares)	497.00	489.00	-1.61%
Palay yield (metric tons/hectare)	4.23	4.09	-3.31%
Corn yield (metric tons/hectare)	1.17	1.16	-1.03%
Source: Philippine Statistics Authority, Highlights of the Full Year 2025 Palay and Corn Production Statistics in Biliran (2026a).			

Table 2: *Food Security Dimensions and Their Relevance to Multi-Hazard Preparedness.*

Food security dimension	Meaning	Potential multi-hazard disruption	Preparedness implication
Availability	Sufficient food supplies from production, stocks, trade, and other sources	Crop damage, fisheries disruption, storage losses, and interrupted supply	Protect production, storage, and supply sources
Access	Ability of households to obtain food	Income losses, price increases, displacement, and transportation disruption	Strengthen social protection, emergency assistance, and market access
Utilization	Appropriate nutritional and safe use of food	Unsafe water, sanitation problems, disrupted health services, and limited dietary diversity	Protect nutrition, water, sanitation, and health services

Stability	Continued availability, access, and utilization over time	Repeated disasters, prolonged livelihood losses, and recurring supply disruptions	Develop contingency plans and strengthen recovery capacity
Source: Adapted from FAO (2008).			

Table 3: *Identified Policy Considerations and Recommended Strategic Responses.*

Policy consideration	Documentary basis	Recommended strategic response
Food security integration in disaster planning	RA 10121 and RA 12287	Include food-system protection and anticipatory measures in local DRRM plans
Agricultural production vulnerability	PSA Biliran 2024–2025 production statistics	Strengthen agricultural monitoring and risk-informed production planning
Emergency food logistics	DSWD AO No. 02, s. 2021 and RA 12287	Review food inventory, storage, prepositioning, transport, and distribution arrangements
Household food access	FAO food security framework and PSA national poverty statistics	Improve the availability of local income, food-price, poverty, and nutrition indicators
Digital and AI preparedness	FAO (2025) and UNDRR et al. (2026)	Assess data readiness, infrastructure, skills, and responsible AI governance
Institutional continuity	Sendai Framework and Philippine DRRM policies	Strengthen continuity planning for essential services and institutional operations
Source: Researcher's synthesis of the documentary evidence.		

Food assistance, logistics, and continuity of essential supplies

The documentary review identified food assistance and logistics management as important components of disaster preparedness and response. The Department of Social Welfare and Development's Administrative Order No. 02, s. 2021, provides guidelines on food and non-food items and logistics management for disaster response operations. These guidelines are relevant because emergency assistance depends on the timely procurement, storage, movement, and distribution of relief supplies. Food stocks that are available but cannot be transported or distributed promptly may not provide effective assistance to affected households. Republic Act No. 12287 further strengthens the policy basis for prepositioning and distributing food and non-food items before an imminent disaster. It also provides for contingency plans intended to protect agricultural products and food supply systems. Together, these documents demonstrate policy recognition of the need to protect food supplies before and during emergencies. However, the materials reviewed do not independently establish the current stock levels, warehouse capacity, delivery performance, or distribution efficiency of individual local government units in Biliran. Those conditions would require separate documentary evidence.

Food security dimensions and household vulnerability

The FAO framework provides a useful basis for interpreting the relationship between disaster preparedness and food security (Table 2).

The table demonstrates that preparedness must address more than the physical availability of food. A locality may retain food stocks but still experience food insecurity if households lose income or

cannot access markets. Similarly, food may be available but unsuitable for consumption if sanitation and food safety conditions deteriorate. The PSA's 2023 national poverty statistics provide broader socioeconomic context. The reported national poverty incidence among families was 10.9 percent, while subsistence incidence among families was 2.7 percent [9]. These national figures illustrate the importance of household economic access to food. However, they do not establish the poverty or food insecurity rate of Biliran Province. The study therefore uses them as national context rather than as provincial evidence.

AI and digital technologies for food-system resilience

International documentary sources identify digital technologies as potentially useful tools for improving disaster preparedness and agricultural resilience. FAO discusses digital solutions for reducing disaster risks and impacts on agriculture and food security. UNDRR and partner organizations examine the potential contribution of AI to multihazard early warning systems. The analysis identifies several potential applications of AI and digital technologies in strengthening food security and disaster preparedness, including agricultural monitoring, risk forecasting and early warning, food supply and price monitoring, emergency logistics, and institutional communication. These tools may support crop assessment, hazard identification, market monitoring, relief distribution, and timely dissemination of preparedness information. However, these are potential or documented international applications and should not be interpreted as evidence that equivalent systems are already operational in Biliran Province. Effective application also requires reliable datasets, appropriate infrastructure, trained personnel, accessible communication systems, and clear institutional responsibilities. AI systems may produce inaccurate or incomplete outputs when data are poor or when local conditions are not adequately represented. Accordingly, AI should function as a decision-support tool. Human oversight, transparency, accountability, privacy protection, fairness, and cybersecurity remain essential.

Synthesis of documentary findings

The documentary analysis identified several areas of alignment between international frameworks and Philippine policies.

First, both international and national frameworks recognize the importance of preparedness and risk-informed governance. The Sendai Framework provides international priorities, while Republic Act No. 10121 establishes the Philippine disaster risk reduction and management framework.

Second, Republic Act No. 12287 provides a more direct policy connection between anticipatory action and food-system protection. Its provisions concerning prepositioned food supplies and agricultural contingency planning are particularly relevant to food security.

Third, official Biliran agricultural statistics demonstrate the value of local production monitoring. The reported reductions in palay and corn production provide descriptive evidence that can inform further investigation and preparedness planning, although they do not identify the causes of the changes.

Fourth, food security requires attention to availability, access, utilization, and stability. Agricultural production statistics alone cannot establish the overall food-security situation of a locality.

Fifth, AI and digital technologies offer potential support for forecasting, monitoring, early warning, and logistics. Their effectiveness depends on institutional readiness, data quality, infrastructure, and responsible governance.

Taken together, these findings suggest that food security should be treated as an integral component of multi-hazard preparedness rather than as a separate concern addressed only after disasters occur.

Policy gaps, institutional challenges, and strategic implications

The documentary evidence indicates several policy and institutional considerations.

First, the integration of food security into local disaster planning requires continued attention. National legislation provides a basis for protecting food supplies and agricultural production, but local plans must translate these provisions into specific responsibilities, resources, and operational procedures.

Second, agricultural production monitoring should be connected to preparedness planning. The Biliran production figures demonstrate the value of maintaining updated information on crops, harvested areas, and yields. Additional data on fisheries, livestock, market prices, storage, and household access would provide a more comprehensive assessment.

Third, emergency food logistics require sustained coordination. Food assistance depends on procurement, storage, transportation, inventory management, and distribution. These functions should be addressed through contingency planning and coordination among relevant agencies.

Fourth, household access and vulnerability require attention. Production data cannot establish whether households can afford or obtain adequate food. Local poverty, income, market, nutrition, and food-price data are needed for a more complete assessment.

Fifth, digital preparedness requires institutional readiness. AI and other digital technologies may support risk identification and food-system monitoring, but their application requires reliable data, technical capacity, infrastructure, governance safeguards, and human oversight.

Sixth, institutional continuity should be incorporated into preparedness planning. Educational institutions and other essential service providers may need continuity arrangements for communication, personnel safety, essential supplies, facilities, and the resumption of services. These are policy considerations, not findings that particular institutions lack such arrangements (Table 3). The table presents recommendations derived from the reviewed documents. It does not claim that every identified concern represents a verified failure in a specific institution or locality.

Conclusion

This study examined multi-hazard preparedness and food security through international and Philippine documentary evidence, using Biliran Province as a contextual case. The analysis demonstrates that food-system resilience requires an integrated approach that considers agricultural production, household access, utilization, supply-chain continuity, disaster governance, and institutional preparedness. International frameworks emphasize risk understanding, governance, resilience investment, and preparedness. The FAO Food Security Framework further establishes that food security involves availability, access, utilization, and stability. These perspectives demonstrate that agricultural output alone is insufficient to determine the food-security condition of a population. Philippine legislation provides important foundations for disaster preparedness. Republic Act No. 10121 establishes the national disaster risk reduction and management framework, while Republic Act No. 12287 strengthens anticipatory action by enabling measures before a forecasted disaster occurs. Its provisions concerning food prepositioning and agricultural contingency planning directly connect disaster preparedness with food-system protection. The Biliran agricultural statistics show that palay and corn production declined between 2024 and 2025. These changes highlight the importance of monitoring agricultural performance and strengthening preparedness. However, the figures do not establish the causes of production changes or the overall food-security condition of households in the province. The study also identifies AI and digital technologies as potentially useful tools for risk forecasting, agricultural monitoring, early warning, and emergency logistics. Their contribution depends on reliable data, infrastructure, institutional capacity, responsible governance, and human oversight. The documentary evidence reviewed does not establish that specific AI systems are operational in Biliran Province. Overall, the study concludes that multi-hazard preparedness should incorporate food security as a central component of disaster risk reduction and institutional resilience. Effective preparedness requires the translation of national policy provisions into locally appropriate plans, operational arrangements, reliable information systems, and coordinated actions that protect production, supply, household access, and essential services [13-15].

Recommendations

Based on the findings and conclusions, the following recommendations are proposed:

1. For national government agencies: Strengthen coordination among disaster risk reduction, agriculture, social welfare, transportation, and other relevant agencies to ensure that food-system protection is consistently integrated into preparedness and response planning.
2. For local government units in Biliran Province: Review and, where necessary, strengthen Local Disaster Risk Reduction and Management Plans to incorporate agricultural protection, food-supply continuity, anticipatory action, and emergency food logistics consistent with Republic Act No. 12287 and its implementing rules.
3. For agricultural agencies and stakeholders: Improve the regular monitoring of palay, corn, fisheries, livestock, agricultural inputs, harvested areas, and yields. Link production monitoring with risk assessments and contingency planning.
4. For disaster response and social welfare agencies: Review food inventory management, storage arrangements, prepositioning procedures, transportation access, and distribution systems to support timely assistance during emergencies.
5. For local planning and statistical offices: Improve the availability of local socioeconomic indicators, including food prices, household income, and poverty, nutrition, and market access. These indicators would help provide a more comprehensive assessment of food security beyond agricultural production.
6. For educational institutions and other essential service providers: Strengthen institutional continuity arrangements covering personnel safety, emergency communication, essential supplies, facilities, and the continuity or resumption of services during and after disasters.
7. For agencies considering AI and digital technologies: Conduct readiness assessments before adopting AI-supported forecasting, agricultural monitoring, or logistics systems. Ensure that applications are supported by reliable data, trained personnel, infrastructure, transparent procedures, privacy protection, cybersecurity, and human oversight.
8. For future researchers: Conduct further research using additional provincial and municipal data on fisheries, food prices, household income, nutrition, agricultural losses, and

disaster impacts. Future studies may also examine documented implementation of anticipatory action and local food-system preparedness.

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