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REVIEW

A Review of Different Policies in Asia to Overcome Floods in the Rice Fields

Nurilla Elysa Putri [1,2] , ***Mohd Idris Nor Diana*** [1*] , ***Khai Ern Lee*** [1]

[1] *Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM), Bangi 43600, Selangor, Malaysia*

[2] *Socio Economic Department, Agriculture Faculty, University of Sriwijaya, Indralaya 30128, South Sumatra, Indonesia*

ABSTRACT

Floods are increasingly affecting developing countries, particularly in Asia. The policies are needed to overcome floods and help small-scale rice farmers protect their rice fields. There has been much research on flooding, but research to solve the problem of flooding in rice fields, especially for small-scale farmers, has not yet been done. Hence, this research is very needed to formulate policies to deal with flooding in rice fields in Asian countries. This study method was a systematic literature review using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). According to the results, the policies to overcome floods for small-scale rice farmers are the responsibilities for flood protection, skill flood experience and knowledge, and dynamic regulation and management decision-making. The responsibility for the flood protection theme is divided into three subthemes: flood mitigation, flood management policies, and financial coping. The skill, flood knowledge, and experience theme consists of three subthemes: ecosystem-based adaptation, livelihood strategy, and preventive measures. The dynamic regulation and management decision-making theme is divided into three subthemes, which were obtained from this review article: farm management, access to information, and social response. The policies assist policy-making for the level of farmer groups, rural communities, local governments, regional governments, and national agencies in-

*CORRESPONDING AUTHOR:
Mohd Idris Nor Diana, Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM), Bangi 43600, Selangor, Malaysia; Email: nordiana@ukm.edu.my

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volved in socially responsive community action that can be carried out by small-scale rice farmers in flood-prone areas. There are differences in policies in Asian countries regarding flood management, which shows that the focus of flood management carried out by each country is a local problem priority in each country.
Keywords: Systematic Review; Policies; Flood; Rice Field; Farmers; Asia

1. Introduction

Climate change is causing a significant increase in the frequency and intensity of flooding events worldwide. Locations that experience the most severe flooding impacts are in developing countries, especially Asia [1]. The increasing frequency and intensity of flooding are one of the consequences of climate change. An important step in overcoming flooding is to maintain the aquatic ecosystem through joint efforts between the community and related stakeholders [2]. Floods have become a recurring disaster in several countries, especially in Asia. Therefore, many areas experiencing flooding require policies to address this problem. There is a need for flood control with shared awareness so that flood conditions can be handled through policies that can be implemented with the active participation of stakeholders and communities affected by flooding [3].

Floods are one of the most devastating natural catastrophes caused by climate change [4]. Floods cause farmers to lose their main livelihood, namely rice harvests, because farmers end up abandoning their rice fields, or selling and renting out their agricultural land [5]. It is important to determine changes in the distribution and types of floods and their characteristic in future climatic scenarios to assess flood consequences and risk management. The reason is that future changes in flood types will have ramifications for societal and biological systems [6]. Understanding flood risk makes it possible to predict how to protect against natural disasters like floods and help policy-makers and institutional organisations develop and implement effective plans that suit community needs. There is also an inclusive two-way discussion between the public and the government regarding the main concerns and their impacts, increasing preparedness and effective action in dealing with floods [7]. Local flood risk mitigation is frequently carried out by an informal collection of governmental, nongovernmental enterprises, and academic entities [8]. Flood disasters have increased considerably in various countries due to the impact of climate change [9]. Climate change has led to increased incidence of flooding which poses a threat to the livelihoods of small farmers [10].

According to a study by Conde et al. [11], Food agriculture in Asia covers 85.7% of the world's rice fields and contributes to producing 89.8% of the world's rice production. This amount is the largest flood damage value for Asian countries, specifically the Philippines, Thailand, Cambodia, and Pakistan. Rainfall and high summer temperatures are common during the rainy season in several locations. According to Singh et al. [12], Farmers in the Ganga River face uncertainty in flood timing and duration, using various coping strategies. Surveys show they switch to livelihood activities, seek government assistance, local mobility, relatives, wait helplessly, and learn skills for new employment opportunities. Floods are a disaster that is increasingly occurring throughout the world, this condition is mainly caused by climate change, floods have an impact on the sustainability of life and the economy [13]. Livelihood values vary across communities upstream, midstream, and downstream [14].

Farmers adopted both agricultural and non-agricultural activities as adaptation strategies to floods and the estimation results showed that these strategies improved food security conditions and recovery from flood impacts [15]. Effective collaboration and governance between the extension workers and policymakers, and more logistical and financial support to the farmers were needed to manage strategic interventions [16]. Rice growing in paddy fields is the primary economic activity in most Asian Countries. Rice production is more prone to flooding than other production crops, which has resulted in the conversion of rice fields into built-up areas and industrial zones in flood-prone lowlands [17]. Flash flooding is a catastrophic meteorological phenomenon that significantly destroys agricultural

produce and livelihoods. Flash flooding has a significant impact on the production of rice, a crop that is the Asian country's staple food [18].

Sustainable water management are doing for balance the rice productivity in flooded ecosystem with agro-ecological practices, soil and water conservation in integrated farming system [19]. Small-scale farmers frequently face flood conditions in their rice fields, threatening the livelihoods of farmer households in a region. Farmers must address household livelihood concerns caused by flooding in paddy fields, as crops in paddy fields are no longer the primary source of revenue. Floods in rice fields have curtailed rice output.

This condition impacts agricultural households' income losses and the potential to increase rural poverty rates. As the sustainable livelihood potential of households becomes more vulnerable, their capacity to meet basic requirements falls. Small-scale farmers' difficulties usually go undetected due to challenges associated with rural locations, difficulty accessing places, and a lack of information and communication with the central government. Small-scale farmers' rice field management is a neglected topic of flood issues. There has been a lot of research on flooding, but research to solve the problem of flooding in rice fields, especially for small-scale farmers, has not been done, so this research aims to formulate policies to deal with flooding in rice fields. This research tries to solve the problems of farmers who experience flooding in rice fields and for local government decision-making. This research provided an overview of the policies of Asian countries that can be adopted by each other, thus contributing to policy-making related to flooding in rice fields faced by farmers in Asian countries. The Systematic Review summarises and synthesises the policies and gives policy recommendations for farmers' actions [19]. The research objective is to provide flood policy recommendations to help farmers manage floods in their rice fields and sustain their livelihoods. A review policy in Asia is needed to overcome floods in rice fields that help small-scale farmers prevent the destruction of their sustainable livelihoods due to a lack of stakeholder participation. The study was conducted to formulate recommendations for policies to overcome floods in the rice fields for small-scale farmers based on a systematic review of different policies in Asia.

2. Materials and Methods

2.1. Data Source

2.1.1. Prisma

A systematic literature review was conducted to retrieve relevant publications related to the subject area [20]. The study method was a systematic literature review using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A systematic study on the Scopus and Web of Science databases was conducted based on the PRISMA report analysis method [21, 22].

This research was analysed with 123 WoS papers and 3 Scopus articles. N = 126, excluded 43 papers that did not meet the criteria (**Table 1**). Then continue to the retrieval study, N = 83, study access for eligibility n = 40.

Table 1. Inclusion and Exclusion Criteria.

Criteria	Inclusion	Exclusion
Literature type	Indexed Journal (research articles)	Non-indexed journals, Systematic literature Review journals, chapter in a book, conference proceedings
Language	English	Non-English
Time line	Between 2012-2023	<2012
Subject Area	Environmental Science, Agriculture, Social Science	Other than Environmental Science, Agriculture, and Social Science
Countries and territories	Asian Countries	Non-Asian Countries

2.1.2. Resources

This study identified and synthesised the scientific literature to find, select, and evaluate important research on different policies in Asia to overcome floods in the rice fields for small-scale farmers. The authors use data from Scopus and Web of Science to analyse a Sys-

tematic Literature Review (SLR) [2].

Scopus is a journal article bibliographic database that includes abstracts and citation sources [21]. Scopus and Web of Science (WoS) were used as the primary journal databases for the review. The second database utilised in the literature reviews was Scopus [23]. The systematic literature review was conducted using the WoS and Scopus databases. Web of Science (WoS) is a database that indexes reputable journals that have impact factors. WoS provides clear analytics for articles covering 256 disciplines and 33,000 journals from 1900 to 2020 [21]. In 2023, Scopus covers 34,346 peer-reviewed journals in top-level subject fields: life sciences, social sciences, physical sciences, and health sciences.

2.2. Data Analysis

2.2.1. Systematic Review Process

Systematic reviews are used to obtain answers to research problems using explicit and repeatable methods to identify, assess in detail, and synthesise the results of the study [24]. The research question in a systematic review does not provide a focused research question, but only gives in biased [22]. A systematic review is one of the important tools for building theory by summarising existing literature. The benefits of the synthesis result are to formulate discoveries using systematic reviews that make an impact on the development of science [25]. The systematic review process carried out in this study consists of three stages: identification, screening, and eligibility. These three processes are carried out to obtain results related to the problems studied.

2.2.2. Identification

A systematic literature review is conducted to summarise some of the findings and opinions of academics using organised and transparent techniques so that the process can be replicated by other researchers [26]. The systematic review process carried out in this study consists of three stages: identification, screening, and eligibility. These three processes are carried out to obtain results related to the problems studied.

The keywords utilised in the string search were decided manually during the identification stage (handpicking, citation tracking, and reference tracking). Researchers collected and read the articles. The keywords collected were utilised in a literature search based on Web of Science and Scopus to find journals relevant to the research topic. The number of papers retrieved by search strings from Web of Science and Scopus was comparable (**Table 2**).

Table 2. Keywords Searched Followed the Requirements.

Database	Keywords Used
Web of Science	TS=((”Overcome* Flood*” OR ”Policy*” OR ”Floodin OR ”overcome* Inundation*” OR ”Overcome* floods*” OR ”Policy* Needed*” OR ”Policy Required*” OR ”Water Inundation*” OR ”*” OR ”Sternutation” OR ”Flood Hazard AND (”Aspect* elements*” OR ”Cause*Indicators*” OR ”Causes* parameters*” OR ”Component*floods*” OR ”thing* ”) AND (farmer* OR farmers* OR Rice Farmers* OR Paddy farmers*))
Scopus	TITLE-ABS-KEY((”Overcome* Flood*” OR ”Preventives* Flood*” OR ”Overcome* inundation*” OR ”Overcome* Flood*” OR ”Face Of* Policy Asia*” OR ”Policy Required*” OR ”Flood Adaptive*” OR ”Flood Risk*” OR ”Floods Mitigation*” OR ”Hazard” OR ”Damage AND (”Adapt* abilit*” OR ”adapt* Policy*” OR ”Protection* Rule Protection*” OR ”Policy Asia* Protection of flood*” OR ”Risk* Impact*” OR ”Governance* Risk management*” OR ”Historical* Narrative*” OR ”Expectation* System*” OR ”Rule* Support*” OR ”Access * Knowledge*” OR ”Education*potential*” OR ”awareness* strategy*” OR ”Learning*Effect*”) AND (Farmers*n OR Rice Farmers* ORfarm*Farming*))

2.2.3. Screening

Inclusion and Exclusion Criteria

The second part of the systematic review process is screening[27]. The screening process determines the selection criteria for articles in a systematic literature review. Quantitative and qualitative data are obtained based on established criteria, and duplicates are identified. Articles meeting the criteria and following the study objectives are obtained (**Table 1**).

Inclusion and exclusion criteria can include the date of publication, publication type, and language of a study[28]. This study screened 126 articles using inclusion and exclusion criteria, focusing on journal research articles and excluding non-English articles. The chosen language was English, and the publication period was 2012–2023. The country and territory criterion was Asia. The subject areas were environmental science, agriculture and social science. Forty-three articles were excluded, and forty were found to be relevant to the study topic[21].

The inclusion and exclusion criteria used to filter the articles that can give a result article are matched to this study. This stage is an important part of the systematic review process, and gives the conclusion article used in this study based on the particular criteria.

Eligibility

The eligibility of the articles selected from the review about meeting the criteria was determined; if an article was not eligible, it was excluded. The evaluation process for selecting the articles was based on the quality of the paper, the objective, and the findings. The authors manually evaluated the remaining publications to determine if they matched the defined inclusion criteria (by reading the title, abstract, or the complete written content)[27, 28].

According to **Figure 1**, the result concluded that 12 eligible articles were synthesised to obtain policy recommendations for flood management in paddy fields that can be applied to small-scale farmers in Asia. These eligible articles were selected from 126 articles screened in the initial analysis stage. The articles included in the review were used to formulate policies in Asian countries that can be recommendations for flood management efforts in paddy fields.

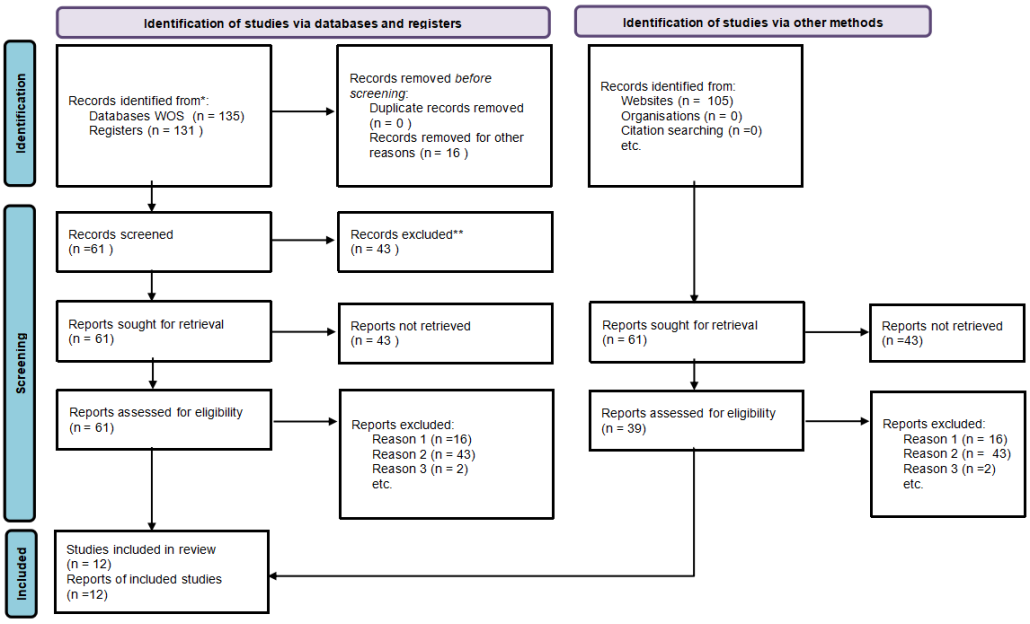

Figure 1. Literature Search Based on Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) Guidelines (Adapted from Page et al. 2021).

**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools. *From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. Doi: 10.1136/bmj.n71. For more information, visit:http://www.prisma-statement.org/

2.3. Data Extraction and Analysis

Data analysis methods involve quantitative and qualitative approaches. Study data gathered through abstract analysis, identifying themes and subthemes and organising them into an article typology. Braun and Clarke[29] organised data at granular levels, extracted data related to the main research question, and generated themes using inductive coding frameworks to identify interests, similarities, and connections[28]. Regarding the distribution, Climate Risk Management is the leading source of published articles (27 articles), followed by the International Journal of Disaster Risk Reduction (15 articles) and Water (4 articles). A total of 126 different journals were identified.

According to **Figure 2**, most articles related to policies to overcome floods can be found more in the Journal of Hydrology and the International Journal of Disaster Risk Reduction. This result shows that the focus of the study area for this study is on Hydrology and disaster risk reduction. Another source of articles also related to this study is about natural hazards, regional studies in marine science and Environmental Research Letters.

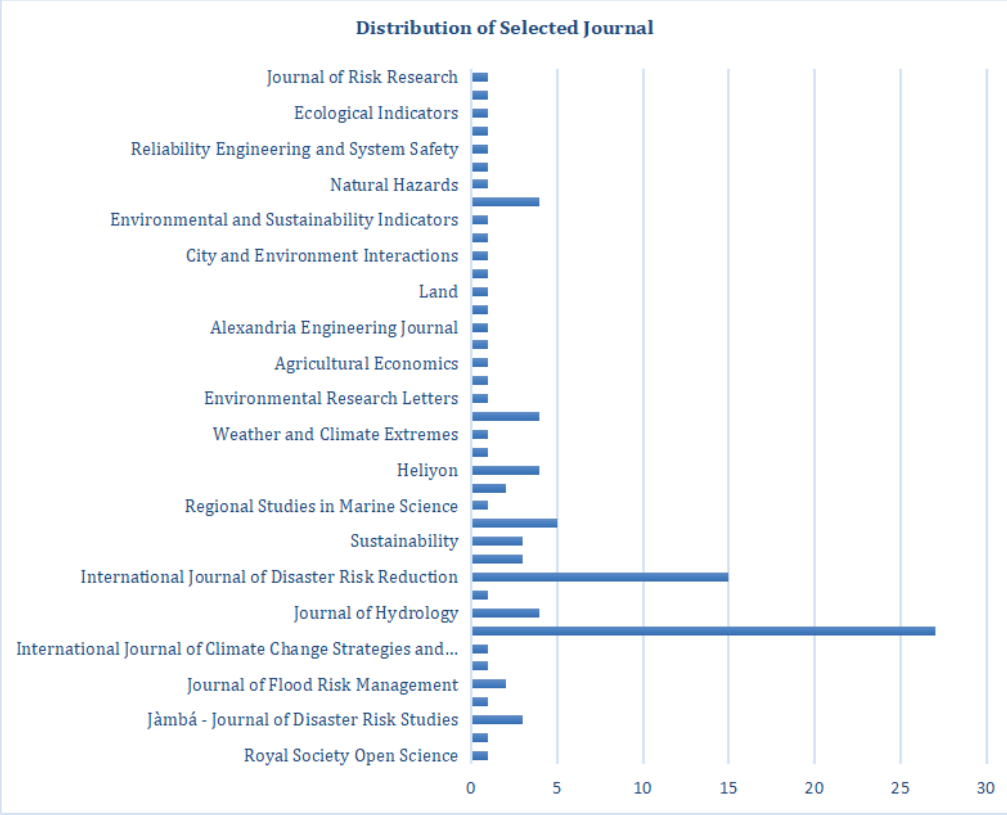

Figure 2. The Distribution of the Selected Research Articles Per Journal.

3. Results

3.1. Systematic Review of Different Policies in Asia to Overcome Floods in the Rice Fields

The variables in **Figure 3** are policy identification in Asia to overcome floods. There are three elements: the responsibility for flood protection[30]; skill, flood experience and knowledge[30]; and dynamic regulation and management decision-making[31]. Factors with lower scores included key skills availability, local authority experience, road accessibility, and ecosystem services for flood risk prevention[30]. Given the numerous shortcomings in current flood disaster resilience research in terms of uncertainty assessment, dynamic regulation, and management decision-making, a new method for analysing the driving mechanisms of flood

disaster resilience and management decision-making is offered [31]. Flood-prone people face financial hardship, losing jobs and income and reducing their daily needs to cope with potential floods [32].

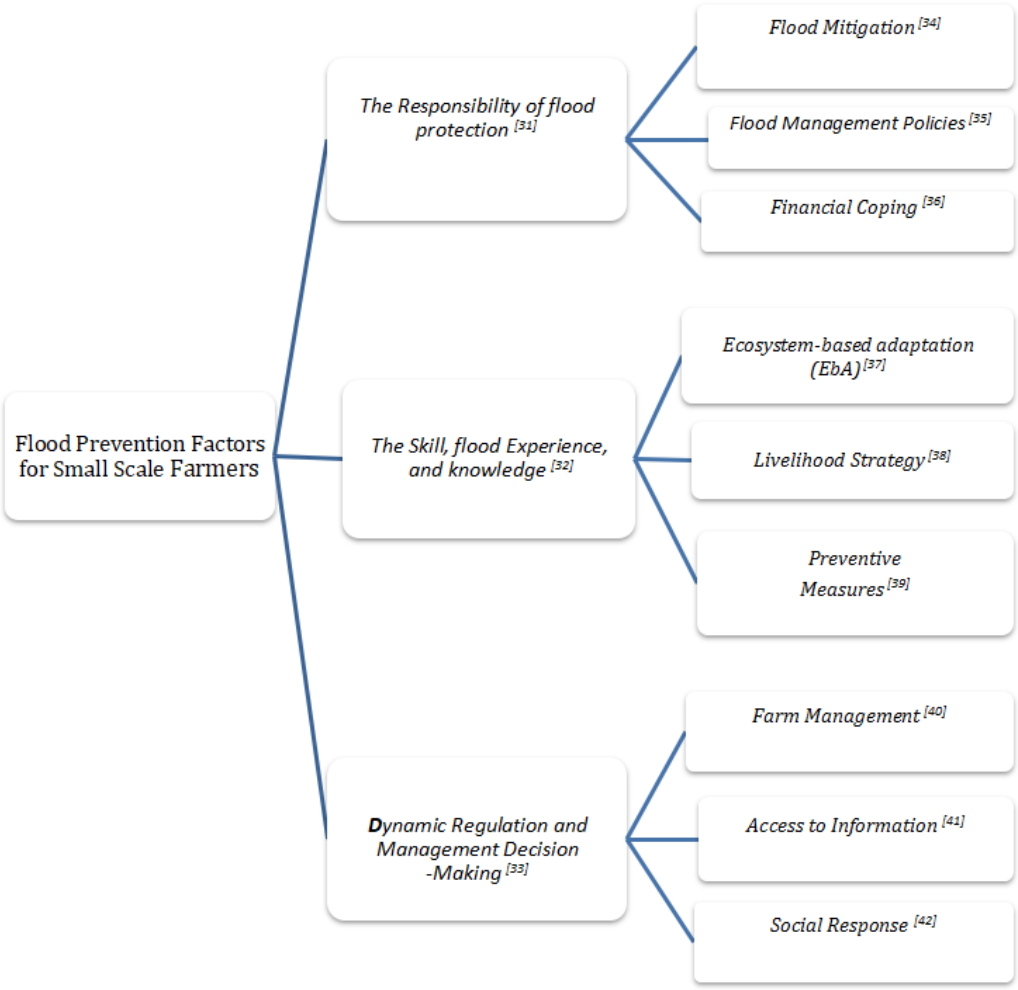

Figure 3. Policy Recommendation to Overcome Floods for Small-Scale Farmers in Asia [30–41].

The results of the synthesis of policies of several Asian countries show that flood management policies are carried out comprehensively and involve relevant stakeholders. The identified flood management policies are three themes divided into nine subthemes that represent the policies of Asian countries. The results provide an overview of the policies that Asian countries can implement to handle flood problems. The results of the policy review are expected to provide recommendations that can be implemented by the government, agencies, NGOs, and local communities of farmers in handling flood problems in rice fields.

This systematic review divided the required elements into themes and subthemes. The subthemes provide detailed information to characterise the themes and broader information to provide recommendations for flood prevention in rice fields (**Table 3**).

Table 3. Policy Recommendation to Overcome Floods for Small-Scale Farmers in Asia.

Author, Year	Country	Title	Identified Policies	Code
(Wang et al., 2018) [30]	China	Analysis of the Public Flood Risk Perception in a Flood-Prone City: The Case of Jingdezhen City in China	The Responsibility of flood protection	A
(Munpa et al., 2022) [31]	Thailand	Climatic and Hydrological Factors Affecting the Assessment of Floo	The Skill, flood Experience and knowledge	B
(Liu et al., 2022) [32]	China	A new method to analyse the driving mechanism of flood disaster resilience and its management decision-making	Management Decision-Making	C
(Hapsari and Zenurianto, 2016) [33]	Indonesia	View of Flood Disaster Management in Indonesia and the Key Solutions	Flood Mitigation	A1
(Luo et al., 2015) [34]	Japan-China	Historical assessment of Chinese and Japanese flood management policies and implications for managing future floods	Flood Management Policies	A2
(Poontirakul et al., 2022) (Hossain et al., 2020) (Gordon and Yiannakoulias, 2020; Griffin et al., 2023) [35, 41–43]	Bangladesh	Climate change induced extreme flood disaster in Bangladesh: Implications on people's livelihoods in the Char Village and their coping mechanisms	Financial Coping	A3
(Hagedoorn et al., 2021) [36]	Vietnam	Preferences of vulnerable social groups for ecosystem-based adaptation to flood risk in Central Vietnam	Ecosystem-based adaptation (EbA)	B1
(Thanh Thi Pham et al., 2020) [37]	Vietnam	Vulnerability assessment of households to flash floods and landslides in the poor upland regions of Vietnam	Livelihood Strategy	B2
(Shrestha et al., 2021) [38]	Asia	Development of flood damage functions for crops and their applicability in regions of Asia	Preventive Measures	B3
(Shaffril et al., 2018) [39]	Asia	A systematic review on Asian farmers' adaptation practices towards climate change	Farm Management	C1
(Nor Diana et al., 2022b) (Hahirwabasenga et al., 2024) [40, 44]	South East-Asia	Farmers' Adaptation Strategies to Climate Change in Southeast Asia: A Systematic Literature Review	Access to Information	C2
(Zhu et al., 2023) (Bott et al., 2020) [41, 45]	China	The influencing factors and mechanisms for urban flood resilience in China: From the perspective of a socio-economic-natural complex ecosystem	Social Response	C3

Policy Recommendations to overcome floods for small-scale farmers in Asia obtained from the results of this study indicate that in each country, the policies implemented are very location-specific, as this is due to differences in climate, topography, and types of related policies in each country, which greatly influence policy making to deal with flooding.

The review results in **Table 4** show that there are differences in policies in Asian countries regarding flood management. It shows that the focus of flood management carried out by each country is a local problem priority in each country. On average, each country has two policy areas for dealing with floods. The review results show that China has policies on the environment, forest management, and land use. Thailand takes policies on infrastructure, agricultural technology, skills, knowledge, and community action. Indonesia has policies on the environment, forests, and community action. Japan has policies on the environment, forests, and land use. Bangladesh and Pakistan focus on economic, agricultural, skills, and knowledge policies. Vietnam focuses on economics, agricultural skills, knowledge, and community action policies. Generally, in Southeast Asia and Asia, the policies implemented in handling floods are environmental, forest, land use, infrastructure and technology to deal with flood problems.

Table 4. Different Policies to Overcome Floods for Small-Scale Farmers in Asia.

Country	Identified Policies			
	Environment, Forest, Land Use	**Economic, Agriculture Insurance**	**Infrastucture-Technology**	**Skill, Knowledge, Community Action**
China	✓			
Thailand			✓	✓
Indonesia	✓			✓
Japan	✓			
Bangladesh-Pakistan		✓		✓
Vietnam			✓	✓
South East Asia	✓		✓	
Asia	✓		✓	

3.2. The Responsibility for Flood Protection (A)

The responsibility for flood protection [30] theme is divided into three subthemes: flood mitigation [33], flood management policies [34], and financial coping [35]. The subthemes become factors required to prevent flooding in rice fields and can be developed to increase farmers' ability to maintain their sustainable livelihoods. These three subthemes will be further refined into detailed actions that can constitute recommendations for paddy farmers in dealing with floods. The responsibility for flood protection requires flood mitigation, flood management policies, and financial coping.

The responsibility for flood protection is influenced by a person's level of responsibility. The majority of respondents in China believe that the government (48.4%) and flood management experts (24.6%) should take responsibility for public flood protection. However, only 13.9% of respondents believe that they should be responsible for flood protection and disaster mitigation. People with higher trust in the government perceive lower disaster consequences and prepare less. Low trust levels were found, with the highest trust [30].

According to **Table 5**, the Indonesian National Board for Disaster Management (BNPB) manages disaster countermeasures in three stages: before, during, and after. Pre-disaster tasks involve protecting resources, planning countermeasures, increasing community resilience, estimating disaster impact, and analyzing risk. Post-disaster responses involve rehabilitation and reconstruction. Technical cooperation with developed countries is being pursued to develop flash flood disaster mitigation models [33]. Flood management policies are crucial for preventing floods, particularly in forestry areas. Environmental changes, land use, and climate change significantly impact flood disasters [34]. Rural people face challenges from frequent floods, affecting their livelihoods, agriculture, infrastructure, and food supply systems. They suffer from hunger, food problems, loss of income, and loss of occupation. NGOs and governments should intervene and develop coping strategies to mitigate the impacts of floods [33]. Insurance consumption has a significant effect on the impact of floods on farmers. The results of this study indicate that insurance, especially non-life insurance, is effective as an ex-ante effort to reduce farmer poverty after a flood [35]. The incentives for overcoming the flood risk should be applied early to the flood event, which can support the mitigation [43, 46].

Table 5. Factors and Policy of the Responsibility for Flood Protection (A).

Code	Factors	Policy	Author, Year, Country
A1	*Flood Mitigation*	Predisaster: – Tasks involve protecting resources, – Planning countermeasures, – Increasing community resilience, – Estimating disaster impact and analyzing risk. Post-disaster – Responses involve rehabilitation and reconstruction. – Technical cooperation with developed countries is being pursued to develop flash flood disaster mitigation models	(Hapsari & Zenurianto, 2016), Indonesia [33]

Table 5. *Cont.*

Code	Factors	Policy	Author, Year, Country
A2	*Flood Management Policies*	– Preventing floods, particularly in forestry areas. – Preventing the environmental changes, land use change, and climate change that significantly impact flood disasters	(Luo et al., 2015), Japan-China [34]
A3	*Financial Coping*	– NGOs and governments should intervene and develop coping strategies to mitigate the impacts of floods – Provide agriculture, infrastructure, and food supply – Non-life insurance is effective as an ex-ante effort to reduce farmer poverty after a flood – The incentives for overcoming the flood risk	(Hossain et al., 2020), Bangladesh (Poontirakul et al, 2022) Pakistan (Gordon and Yiannakoulias, 2020; Griffin et al., 2023 [35, 41–43]

3.3. Skill, flood Experience and knowledge (B)

The efforts to adapt to flooding in the form of rice field extensification and intensification, temporary migration, planting flood-resistant varieties, irrigation, and livelihood diversification have caused maladaptive behaviour, which worsens farmers' vulnerability in the future, so flood efforts must be based on local conditions [47]. The skill, flood experience, and knowledge theme consists of three subthemes: ecosystem-based adaptation (EbA) [36], livelihood strategy [37], and preventive measures [38]. These three subthemes are further refined into two elements for each subtheme. On the themes of knowledge and education, the studies provided an overview of the factors needed to protect farmers from floods in paddy fields through the existence of original knowledge as well as local knowledge and skill in the community thus far and the joint actions that have been carried out when dealing with floods in paddy fields.

The survey found that half of the respondents had never received flood information or participated in flood preparedness training. Positive correlations were found between flood disaster relief payments, preparedness training, access to flood hazard mapping, emergency health services, and flood preparation actions [31]. Traditional flood risk management, such as levees, can negatively impact vulnerable social groups' livelihoods, as ecosystem degradation is a major cause of disasters and climate risks [36]. Farmers who participate in farming and climate change programs understand and adapt to climate change. Higher education levels can influence farmers' adaptation. Both formal and informal training are valuable in the agricultural sector [40].

According to **Table 6**, the livelihoods of farmers in rural areas are the most vulnerable to the natural hazards identified by the social network, sociodemographic profile, and water component factors. It subsequently identified and prioritised measures to ensure sustainable livelihoods for local farmers through practices such as improving people's literacy, enhancing production systems, and strengthening natural resource management strategies [37]. This study assesses flood damage to rice crops and evaluates the effectiveness of flood prevention measures. Implementing preventive measures and land use plans, including flood protection, drainage capacity, and submergence-tolerant rice varieties, can reduce damage [38]. Farmers need to adapt to climate change through local knowledge and local values, This is related to farmer ownership, such as financial capacity, access to land, debts and levels of participation, which greatly influence farmers' adaptability [46].

3.4. Dynamic Regulation and Management Decision-Making (C)

Flood-related changes require social, economic, and natural responses. Social factors include early warning, emergency management, and learning ability. Economic response impacts resilience, while increasing flood insurance reduces losses and improves resilience [41]. Households with higher translocal contacts tend to be proactive about floods, but poor households have fewer translocal social ties, so their ability to adapt to flood risks is lower. Interventions for poor communities designed to increase translocal social capital are needed to overcome flooding in rice fields [45].

Table 6. Factors and Policy of Skill, Flood Experience and Knowledge (B).

Code	Factors	Policy	Author, Year, Country
B1	*Ecosystem-based adaptation (EbA)*	– Through the existence of original knowledge as well as local knowledge – Skill in the community, thus far The joint actions Formal and informal training – Flood preparedness training – Flood hazard mapping, – Emergency health services – Flood preparation actions	(Hagedoorn et al., 2021), Vietnam (Munpa et al., 2021), Thailand [37,32]
B2	*Livelihood Strategy*	– Improving people's literacy – Enhancing production systems – Strengthening natural resource management strategies	Thanh Thi Pham et al., 2020), Vietnam [38]
B3	*Preventive Measures*	– Implementing preventive measures – Land use plans – Flood protection, drainage capacity – Submergence – Tolerant rice varieties	(Srestha et al., 2021), Asia [39]

Refers to **Table 7**, twenty-five studies identified farm management as an adaptation measure for Asian farmers, with six subthemes: soil conservation, insurance schemes, tree planting, agroforestry/organic farming, in-house farming, and other practices [39]. The dynamic regulation and management decision-making theme was divided into three subthemes, which were obtained from this review article: farm management [39], access to information [40] and social response [41].

These three subthemes are factors that can be adopted to protect farmers from flooding in paddy fields. Farmers access information through experience and education to adapt to climate change, focusing on resources such as the internet, experiences, and training. These resources help farmers understand and adapt to the changing landscape [40]. Knowledge about the impact of flooding in water catchment areas is still limited, and the availability and quality of data are the main requirements for carrying out flood risk management. Efforts are needed to increase the number of rainfall and river flow measuring stations to facilitate studies of the hydrological characteristics of floods, so that information and early flood warnings are more accurate for the community [44].

Table 7. Factors and Policy of Dynamic Regulation and Management Decision-Making (C).

Code	Factors	Policy	Author, Year, Country
C1	*Farm Management*	– Soil conservation – Insurance schemes – Tree planting – Agroforestry/organic farming – In-house farming – Other practices	(Shaffril et al., 2018), Asia [39]
C2	*Access to Information*	– Experience and education adapt to climate change, – Focusing on resources such as the internet, experiences, and training. – These resources help farmers understand – Adapt to the changing lands – Increase the number of rainfall and river flow measuring stations – Facilitate studies of the hydrological characteristics of floods, – Provide information and early flood warnings	(Nor Diana et al., 2022b), South East-Asia (Hahirwabasenga et al., 2024) [40, 44]
C3	*Social Response*	– Social, economic, and natural responses. – Social factors include early warning, emergency management, and learning ability. – Economic response impacts resilience, while increasing flood insurance reduces losses and improves resilience. – Increase translocal social capital for poor communities	Zhu et al., 2023), China (Bott et al., 2020), Indonesia [41, 45]

4. Discussion

Climate change is characterised by changes in climate conditions that can result from erratic daily weather [48]. Flooding is a disaster risk in the prone area that happens most frequently [49]. The problem of flooding in rice fields is a problem that is not currently the focus of attention because flood problems have a broad impact. Many studies have been carried out to identify efforts to address flooding in urban areas, but studies have not focused on flood control efforts in rice fields, which have an impact on the sustainability of small-scale farmers. This study provides an overview of different policies to overcome floods in rice fields, especially reducing the losses of small-scale farmers. The identification of several policies by 12 scholars is expected to provide policy recommendations for flood management efforts in paddy fields.

According to the results of the systematic analysis, the three key variables in flood management policies in paddy fields are the responsibility for flood protection, skill, flood experience and knowledge, and dynamic regulation and management decision-making. Each of these themes is further subdivided into three subthemes, for a total of nine subthemes that outline the policies to overcome floods that can be implemented to assist rice farmers in rural regions, particularly in Asia.

The forestry policy contribution to small-scale farmers' interests and local economic development. It can be through community awareness to maintain and manage the rice field for the implementation of regional plans [50]. The responsibility for flooding prevention in paddy fields has not yet received crucial regulation; this necessitates a collaborative role at both the national and local levels of government to carry out flood prevention management in collaboration with NGOs and the private sector. The responsibility for preventing floods in paddy fields can be implemented by carrying out countermeasures at the pre-disaster and post-disaster response stages, which become mitigation efforts. Policy-making for flood prevention is needed to avoid both economic and social losses. Economic losses will cause flood-affected farmers to implement different financial coping strategies after floods in paddy fields, causing financial losses in both farming capital and paddy field infrastructure capital. Levels of government to carry out flood prevention management in collaboration with NGOs and the private sector.

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Global, regional, and local initiatives to overcome floods are different policies and have different impacts on the rice production and agricultural sectors [51]. Factors that also influence efforts to protect against flooding in paddy fields, namely, access to information for farmers about flood conditions that may occur at paddy fields, provide preparedness for farmers to avoid losses. Assisting with flood control between the government and the private sector has proven effective in protecting against flooding in paddy fields. Information on flood hazard mapping in paddy fields should be provided to paddy farmers in flood-prone locations. The construction of traditional embankments carried out by farmers in several regions in Asia has shown a negative impact, namely, in the form of ecosystem degradation, which adds to climate disasters in paddy fields. The ability to adapt to climatic conditions also needs to be developed by farmers so that they can adjust the planting season to seasonal changes that allow flooding in paddy fields. The need for knowledge, skills, and information about flood disaster mitigation is a necessary factor to protect small-scale farmers from the dangers of flooding in paddy fields.

Rice field communities-livelihoods are an important factor in livelihood vulnerability due to overcome characteristics of conducting agriculture in flood inundation areas [52]. Farming management, namely, soil conservation, agricultural insurance schemes, forestry agriculture, and yard farming, is one of the efforts to protect against flooding that can reduce the impact of flooding. In addition, communication technology is needed for flood protection in paddy fields. Information training via the internet, education on changing the landscape of agricultural land, and the sharing of flood experiences can be references for flood management in the future. The social response is an important part of flood prevention efforts in paddy fields, both before and after a flood response is needed to minimise the risk of losses for farmers in flood-prone areas. Different ecological adaptation strategies exist between rice farmers in Asia, which include adjustments in planting time, control of pests and diseases, crop rotation, and the use of pumping systems. In addition to these scientifically based strategies, local knowledge plays an important role in adaptation processes [53]. The dynamic nature of rice species that thrive in rural areas in response to flood conditions shows the action for proactive conservation efforts and adaptation management strategies to mitigate potential ecological impacts [54].

Policy recommendations would suggest that local governments support farmers in coping with flood-related crop damage is socially responsive community action. The flood protection factors that emerge from the results of this systematic review are nontechnical or non-infrastructure and technological factors. The reason is that these flood protection factors in paddy fields will be used as policy recommendations for small-scale farmers who live in rural areas with limited access to modern agricultural infrastructure and sophisticated agricultural technology. The factors found in this systematic review will assist policy-making at the level of farmer groups, village governments, regional governments, and national agencies involved in socially responsive community action that may be carried out by small-scale rice farmers with limited agricultural infrastructure and technology in flood-prone locations. The farmers' local knowledge and attitudes considerably impact changes in the rice field, especially in the rainy season [55].

5. Conclusions

In conclusion, the systematic review identified the different policies in Asia to overcome floods in the rice fields. There are three policy elements: the responsibility for flood protection; skill, flood experience and knowledge; and dynamic regulation and management decision-making. The policies are divided into themes and subthemes in this systematic review.

According to the results of the systematic analysis, the three key variables in flood management policies

in paddy fields are the responsibility for flood protection, skill, flood experience and knowledge, and dynamic regulation and management decision-making. Each of these themes is further subdivided into three subthemes, for a total of nine subthemes that outline the factors to overcome floods that can be implemented to assist rice farmers in rural regions, particularly in Asia. The responsibility for the flood protection theme is divided into three subthemes: flood mitigation, flood management policies, and financial coping. The skill, flood knowledge, and experience theme consists of three subthemes: ecosystem-based adaptation, livelihood strategy, and preventive measures. The dynamic regulation and management decision-making theme is divided into three subthemes, which were obtained from this review article: farm management, access to information, and social response. The themes and subthemes become policy recommendations in Asian countries for a group of small-scale farmers, local authorities, local governments, and regional governments to face floods in rice fields with synergy between stakeholders and private actors. There are differences in policies in Asian countries regarding flood management, which shows that the focus of flood management carried out by each country is a local problem priority in each country. Generally, in Southeast Asia and Asia, the policies implemented in handling floods are environmental, forest, land use, infrastructure and technology to deal with flood problems. Policy recommendations would suggest that local governments support farmers in coping with flood-related crop damage is socially responsive community action.

Author Contributions

Conceptualisation, M.I.N.D., and N.E.P.; methodology, M.I.N.D., and N.E.P.; software, N.E.P.; validation, M.I.N.D., and K.E.L.; formal analysis, N.E.P.; investigation, M.I.N.D. and K.E.L.; resources, N.E.P.; data curation, M.I.N.D. and N.E.P.; writing- original draft preparation, N.E.P., and M.I.N.D.; writing - review and editing, M.I.N.D. and N.E.P.; visualization, N.E.P.; supervision, M.I.N.D., and K.E.L.; project administration, M.I.N.D.; funding acquisition, M.I.N.D. All authors have read and agreed to the published version of the manuscript.

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Data supporting reported results can be found in the links to publicly archived datasets analyzed. DOI: https://doi.org/10.3390/w10111577, DOI: https://doi.org/10.3390/w14101603, DOI: https://doi.org/10.3390/su141811665, DOI: https://doi.org/10.1007/s13280-021-01654-3, DOI: https://doi.org/10.1016/j.pdisas.2020.100079, DOI: https://doi.org/10.1016/j.crm.2022.100449, DOI: https://doi.org/10.1111/jfr3.12648, DOI: https://doi.org/10.1016/j.crm.2020.100215, DOI: https://doi.org/10.1016/j.ejrh.2021.100872, DOI: https://doi.org/10.1007/s11069-021-04797-4, DOI: https://doi.org/10.3390/su14063639, DOI: https://doi.org/10.1016/j.ijdrr.2024.105012, DOI: https://doi.org/10.21203/rs.3.rs-1521035/v, DOI: https://doi.org/10.1016/j.geoforum.2020.08.012.

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Conflicts of Interest

The authors declare no conflict of interest.

References

[1] Phouratsamay, S.L., Scaparra, M.P., Tran, T.H., et al., 2024. Strategic flood impact mitigation in developing countries' urban road networks: Application to Hanoi. European Journal of Operational Research. 319(3), 862–876. DOI: https://doi.org/10.1016/j.ejor.2024.06.035

[2] Fabian, P.S., Kwon, H.H., Vithanage, M., et al., 2023. Modelling, challenges, and strategies for understanding impacts of climate extremes (droughts and floods) on water quality in Asia: A review. Environmental Research. 225, 115617. DOI: https://doi.org/10.1016/j.envres.2023.115617

[3] Setiadi, S., Sumaryana, A., Bekti, H., et al., 2023. The flood management policy in Bandung city: Challenges and potential strategies. Cogent Social Sciences. 9(2), 2282434. DOI: https://doi.org/10.1080/23311886.2023.2282434

[4] Danumah, J.H., Odai, S.N., Saley, B.M., et al., 2016. Flood risk assessment and mapping in Abidjan district using multi-criteria analysis (AHP) model and geoinformation techniques (Côte d'Ivoire). Geoenvironmental Disasters. 3(1), 1–13. DOI: https://doi.org/10.1186/s40677-016-0044-y

[5] Michael, P.S., Mwakyusa, L., Sanga, H.G., et al., 2023. Floods stress in lowland rice production: experiences of rice farmers in Kilombero and Lower-Rufiji floodplains, Tanzania. Frontiers in Sustainable Food Systems. 7. DOI: https://doi.org/10.3389/fsufs.2023.1206754

[6] Turkington, T., Breinl, K., Ettema, J., et al., 2016. A new flood type classification method for use in climate change impact studies. Weather and Climate Extremes. 14, 1–16. DOI: https://doi.org/10.1016/j.wace.2016.10.001

[7] Cologna, V., Bark, R.H., Paavola, J., 2017. Flood risk perceptions and the UK media: Moving beyond 'once in a lifetime' to 'Be Prepared' reporting. Climate Risk Management. 17, 1–10. DOI: https://doi.org/10.1016/j.crm.2017.04.005

[8] Knighton, J., Hondula, K., Sharkus, C., et al., 2021. Flood behaviours of United States riverine metropolitan areas are driven by local hydrology and shaped by race. Proceedings of the National Academy of Sciences. 118(13), e2016839118.

[9] Gbaa, S., 2022. Analysis of flood disaster adaptation strategies among people of Guma Local Government Area, Benue State, Nigeria. Indonesian Journal of Earth Sciences. 2(2), 226–235. DOI: https://doi.org/10.52562/injoes.v2i2.415

[10] Raghu, P.T., Veettil, P.C., Das, S., 2022. Smallholder adaptation to flood risks: Adoption and impact of Swarna-Sub1 in Eastern India. Environmental Challenges. 7, 100480. DOI: https://doi.org/10.1016/j.envc.2022.100480

[11] Conde, S., Catarino, S., Ferreira, S., et al., 2025. Rice Pests and Diseases Around the World: Literature-Based Assessment with Emphasis on Africa and Asia. Agriculture. 15(7), 667. DOI: https://doi.org/10.3390/agriculture15070667

[12] Singh, R.K., Singh, A., Kumar, S., et al., 2020. Perceived climate variability and compounding stressors: Implications for risks to livelihoods of smallholder Indian farmers. Environmental Management. 66, 826–844. DOI: https://doi.org/10.1007/s00267-020-01345-x

[13] Shamsudduha, M., 2025. Redefining flood hazard and addressing emerging risks in an era of extremes. npj Natural Hazards. 2(1), 29. DOI: https://doi.org/10.1038/s44304-025-00082-7

[14] Shreevastav, B.B., Tiwari, K.R., Mandal, R.A., et al., 2021. Assessing flood vulnerability on the livelihood of the local community: A case study from the southern Bagmati corridor of Nepal. Progress in Disaster Science. 12, 100199. DOI: https://doi.org/10.1016/j.pdisas.2021.100199

[15] Alhassan, H., 2020. Farm households' flood adaptation practices, resilience and food security in the Upper East region, Ghana. Heliyon. 6(6), e04167. DOI: https://doi.org/10.1016/j.heliyon.2020.e04167

[16] Baishakhy, S.D., Islam, M.A., Kamruzzaman, M., 2023. Overcoming barriers to adapting rice farming to recurring flash floods in the haor wetlands of Bangladesh. Heliyon. 9(3), e14011. DOI: https://doi.org/10.1016/j.heliyon.2023.e14011

[17] Wang, L., Liu, Y., Zhang, Y., et al., 2023. Riverine flood risk assessment with a combined model chain in southeastern China. Ecological Indicators. 154, 110686. DOI: https://doi.org/10.1016/j.ecolind.2023.110686

[18] Kamruzzaman, M., Rahman, A.T.M.S., Basak, A., et al., 2023. Assessment and adaptation strategies of climate change through the prism of farmers' perception: A case study. International Journal of Environmental Science and Technology. 20(5), 5609–5628. DOI: https://doi.org/10.1007/s13762-022-04254-0

[19] Mandal, K.G., Banerjee, K., Purbey, S.K., 2024. Potential Measures to Enhance Ecosystem Services of Flood-Prone and Wetland Agricultural Systems. Available from: https://www.researchgate.net/publication/386094542_Potential_Measures_to_Enhance_Ecosystem_Services_of_Flood-Prone_and

_Wetland_Agricultural_Systems (cited 21 February 2025).

[20] Osei-Kyei, R., Jin, X., Nnaji, C., et al., 2023. Review of risk management studies in public-private partnerships: A scientometric analysis. International Journal of Construction Management. 23(14), 2419–2430. DOI: https://doi.org/10.1080/15623599.2022.2063013

[21] Nor Diana, M.I., Muhamad, N., Taha, M.R., et al., 2021. Social vulnerability assessment for landslide hazards in Malaysia: A systematic review study. Land. 10(3), 315. DOI: https://doi.org/10.3390/land10030315

[22] Mathew, J.L., 2022. Systematic Reviews and Meta-Analysis: A Guide for Beginners. Indian Pediatr. 59(4), 320–330. DOI: https://doi.org/10.1007/s13312-022-2500-y

[23] Ador, S.F., Idris, N.D.M., Siwar, C., et al., 2022. Bibliometric analysis of peer-reviewed literature on livelihood assets and the relationships towards sustainable livelihoods. Journal of Pharmaceutical Negative Results. 13, 5858–5876. DOI: https://doi.org/10.47750/pnr.2022.13.S09.705

[24] Pollock, A., Berge, E., 2018. How to do a systematic review. Clinical Rehabilitation. 13(2), 138–156. DOI: https://doi.org/10.1177/1747493017743796

[25] Paul, J., Khatri, P., Duggal, H.K., 2023. Frameworks for developing impactful systematic literature reviews and theory building: What, why and how? Journal of Decision Systems. 33(4), 537–550. DOI: https://doi.org/10.1080/12460125.2023.2197700

[26] Shaffril, H.A.M., Ahmad, N., Samsuddin, S.F., et al., 2020. Systematic literature review on adaptation towards climate change impacts among indigenous people in the Asia Pacific regions. Journal of Cleaner Production. 258, 120595.

[27] Shaffril, H.A.M., Krauss, S.E., Hamzah, A., et al., 2021. Behavioural correlates of GPS device usage among small-scale fishers in Malaysia. SAGE Open. 11(1), 21582440211000051. DOI: https://doi.org/10.1177/21582440211000051

[28] Shaffril, H.A.M., Samah, A.A., Kamarudin, S., 2021. Speaking of the devil: A systematic literature review on community preparedness for earthquakes. Natural Hazards. 108(3), 2393–2419. DOI: https://doi.org/10.1007/s11069-021-04797-4

[29] Braun, V., Clarke, V., 2019. Reflecting on reflexive thematic analysis. Qualitative Research in Sport, Exercise and Health. 11(4), 589–597.

[30] Wang, Z., Wang, H., Huang, J., et al., 2018. Analysis of the public flood risk perception in a flood-prone city: The case of Jingdezhen city in China. Water. 10(11), 1577. DOI: https://doi.org/10.3390/w10111577

[31] Munpa, P., Phumee, P., Thanapakpawin, P., et al., 2022. Climatic and hydrological factors affecting the assessment of flood hazards and resilience using modified UNDRR indicators: Ayutthaya, Thailand. Water. 14(10), 1603. DOI: https://doi.org/10.3390/w14101603

[32] Liu, Y.S., Yigitcanlar, T., Guaralda, M., et al., 2022. Leveraging the opportunities of wind for cities through urban planning and design: A PRISMA review. Sustainability. 14(18), 11665. DOI: https://doi.org/10.3390/su141811665

[33] Hapsari, R.I., Zenurianto, M., 2016. View of flood disaster management in Indonesia and the key solutions. American Journal of Engineering Research (AJER). (5), 140–151.

[34] Luo, P., Yang, P., Jin, S., et al., 2022. Exploring sustainable solutions for the water environment in Chinese and Southeast Asian cities. Ambio. 51, 1199–1218. DOI: https://doi.org/10.1007/s13280-021-01654-3

[35] Hossain, B., Sohel, M.S., Ryakitimbo, C.M., 2020. Climate change induced extreme flood disaster in Bangladesh: Implications on people's livelihoods in the Char Village and their coping mechanisms. Progress in Disaster Science. 6, 100079. DOI: https://doi.org/10.1016/j.pdisas.2020.100079

[36] Hagedoorn, L.A.G., 2021. Climate resilient water system in Haarlo-Olden Eibergen: A design study [Master's Thesis]. University of Twente: Enschede, Netherlands.

[37] Pham, N.T.T., Nong, D., Sathyan, A.R., et al., 2020. Vulnerability assessment of households to flash floods and landslides in the poor upland regions of Vietnam. Climate Risk Management. 28, 100215. DOI: https://doi.org/10.1016/j.crm.2020.100215

[38] Shrestha, B.B., Kawasaki, A., Zin, W.W., 2021. Development of flood-damage functional crops and their applicability in regions of Asia. Journal of Hydrology: Regional Studies. 36, 100872. DOI: https://doi.org/10.1016/j.ejrh.2021.100872

[39] Shaffril, H.A.M., Krauss, S.E., Samsuddin, S.F., 2018. A systematic review of Asian farmers' adaptation practices towards climate change. Science of the Total Environment. 644, 683–695.

[40] Nor Diana, M.I., Zulkepli, N.A., Siwar, C., et al., 2022. Farmers' adaptation strategies to climate change in Southeast Asia: A systematic literature review. Sustainability. 14(06), 3639. DOI: https://doi.org/10.3390/su14063639

[41] Zhu, W., Zhang, Y., Wu, Q., et al., 2022. A quantitative analysis of research trends in flood hazard assessment. Research Square. 37(1), 413–428. DOI: https://doi.org/10.21203/rs.3.rs-1521035/v1

[42] Poontirakul, P., Tsusaka, T.W., Pal, I., et al., 2022.

Does insurance work? Dynamic assessment of insurance, poverty, and climatic hazard outcomes in Thailand. Climate Risk Management. 37, 100449. DOI: https://doi.org/10.1016/j.crm.2022.100449

[43] Gordon, J.N., Yiannakoulias, N., 2020. A serious gaming approach to understanding household flood risk mitigation decisions. Journal of Flood Risk Management. 13(4), e12648. DOI: https://doi.org/10.1111/jfr3.12648

[44] Hahirwabasenga, J., Nilsson, E., Larson, M., et al., 2024. Flooding in Sebeya catchment, Rwanda – A review of causes, impacts, and management. International Journal of Disaster Risk Reduction. 114, 105012. DOI: https://doi.org/10.1016/j.ijdrr.2024.105012

[45] Bott, L.M., Pritchard, B., Braun, B., 2020. Translocal social capital as a resource for community-based responses to coastal flooding – Evidence from urban and rural areas on Java, Indonesia. Geoforum. 117, 1–12. DOI: https://doi.org/10.1016/j.geoforum.2020.08.012

[46] Griffin, C., Wreford, A., Cradock-Henry, N.A., 2023. 'As a farmer, you've just got to learn to cope': Understanding dairy farmers' perceptions of climate change and adaptation decisions in South South Island of Aotearoa-New Zealand. Journal of Rural Studies. 98, 147–158. DOI: https://doi.org/10.1016/j.jrurstud.2023.02.001

[47] Antwi-Agyei, P., Dougill, A.J., Stringer, L.C., et al., 2018. Adaptation opportunities and maladaptive outcomes in climate vulnerability hotspots of northern Ghana. Climate Risk Management. 19, 83–93. DOI: https://doi.org/10.1016/j.crm.2017.11.003

[48] Akdah, R.D., Wijayanto, N., Hartoyo, A.P.P., 2024. Species composition, stand structure, and carbon stock in the agroforestry system of Wana Lestari Community Forestry, West Nusa Tenggara, Indonesia. Biodiversitas. 25(9), 3350–3358. DOI: https://doi.org/10.13057/biodiv/d250957

[49] Yen, B.T., Son, N.H., Tung, L.T., et al., 2019. Development of a participatory approach for mapping climate risks and adaptive interventions (CS-MAP) in Vietnam's Mekong River Delta. Climate Risk Management. 24, 59–70. DOI: https://doi.org/10.1016/j.crm.2019.04.004

[50] Natsir, M., Ulya, Z., Fitriani, R., 2022. Mangrove utilisation policies reconceptualising to improve the regional economy in Aceh Tamiang District, Indonesia. Biodiversitas. 23(12), 6570–6578. DOI: https://doi.org/10.13057/biodiv/d231256

[51] Yassi, A., Demmallino, E.B., Sultani, H.R., 2023. Tropical climate change and its impact on horticultural plants in Enrekang District, South Sulawesi, Indonesia. Biodiversitas. 24(6), 3073–3079. DOI: https://doi.org/10.13057/biodiv/d240601

[52] Herawati, T., Rohadi, D., Rahmat, M., et al., 2019. An exploration of gender equality in the household: A case from a peatland-based community in Riau, Indonesia. Biodiversitas. 20(3), 853–861. DOI: https://doi.org/10.13057/biodiv/d200332

[53] Busthanul, N., Ilham, R., Darwis, M., et al., 2023. Ecological adaptation of smallholders to tropical climate change in the highland zone of South Sulawesi, Indonesia. Biodiversitas. 24(10), 5328–5335. DOI: https://doi.org/10.13057/biodiv/d241014

[54] Khairunnisa, H., Ramadhan, S., Ahmad, M.N., et al., 2023. Prediction of potential climate change impacts on the geographic distribution shift of Casuarina junghuhniana and C. equisetifolia in Southeast Asia. Biodiversitas. 24(11), 6360–6371. DOI: https://doi.org/10.13057/biodiv/d241161

[55] Sudarmanto, B., Suranto, S., Suntoro, S., et al., 2023. Measuring climate action readiness in maintaining ecological resilience using satellite imagery and field research in the Garang Watershed, Central Java, Indonesia. Biodiversitas. 24(5), 2958–2974. DOI: https://doi.org/10.13057/biodiv/d240551