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Review

Farmers' Adaptation Strategies to Climate Change in Southeast Asia: A Systematic Literature Review

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Abstract: This systematic review focuses on the relationship between the factors of adaptation strategies and the impact of climate change among farmers in Southeast Asia. Climate change, a phenomenon that occurs over many years, has affected the lives of farmers in the agricultural sector. Therefore, it is essential to analyse the factors that affect farmers' decisions to determine their ability to adapt to climate change and maintain their livelihoods. As such, the present study examines farmers' understanding of climate change and its impact on adaptation strategies in Southeast Asia. Approximately 15 related studies were found based on a systematic review of the repositories from Scopus and the Web of Sciences using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Hence, the paper delineates five key themes: (1) sociodemographic factors, (2) physical capital, (3) assistance, (4) information, and (5) social networking. Therefore, the results underlining the determinant factors, such as income, household members, farm size, land, number of workers, access to information, education, experiences, training, support from agencies, and social networks, influence the adaptation strategies among Southeast Asian farmers. This systematic review study emphasises information accessibility, education, training, and income as the most important factors for developing adaptation strategies for farmers to deal with climate change, rather than programme, internet usage, relatives, and the number of workers. Finally, combining the main factors can promote technological advancement for farmers who rely on agriculture as their main source of income and help farmers deal with climate variability to sustain their livelihood.

Keywords: adaptation strategies; farmers; Southeast Asia; climate change; agriculture; systematic review

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1. Introduction

Agriculture contributes not only to the global economy, but also plays a pivotal role in society and for individuals around the world whose lives depend solely on agriculture. Agriculture helps reduce starvation, raise income, and improve food security for 80% of impoverished smallholders [1] who live in rural areas and mainly work in agriculture. The World Bank Group is a leading agriculture financing organisation that assists agricultural development in impoverished areas. Together with the International Bank for Reconstruction and Development (IBRD/IDA), investments into agricultural financing amounted to USD 6.8 billion in 2018 [2]. Based on statistics in 2014, it is essential for the global economy that one-third of its gross domestic product (GDP) comes from agriculture, as agriculture not only generates national income, but also contributes to the food supply to the world population, reduces regional inequality, provides job opportunities, increases foreign exchange, fosters imports and exports, and improves rural welfare [3]. It also contributes to green growth, which bolsters economic growth and sustainability; thus, preventing the destruction of the ecosystem, loss of biodiversity, and waste of natural resources. The goal is to increase the chances of utilising cleaner sources of growth to transition to a growth model that is more environmentally friendly [4].

Therefore, agriculture is vital for the economy of developing countries in Southeast Asia. Moreover, agriculture in this area of the world consumes a lot of labour. Data from the World Bank suggest that there is potential to support employment in these countries [5]. Nevertheless, trends remained unchanged between early 2000 and 2014–2016. Figure 1 shows the pattern of employees engaged in agriculture at the beginning and the middle of the year between 2000 and 2002 in Southeast Asian countries. Cambodia (67.2%), Vietnam (62%), Myanmar (60.2%) and Timor-Leste exceeded the percentage of total employment in agriculture, while Indonesia, Thailand, and the Philippines recorded 44.3%, 43.8% and 37% of total employment in agriculture, respectively; Malaysia (14.9%), Brunei (1.1%), and Singapore (0.8%) recorded the lowest engagement in agriculture [5]. However, between 2014 and 2016, the total agricultural employment in many Southeast Asian countries dropped significantly, especially in Timor-Leste and Vietnam, which decreased by approximately 10.9 percent and 20.1 percent, respectively, while Myanmar still maintained the total agricultural employment of more than 50 percent on average [5]. However, Cambodia recorded a sharp decrease from 37.5 to 29.7 percent; Indonesia and Thailand dropped by approximately 12.5% [5]. Malaysia recorded a 3.5 percent drop, whereas Brunei and Singapore remained static [5].

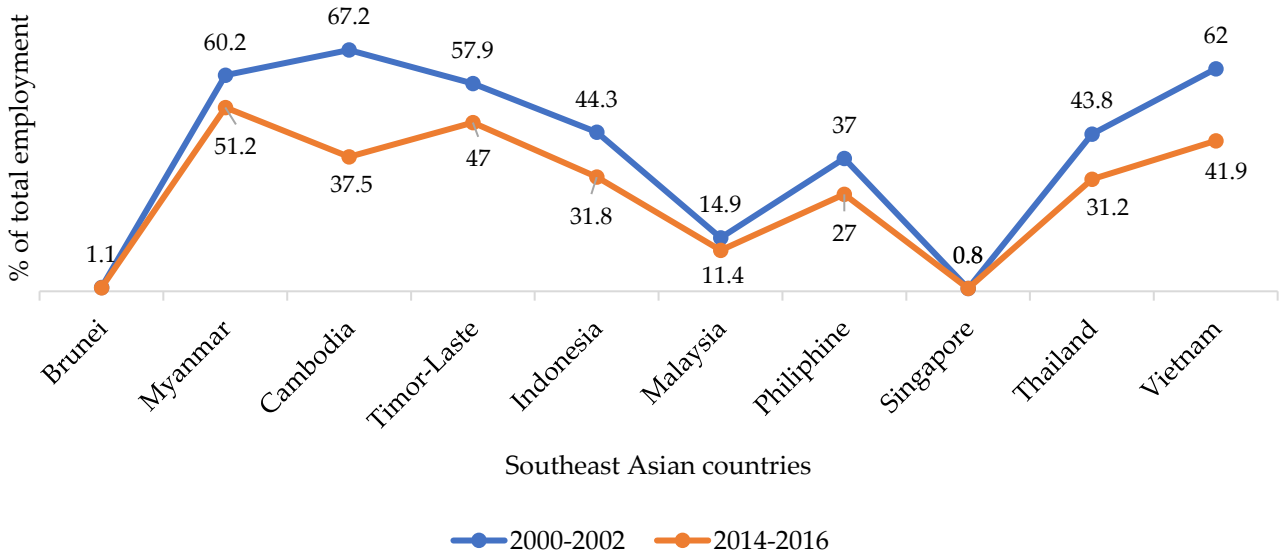

Figure 1. The agricultural employment of Southeast Asian countries for 2000–2002 and 2014–2016 (% total employment). Source: The World Bank [5].

While agriculture contributes to individuals, the society, and economy, farmers face the challenge of climate change. Climate change can manifest as drought, extreme heat, wildfire, water shortages, rising sea levels, and other abnormal conditions. Moreover, climate change has also impacted their production, incomes, and livelihoods. Climate change has dramatically affected the lives of farmers not only in agriculture, but also in everyday life. In fact, drought and extreme heat have caused losses to agricultural production in many parts of the world, especially from 1964 to 2007 [6]. Thus, climate change is a serious problem that affects the agricultural sector, which is responsible for producing food for the world population [7].

Therefore, many efforts have been initiated to mitigate climate change and help farmers adapt to changing climactic conditions. Using technology is one common strategy to adapt to climate situations. A study by Lobell et al. [8] used nine years of satellite images of wheat growth in northern India to monitor the rate of senescence, as a limited understanding of climate change and the lack of observations on crops reduced the crop yield. The study concluded that extreme heat and an increase in temperature accelerated the effects or process of senescence [8]. Another study [6] showed that droughts had

significantly reduced crop yields, where the cereal yield has been especially affected by extreme heat.

The current climate scenarios are worsening day-by-day, and these changes undoubtedly affect the daily lives of farmers. Climate change has also changed farmers' livelihoods, affected crop production, and farming income. Moreover, climate change is also associated with drought, changes in temperature, variation in rainfall, and other climate scenarios. The frequency, severity, and intensity of climate change have undoubtedly impacted the lives of farmers in many ways. Therefore, it is essential to determine farmers' adaptation strategies to climate change as well as their ability to adapt to climate change and maintain their livelihood.

The Blow of Climate Change on Agriculture

Southeast Asia is one of the regions most vulnerable to climate change due to its long coastlines, seasonal monsoon patterns, high proportion of population and economic activities occurring in coastal areas, and a heavy reliance on agriculture, fisheries, forestry, and other natural resources [9]. Climate conditions are significant determinants of trends in crop growth. In Malaysia, climate change has had adverse and constant effects on agriculture. For example, the recent El Niño phenomenon reduced the production of palm oil. Furthermore, the World Bank predicted that climate change reduces the productivity of rice [2]. Therefore, rice productivity is expected to fall between 4 percent and 10 percent based on the geographical area and the rise in temperatures. In Malaysia, climate change has caused a decline in the production of rice and other crops. For example, Siwar et al. stated that the rice industry suffered a 13–80% reduction in rice production and a 10–30% reduction in other crops as a result of the impacts of climate inconsistency [10].

Alam et al. argued that to preserve crop production and sustain food supply, farmers must adapt and find ways to mitigate the inevitable and permanent harm caused by climate change [11]. These steps toward adaptation must take place immediately and align with the current variations in climate [12]. In addition, effective methods to adapt to changes in different and vulnerable climates are necessary to avoid the adverse effects of climate change to farmers' sustainable livelihoods and national food security [13]. It is daunting to compute the impacts of climate change on agriculture due to significant uncertainties in regional climate change forecasts, crop response to environmental changes, the relationship between climate models and the functions of crop production, and the capacity of the agricultural system to adapt to rapid climate change [14].

Notably, oil palm production decreases from 2 percent to 5 percent for each 10 °C increase in temperature. In addition, changes in rainfall patterns and intensity also impact agriculture. Furthermore, the grains become eroded in the production of agriculture, curtailing the maximum realised potential. Therefore, the agricultural industry plays a significant role in a country's economy as a result of its contribution to national income and export turnover. This, eventually, generates job opportunities. Over the years, scholars have depicted the worsening state of climate change in the world. Every country and region, including Southeast Asia, have been severely impacted by the impacts of climate change. Three out of four poor people in Southeast Asia live in rural areas and are heavily dependent on the agricultural sector [15].

Therefore, climate change affects not only humans, but also every living and nonliving thing on Earth. It is human nature to adapt to changes that affect our daily life. For example, Lasco et al. [16] found that sea levels rose over the 19th century to the 21st century. The short- and long-term impacts of rising sea levels are not yet fully understood. In addition, previous research suggested that tropical countries, especially those in Southeast Asia, were more affected by climate change than other countries. However, global and domestic threats such as natural disasters and factors related to climate change are unavoidable [17]. Evidence around the globe proves that climate change is constantly happening, even right now.

As a result of climate change, water and air temperatures are increasing, snow cover is decreasing, the ice in Antarctica is melting, and sea levels are rising. Climate change has not only transformed individual lives, but also farmers' lives, crop production, and farming income. Climate change has also caused droughts, changes in temperature, and variations in rainfall, among many other long-term weather events. Therefore, farmers must have adaptation strategies to ensure the survival of the farming sector. In general, Southeast Asian farmers lack the skills and technology required to adapt to the increasing rate of climate instability and uncertainty. Hence, it is undeniably necessary to mitigate the possible impacts of climate change and develop an adaptive capacity to reduce its effects on natural resources, ecosystems, and livelihoods to ensure food security and sustainability in Southeast Asia.

2. Materials and Methods

This section discusses the method employed to retrieve articles related to farmers' adaptation strategies to climate change in Malaysia. The study utilised a systematic review method called the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which contains materials from reliable sources. PRISMA entails four processes: (1) identification, (2) screening, (3) inclusion and (4) qualification.

2.1. PRISMA

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guided the systematic review in the present study. PRISMA is often used in the healthcare and environmental sectors to conduct systematic reviews and meta-analyses. PRISMA was used in this study as a guide to the four steps of systematic reviews to determine the factors that influence farmer adaptation strategies. In addition, PRISMA allows for a thorough search of terms related to farmers in Southeast Asia and the factors that influence farmer adaptation strategies.

2.2. Resources

The systematic literature review primarily utilised two journal databases: (1) Scopus, and (2) the Web of Sciences (WoS). Scopus is a bibliographic database for journal articles that provides abstracts and citations. This database encompasses over 5000 publishers worldwide and covers journals in the scientific, technical, medical, and social sciences, with more than 22,000 titles. The Web of Sciences database produces Clarivate Analytics, which includes articles from 256 disciplines, including natural sciences, social sciences, arts, and humanities. The WoS offers multiple materials, such as full-text articles, reviews, editorials, abstracts, proceedings, and chapters of books, and consists of more than 33,000 journals from 1900 to 2020.

2.3. Systematic Review Process

2.3.1. Identification

The systematic review process had three stages to extract relevant articles for the qualitative approach: (1) identification, (2) screening, and (3) eligibility (refer Figure 2). First, in the process of identification, related and similar keywords were identified via dictionaries, thesauri, encyclopaedias, and past research. The keywords were crucial to determine the search strings for the Scopus and Web of Sciences databases (Table 1) and to find related searches. In total, 1554 items were identified via the search string, of which 105 articles were retrieved from Scopus and 1449 were retrieved from the Web of Science.

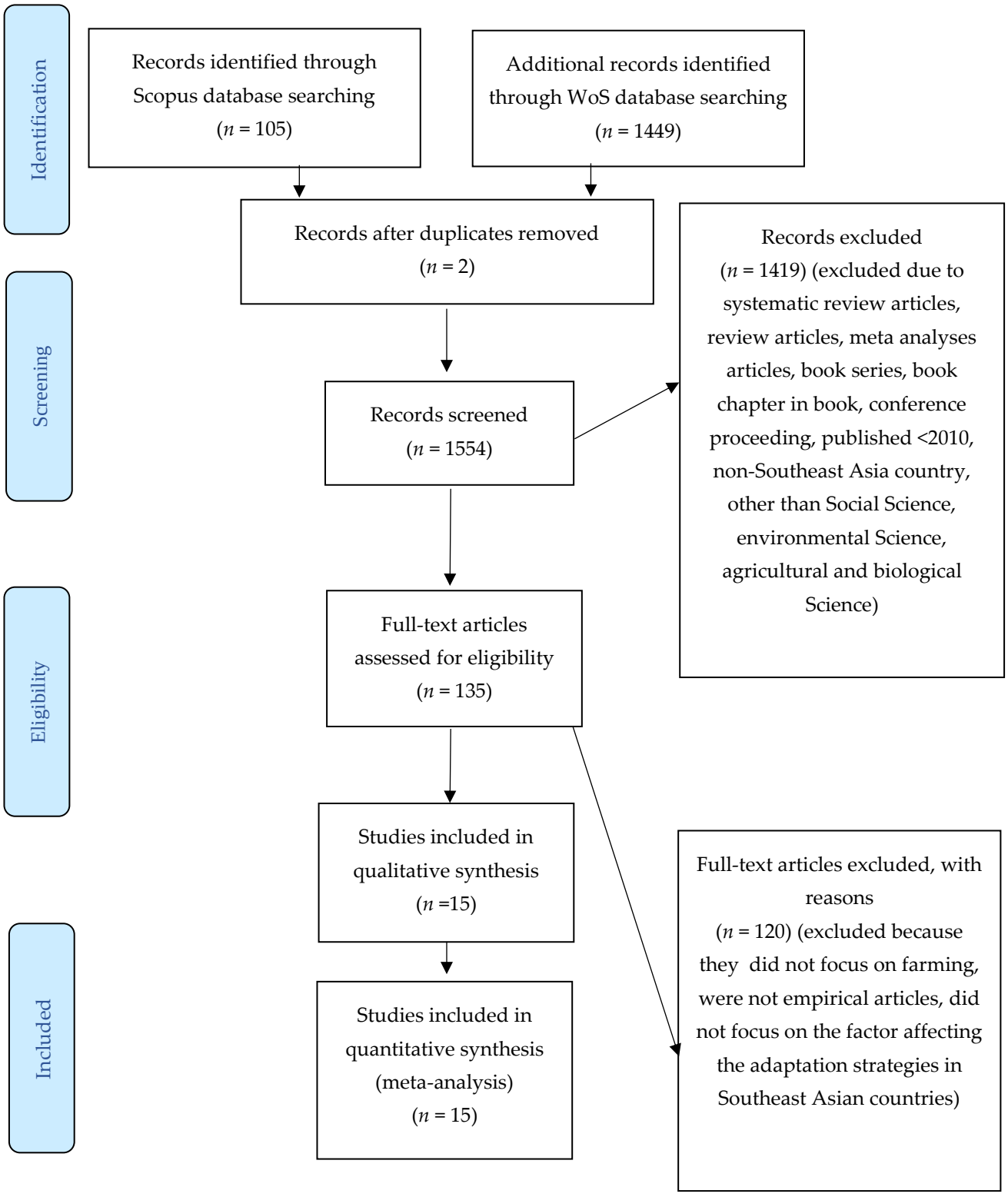

Figure 2. Analysis flow diagram (adapted from Moher et al., 2009) [18].

Table 1. Search string.

Databases	Keywords Used
Scopus	TITLE-ABS-KEY ((“Climate * change *” OR “Climate * risk * OR “ climate * AND variability * “OR “ climate * AND extreme * “ OR “ climate AND variability * OR “climate * uncertainty *”) AND (“Adapt * ability *” OR “adapt * strategy *” OR “adapt * capacity *” OR “adapt * capability *” OR “adapt * strength *” OR “adapt * potential *” OR “adopt * ability *” OR “adopt * capacity *” OR “adopt * capability *” OR “Adopt * potential *” OR adopt * AND strategy *)) AND (farmer * OR farm *)
Web of Sciences (WoS)	TS = ((“Climate * change *” OR “Climate * risk *” OR “climate * variability *” OR “climate * extreme *” OR “climate * variability *” OR “climate * uncertainty *”) AND (“adapt * ability *” OR “adapt * strategy *” OR “adapt * capacity *” OR “adapt * capability *” OR “adapt * strength *” OR “adapt * potential *” OR “adopt * ability *” OR “adopt * capacity *” OR “adopt * capability *” OR “Adopt * potential *” OR “adopt * strategy *”) AND (farmer * OR farm *))

*: This function allows database to search for keywords that contain a variety of spellings.

2.3.2. Screening

The second stage of the systematic review process was screening. This step removed duplicate articles and unrelated articles via inclusion and exclusion criteria. Two items were excluded in this step, whereas the 1554 articles were screened via the inclusion and exclusion criteria (Table 2). The inclusion and exclusion criteria included literature type, language, timeline, countries and territories, and subject area. First, the study decided on the type of research articles to focus on in the journal, and excluded articles such as reviews, books, book chapters, and conference proceedings. In addition, the study decided to only use Malay or English language articles pertaining to Southeast Asia. Additionally, the study eliminated elements that were published prior to 2010 or after 2020. Additionally, the researcher only focused on articles from the social, environmental, natural, and agricultural sciences. Therefore, a total of 1419 materials were excluded according to the inclusion and exclusion criteria.

Table 2. Inclusion and exclusion criteria.

Criterion	Eligibility	Exclusion
Literature type	Journal (Research articles)	Journals (review), books, chapter in a book, conference proceeding
Language	English, Malay	Non-English, non-Malay
Timeline	Between 2010 and 2020	<2010
Countries and territories	Southeast Asian countries	Non-Southeast Asian countries
Subject area	Social science, environmental science, agricultural	Other than social science, environmental science, agricultural

2.3.3. Eligibility

A total of 135 publications was used at this stage for the third level of eligibility. The title, abstract, and content of the materials were essential to examine in evaluating the inclusion criteria and the objective of the review. Due to specific rules, 120 articles were excluded from the analysis. The search string was used for systematic analysis.

2.4. Data Extraction and Analysis

Following article assessment and analysis, the data were extracted for the study. First, the data were obtained by reading the abstracts of the articles. Next, a comprehensive reading of the articles was performed to identify the themes and subthemes related to the

objective. Then, the main issues and subthemes were organised to establish a typology for the articles.

3. Results

The review resulted in five dominant themes and seventeen subthemes related to the factors that affected farmers' adaptation strategies to climate change. The five main items included sociodemographic factors, physical capital, assistance, access to information, and social networking. Meanwhile, the 17 sociodemographic subthemes included the household size and income. Farm size, number of workers, and farmable land comprised the physical capital. Both government and nongovernmental bodies comprised sources of assistance. On the other hand, programme, education, internet, experience, training, and other sources were labelled under access to information. Lastly, friends, neighbours, relatives, and farmers were listed under social.

Table 3 describes a theme of articles consisting of a total of eight studies focused on Vietnamese farmers [19–26], whereas three studies were from the Philippines [27–29]. Additionally, two studies were from Malaysia [30,31], one from Thailand [32], and one from Indonesia [33]. Figure 3 visualises the origins of the articles using a map of Southeast Asia.

Figure 3. Map of Southeast Asian countries.

Most of the works in the literature (eight studies) employed quantitative methods. In contrast. The second most commonly used method was the mixed method (qualitative and quantitative). Hence, six studies employed this method. The final survey utilised the qualitative method. The studies were published between 2011 and 2020. Two studies were from 2014, whereas there was one report from 2015 and 2016 each. Therefore, there were two articles from 2017, three from 2018, five from 2019, and one from 2020.

3.1. Factors Affecting Farmers' Adaptation Strategies towards Climate Change in Southeast Asian Countries

This section focused on the factors that affect farmers' adaptation strategies for climate change in Southeast Asia: sociodemographic factors, physical capital, assistance, information, and social factors. Figure 4 lists the relationships between the main themes and subthemes of the factors that affect farmers' adaptation strategies towards climate change in Southeast Asian countries, which are further discussed below.

Table 3. Theme of the articles.

Author/Countries	Study Design	Socio Demography		Physical Capital			Assistance		Information						Social Networking			
		SH	IN	FS	NW	FL	G	NG	P	E	I	EX	TR	OR	F	N	RE	OF
1. Dang et al. (2017) [19]—Vietnam	QN		*								*				*	*	*	
2. Phuong et al. (2018) [24]—Vietnam	MM								*									
3. Phuong et al. (2017)—Vietnam [23]	MM		*		*	*								*				
4. Dang et al. (2014)—[20] Vietnam	MM													*	*	*	*	
5. Phuong et al. (2019)—[23] Vietnam	QL						*	*							*	*		*
6. Colting-Pulumbarit et al. (2018) [27]—Philippines	MM									*			*					
7. Akhtar et al. (2019) [30]—Malaysia	QN					*					*			*	*			
8. Defiesta et al. (2014) [28]—Philippines	MM			*			*	*		*		*	*	*		*		*
9. Fachrista et al. [33] (2019)—Indonesia	QN	*											*	*				
10. Arunrat et al. (2017) [32]—Thailand	QN	*	*	*	*					*			*	*				
11. Ngo et al. (2019) [21]—Vietnam	QN		*							*		*						*
12. Hayrol Azril et al. (2020) [31]—Malaysia	QN	*	*	*		*				*		*						
13. Tran et al. (2019) [25]—Vietnam	MM									*								
14. Thoai et al. (2018) [26]—Vietnam	QN			*									*					
15. Gomez (2015) [29]—Philippines	QN	*					*	*				*		*				*

Study design: quantitative (QN); qualitative (QL) mix method (MM). Theme: sociodemographic (size of household (SH); income (IN)); physical capital (farm size (FS); number of workers (NW); farmable land (FL)); assistance (government (G); nongovernment (NG)); information (programme (P); education (E); internet (I); experience (EX); training (TR); other resource (OR)); social networking (friend (F); neighbour (N); relative (RE); other farmer (OF)). * Article that mention subthemes in their study.

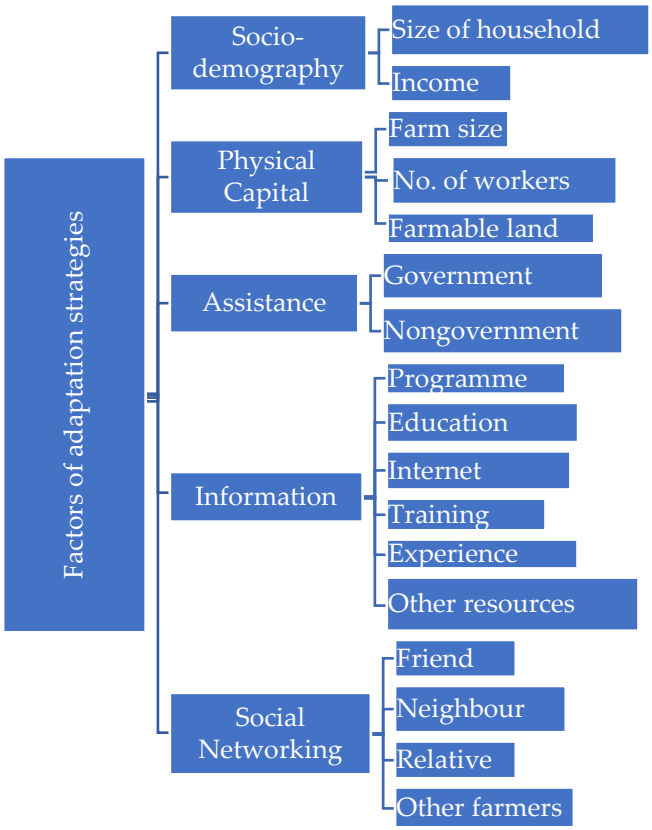

Figure 4. Relationship of domain themes and subthemes of the factor of adaptation strategies by farmers in Southeast Asia.

3.1.1. Sociodemographic Factors

Sociodemographic factors are the characteristics of a population that generally capture age, ethnicity, gender, level of education, level of income, or geographical location. Sociodemographic factors can provide an understanding of how farmers' adaptation strategies are influenced by the their sociodemographic characteristics. Approximately ten studies focused on sociodemographic data. Three articles specifically focused on the size of the household, whereas seven articles highlighted household income and finance.

The findings revealed that family size affected adaptation strategies toward climate change. According to Fachrista et al. [33], the household size could affect the livelihood of organic and conventional farmers. This was because a larger household would reduce the resilience of livelihood as it could create disadvantages for the household. Issues with basic amenities such as food, clothes, shelter, and diseases can arise in larger households. On the other hand, Arunrat et al. [32] stated that it is better to have a large household with excellent education rather than a small family with inadequate knowledge. This is because the probability of adaptation is higher in large families with a high level of education [34]. People with a higher level of education had a greater impact on farmers' decisions in comparison to those with a lower level of education. In addition, farmers with large households had a wider range of perspectives among their family members compared to small households. Gomez [29], on the other hand, posited that the household characteristics determine farmers' decision to change and adapt. These characteristics included the family's age, gender, marital status, literacy, farming experience, and household size.

Additionally, the income or financial status of the household affected farmers' adaptation strategies vis à vis climate change. Phuong et al. [23] delineated five variables that elucidated the diverse adaptation strategies of households: (1) the availability of farmable land in the summer, (2) the number of workers on the farm, (3) the amount of farm income, (4) the amount of existing information, and (5) access to the sources. In particular, farm

income affected the adaptation of a household because if farmers generated enough money from their farm, then they would be less likely to adapt to climate change. Farmers who were financially stable were more committed to adaptation than farmers who had less income. Furthermore, farmers need a huge amount of capital to restart, make changes, and continuously adapt. However, without sufficient funds, it would be impossible to bring about a transformation.

Next, Arunrat et al. [32] studied the relationship between farm income and climate change adaptation. Although the relationship was not statistically significant, their study rendered positive results. In addition, farmers who have higher incomes are more likely to adopt new strategies because they have enough income to deal with the risk of adaptation and usually have reserved money on their own. Additionally, Hayrol et al. [31] and Ngo et al. [21] examined the relationship between the amount of income and climate change adaptation. On the other hand, farmers from the Long An province used a different approach, whereby they only adopted climate change strategies if they perceived physical, financial, social, and psychological risks in life [19].

3.1.2. Physical Capital

Physical capital is a physical resource or asset to which farmers have individual or collective access. A total of eleven studies focused on physical resources, of which three studies focused on farm size, two studies focused on workers, and three studies focused on farmable land. Physical capital has been shown to affect farmers' adaptation strategies to climate change. According to Defiesta and Rapera [28], a farmer who has large farms would usually have greater adaptability to climate change. Additionally, Arunrat et al. [32] stated that farmers would likely adjust to climate change if the size of the farm and land owned increased because they could earn more income and practice a new way of farming or adapting to climate change. In addition, a farmer with a large farm usually has access to many resources that will help them adapt to climate change [35]. Furthermore, farmers who own idle and uncultivated lands could use assistance to reduce the threat of climate change. In addition, Yang et al. [36] stated that the storage capacity of restored ecosystems could be enhanced by adding biochar made from biomass generated by or from abandoned properties.

Efforts to manage plant diversity contribute to optimising carbon capture and the storage of abandoned farmland. These efforts include procedures such as regeneration, generating and applying biochar to soil, and developing renewable energies based on techno-ecological synergies. Meanwhile, small land holders find it more profitable to sell their land to developers in exchange for cash because they lack the capital for seeds, fertilisers, pesticides, and wages to hire workers to plant and harvest the crops.

Next, two studies focused on the number of workers. In addition to farm size, the number of workers played a vital role in influencing climate change adaptation strategies. Therefore, a higher number of workers implied a surplus of human resources that resulted in better education, more experience, knowledge, and skills [28]. A more knowledgeable, educated, and experienced worker will help a farmer develop better strategies for adaptation. Finally, three studies discussed the effects of farmable land on climate change adaptation strategies. Additionally, Phuong et al. [23] stated that farmable land is one of the five variables that explained the diversification of adaptation at the household level. Hence, the farmable land area is essential to prevent the disruption of climate change adaptation strategies.

3.1.3. Assistance

Assistance in this context is defined as external help, such as money, resources, or information, that assists farmers to adapt. Three studies focused on assistance from government and nongovernmental sources. In general, the farming community needs help from external sources. Nonetheless, farmers do not enjoy the luxury of knowledge, capital, education, or physical resources. Therefore, external help would support farmers in expanding

and adapting to climate change. Phuong et al. [24] posited that capital and financial support from government and nongovernmental agencies influenced farmers' transformative process of social learning. Defiesta and Rapera [28] recommended that farmers obtain financial assistance from the government. Furthermore, scholars have stated that farmers who manage to adapt to or recover from climate change risks need an economic boost. In a similar vein, Gomez [29] stated that formal and informal institutional support determined farmers' decisions regarding climate change adaptation strategies. This support can take the form of an official extension, farmer-to-farmer extension, access to credit, and social capital support.

3.1.4. Information

Information is a resource that farmers have accessed or a skill that is acquired through experience or education. Knowledge and information can help farmers adapt to climate change. Fifteen studies focused on access to information. One study examined the curriculum, whereas six were based on education. Two studies explored the internet, four studies examined experiences, five were on training, and seven pertained to other resources. Additionally, farmers who participated in farming and climate change programmes were able to understand and adapt to climate change. Education plays a pivotal role in the farming community. Therefore, workers or family members who have a higher level of education could influence farmers to change or adapt to climate change. Both formal and informal training are useful in the farming sector.

Colting-Pulumbarit [27] stated that farming households should adopt more flexible farming practices and ensure they have the high human capital necessary to gain the appropriate knowledge from formal or informal education and training. Defiesta and Rapera [28] argued that farmers need to undergo training to enhance their skills and techniques to increase their awareness of climate change. Furthermore, it would be more convenient for farmers to equip themselves with technology and modern techniques to increase farming activity. In addition, farmers should be highly educated and possess a large household to increase the probability of climate change adaptation strategies [37]. Moreover, Tran et al. [25] examined the relationship between learning and climate change, whereby farmers' education affected the adaptive capacity of farming.

Hence, farmers with higher education levels possessed a higher adaptive capacity. Next, four studies focused on the experience. Experience plays a vital role in the farming world. Farmers who have more experience can likely adapt to climate change in comparison to farmers who lack such skills. However, Hayrol et al. [31] found a negative correlation between adaptation and experience, i.e., farmers with more experience did not necessarily conform to new methods, as many live by their traditional methods and culture of farming. Training impacted both farmers and the broader farming community. Performing demonstrations helped farmers acquire the necessary knowledge and skills for climate change adaptation strategies. In addition, additional resources, such as the internet, television, and radio, helped farmers adapt their strategies.

3.1.5. Social Networking

A social network is a web of interactions and personal relationships that can influence farmers' adaptation strategies. Approximately 13 studies focused on social themes. Four studies focused on friends, four on neighbours, two on relatives, and three on other farmers. Social relationships or social groups between farmers disseminated valuable knowledge and information related to climate change and its impact. Dang et al. stated that farmers who applied adaptation were more likely pressured from the people around them, including friends, relatives, and neighbours [19]. Akhtar et al. [30] found that most farmers were aware of climate change as a result of information gathered from newspapers, the internet, television, advertisements, and their community and friends. Interaction and knowledge sharing, which affect farmers' decision making, could also be a stage in the climate change adaptation process.

4. Discussion

Climate change is a global phenomenon that affects all farmers. Therefore, the present study attempted to systematically examine the literature on the factors that affect farmers' adaptation strategies to climate change in Southeast Asia. The review revealed that 15 articles discussed the factors that affect climate change adaptation strategies. This review was based on five main themes: sociodemographic, physical resources, assistance, information, and social networks. From the results, there are a few key factors that influence farmers' adaptation strategies to climate change: household income, size of household, size of the farms, farmable land, the number of workers, access to information, experience, the level of education, access to training and programme, assistance from government or nongovernmental agencies, and social networks that include family, friends, neighbours, relatives, and other farmers. These key factors were determined to influence farmers' adaptation strategies in Southeast Asia, particularly in Malaysia, Indonesia, Thailand, Vietnam, and the Philippines.

Additionally, small-scale farmers suffered the most from the effects of intensified climate change. Consequently, it would be worthwhile to strengthen their adaptation practices to climate change. These methods of adaptation depicted the steps that were taken to help the environment and ecosystem confront the current or expected impacts of climate change [38]. It appears to be a mechanism in which society trains itself to better cope with risk. Therefore, small-scale farmers need to strengthen climate change adaptation practices to mitigate negative impacts, minimise risks and vulnerabilities, and take advantage of any opportunities that emerge from the occurrence of climate change.

Multiple factors affected farmers' climate change adaptation strategies in Southeast Asia. Climate change has worsened year after year, and farmers have no choice except to adapt to new approaches to farming. Therefore, adaptation strategies are imperative for the lives of smallholder farmers. Nonetheless, it would be challenging to approach and persuade farmers to adopt adaptation strategies if they do not possess background knowledge on climate change. These factors revealed why the agricultural sector must thrive with adaptation. Limitations to the adaptation of climate change still exist, such as inadequate funds, a lack of government support, high costs associated with adaptation, and insufficient information [30].

Restrictive culture and experience were identified as obstacles to adaptation in farming communities in Southeast Asia. Furthermore, the scale of production, ability to pay, and vulnerability or risk of product failure should be taken into consideration by small-scale farmers in the process of technology adoption [39]. Most people in Southeast Asia live based on a specific lifestyle, where the importance of culture is embodied in everyday life, which is why some conservative farmers prefer to follow farming traditions instead of attempting to innovate. However, updated knowledge and technology can help persuade farmers to adapt. Therefore, this study revealed that other sources, such as television and radio, are channels that quickly disseminate the latest information on climate change to farmers. In fact, the education level plays an important role as an indicator in measuring the success of the climate adaptation strategies. Nonetheless, farmers' adaptation training to climate change also plays an important role, as it can strengthen the concerted efforts and actions of individuals and government support. Efforts to adapt to climate change are also bolstered by income, as financially stable farmers tend to be more committed to adapting new techniques, technologies, and transformations in agriculture. Therefore, the multifunctionality of various agricultural systems should be defined based on this framework to encourage countries to design a transformational adaptation strategy for climate change. Governments are fully aware of the problem and have adopted essential measures. However, they need to put these measures to action because new evidence and technologies appear to support the adaptation of climate-smart agriculture and improve access to information that is amenable to farmers [40].

5. Recommendation

The findings of the systematic review process led to recommendations, which could be helpful in future studies, despite the fact that this study only focused on five countries in Southeast Asia (Malaysia, Vietnam, the Philippines, Thailand, and Indonesia). Hence, there is a need for similar studies in other regions in Asia, such as East Asia (e.g., China, South Korea and Japan), South Asia (e.g., India, Bangladesh, Afghanistan and Nepal), Central Asia (e.g., Kazakhstan, Uzbekistan, and Kazakhstan), and West Asia (e.g., Armenia, Bahrain, Cyprus and Iraq). Since Asia is a large continent with a multitude of different regions, it is imperative to study them, as each region in Asia has unique farming practices and agricultural values or skills that are tied to ethnic heritage and culture, as well as location and climatic conditions. Furthermore, climate change has affected not only Southeast Asia, but also other regions in the world. Therefore, it is wise to also study the factors that influence farmers' adaptation strategies in another region in Asia.

In addition, further research can be conducted regarding advanced technology use in agriculture. Advanced technology in agriculture has helped farmers tremendously produce better and higher crop production. Since no studies mention the use of technologies as one of the strategies used to adapt to climate change, further study can be conducted regarding advanced technology, especially in Southeast Asia. As the years pass, an increasing number of advanced techniques are used in agriculture to ensure better quality crops to the benefit of farmers around the world. The use of advanced technologies, such as digital soil mapping, mechanical tools, smart control, moisture sensors, and aerial images, is one of the agricultural developments that can be seen in today's agricultural scenario. The use of technology is not new to agriculture, but there was no mention of leveraging technology as an adaptation strategy for farmers in Southeast Asia. Therefore, it is imperative to study advanced technological use in agriculture, especially in Southeast Asia.

6. Conclusions

In conclusion, the systematic review highlighted five major themes that affected the adaptation strategies of climate change on farmers in Southeast Asia. These themes included sociodemographic factors, physical resources, assistance, information, and social networks. These themes were further extended to 17 subthemes as a result of the analysis. From the study, the factors that influence farmers' adaptation strategies in Southeast Asia were household income, size of the household, farm size, farmable land, number of workers, access to information, higher level education, experience, access to training and programmes, assistance from government and nongovernmental agencies, and social networks such as family, friends, neighbours, relatives, and other farmers. Nonetheless, the study found that informative and good channel networks, human capital such as higher education, training and skill, and income are the most important factors influencing farmers' adaptation strategies towards climate change, especially in Southeast Asia. Meanwhile, the factors of programme, internet usage, relative, and number of workers are less important for developing adaptation strategies for farmers dealing with climate change in Southeast Asia. Hence, this systematic review provides an understanding of how farmers respond to climate change impacts. Furthermore, the systematic review helped the present study understand the issue of climate change and the importance of adaptation among farmers, specifically in Southeast Asia.

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