



Vietnam, Thailand, and Indonesian Government Policies regarding Rice Cultivation in the Face of Climate Change

Muhammad Darda Mu'adz ^{*1}, Ali Muhyidin²

¹Universitas Indonesia

Article Info

Article History

Submitted 25 April 2024

Revised 08 May 2024

Accepted 12 June 2023

Keywords

climate
change; ecological
modernization;
Indonesia; rice;
Thailand; vietnam

Abstract

The discussion about climate change adaptation usually focuses on technology or policies. It also predominantly addresses the transportation and industrial sectors. When discussing the agricultural sector, the emphasis is often on livestock farming, which indeed generates significant greenhouse gas emissions. Apart from livestock, another significant emitter in agricultural activities is rice cultivation. In the case of Vietnam, rice cultivation produces a greater amount of greenhouse gases compared to the transportation sector. However, rice cultivation is highly vulnerable to climate change. While rice cultivation is prevalent in developing countries such as Vietnam, Thailand, and Indonesia, these countries may not necessarily have sufficient resources to cope with climate change. Therefore, this study will compare how these three countries respond to the issue of climate change based on case studies of policies related to rice cultivation. The research employs the theory of ecological modernization, which seeks solutions to climate change issues through environmentally friendly technological innovations and government policies. Policies that encourage public and private sector participation in climate change prevention are also considered. The study finds that each country has a different orientation, leading to the implementation of diverse policies and technologies according to the context and history of each nation. The mentioned history refers to the history of rice cultivation in a specific country. Meanwhile, the context of each country includes factors such as the challenges faced by a country, the orientation of farmers in rice cultivation, and the role of a country in the international market.

* E-mail: dardamuadz@yahoo.com;

2621-6272

Address: Jl. Prof. Dr. Set Soemardjan, Depok, Jawa Barat, Indonesia

P-ISSN : 2549-0737 E-ISSN :

INTRODUCTION

Climate change is a change in the average weather in a region and in a certain time period. Scientists predict that the average weather will change in the future, meaning that there will be areas that get dry weather more often, or there will be areas that get rainy weather more often. This has also been proven to happen in 2017, when atmospheric conditions became hotter and more humid and warming sea temperatures made hurricanes in America more violent. Meanwhile, dry weather has exacerbated cases of forest fires in California (Armstrong, et.al., 2018: 7-8).

Climate change threatens the agricultural sector. The seasons become chaotic, disrupting the agricultural sector and there is a threat of drought or flooding. The planting cycle is also disrupted by climate change so that the planting season becomes longer (Armstrong, et.al., 2018: 15). More frequent dry weather or more frequent rainy weather can disrupt the agricultural sector (Laforge, et.al, 2021: 18-22). However, the agricultural sector can also be said to be one of the drivers of climate change. Globally, the agricultural sector is responsible for 10% to 12% of greenhouse gas emissions. Activities carried out by humans can also encourage climate change, such as land clearing, forest burning, and changes in vegetation. Groundwater supplies and water flows from rivers for agricultural needs can decrease and affect the agricultural sector. Warming weather can also inhibit plant growth because it causes plants to become heat stressed. Hot and dry weather can make the soil threatened by corrosion which will then affect the quality of air and water around the dry land.

Apart from there being places that get hot weather more often, there are also places that get rainy weather more often. However, more frequent rainy weather cannot be considered a positive phenomenon because apart from causing flooding which also threatens cultivated plants, more frequent rain can cause the soil to be threatened by erosion. Important nutrients can be carried away by rainwater and floods from the soil, reducing soil fertility. Meanwhile, rainwater and floods can also increase soil salt levels which can reduce soil fertility (Laforge, et.al, 2021:18-19). The population of pollinators that can help cultivated plants is also decreasing, while the population of pest creatures such as grasshoppers and wild grass is increasing due to changes in the ecosystem caused by climate change (Laforge, et.al., 2021:20-22). Farmers in the face of reduced crop yields due to climate change are then using short-term methods to increase their crop yields. This has become a kind of vicious circle in discussions about climate change and the agricultural sector (Khare, et.al., 2019: 1). The problems caused by climate change in the agricultural sector certainly have an economic impact as well.

The economies of developing countries still

depend on the agricultural sector. Countries in Southeast Asia such as Vietnam, Thailand and Indonesia. The agriculture, forestry and fisheries sectors contributed 12.6% to Vietnam's GDP in 2021 (Worldbank.org). Vietnam's agricultural exports in 2021 were worth 5.7 billion dollars (Nguyen, 2023). The contribution of Thailand's agriculture, forestry and fisheries sectors to their GDP in 2021 is 8.5% (Worldbank.org). Even so, the agricultural sector employs around 30% of Thailand's workforce or around 6.4 million households (Udomkerdmongkol, 2020). Meanwhile, the contribution of the agriculture, forestry and fisheries sectors to Indonesia's GDP will be 12.4% in 2022 (Worldbank.org). This sector is also the sector that employs many Indonesians with the number of workers being 38.7 million people in 2022, even though jobs in this sector have the lowest average wages (Statista.com). Rice, which is the staple food for Indonesians, will be produced at 55.67 tons in 2022 (Statista.com). Based on data from the World Economic Forum in 2019, these three countries are the largest rice producers from the Southeast Asia region, followed by Myanmar and then the Philippines (Wallach, 2022).

As previously explained, the increasingly pronounced phenomenon of climate change could threaten the agricultural sector, while the agricultural sector still has a fairly large role for these three countries. These three countries also have the same climate characteristics, namely a tropical climate. However, the difference between the three countries is their government system. Even though Vietnam has experienced Dong Moi, it is still controlled by the Communist party, while Thailand has a government that tends to be authoritarian while Indonesia is in the process of post-reform democratization. In accordance with the theory of ecological modernization, apart from dealing with environmental problems by developing technology, policies are also needed that encourage society and the private sector to be more concerned with environmental issues. These differences in government systems will of course produce different policies, therefore this article tries to see how Vietnam, Thailand and Indonesia respond to climate change which affects the agricultural sector. The responses of the three countries can be seen from policies related to rice cultivation because these three countries cultivate rice plants in quite large quantities.

The process of cultivating rice plants is also a producer of greenhouse gases, namely methane (CH₄). This type of greenhouse gas can be said to be more influential than CO₂. The process of cultivating rice plants produces quite a lot of methane gas, namely 10% of the total global methane gas emissions. In several Southeast Asian countries, rice cultivation contributes as much as 15% of greenhouse gas emissions. In fact, in an extreme example in Vietnam, greenhouse gases from rice cultivation are greater than greenhouse gases from the transportation sector (Walsh, 2023). However, to limit the extent of the discussion, the time period chosen is from the early 2000s. This time was

chosen because it was close to the Kyoto Protocol event which discussed environmental problems at the international level under the auspices of the UN. The Kyoto Protocol became a significant event because it raised the issue of climate change to international attention. This event increases the significance of the policies issued by these three countries so that they are relevant to this research. Meanwhile, writing is also limited to the year this research was written, namely 2023 because the policies of the three countries are still ongoing and data for 2023 is available for research.

This research will discuss the background and conditions of rice cultivation in each country. Then the discussion continues by discussing how climate change can affect this situation. This is then followed by a discussion of how each country faces the challenges posed by climate change through policy and technology adoption. These two variables, namely policy and technology adoption, are then compared between the three countries discussed.

Ecological modernization can be interpreted as a change in the ecological direction from previously only focusing on carrying out the industrialization process to thinking about the sustainability aspects of an industry. This concept tries to deal with the environmental crisis without abandoning modernization. According to Huber in Spaargaren and Mol, ecological modernization changes the production and consumption processes ecologically (Spaargaren and Mool, 1992: 334-335).

From the explanation Huber, the first step taken in ecological modernization is to try to develop, formalize and combine new technologies that are better than before that can help in dealing with environmental problems. This step is expected to produce an economic ecological effect that changes the physical processes of production and consumption and opens up the possibility of monitoring these processes. The second step is to include environmental factors into the discussion of the production process which previously only discussed labor and capital (Spaargaren and Mool, 1992: 335).

According to Spaargaren and Mol stated that political programs to deal with the environmental crisis can be divided into two types. The first type of political program is a political program that seeks to compensate for environmental damage that has occurred and seeks to reduce the effects of production and consumption processes on the environment. The second type of political program is a political program that is close to the definition of ecological modernization which focuses on changing production and consumption processes, such as by creating technology that helps make production and consumption processes cleaner. There is a third type of environmental political program, namely deindustrialization, but this program tends to be unpopular (Spaargaren and Mool, 1992: 338-339).

Ecological modernization relies on governments and capital holders to provide solutions to environmental

problems. This concept is used to provide direction for modern society to become more sustainable and believe that environmental problems, even though these problems originate from human economic growth, through technological innovation driven by government policies (Bergendahl, et.al., 2018: 4).

Bergendahl (2018), explains the implementation of Ecological Modernization and Supply Chain Sustainability in managing Food, Energy and Water. Bergendahl uses the use of biosolids in the United States as an example. Ecological Modernization in this case example has three dimensions or levels, namely the technological level, the organizational level, and the government policy level. This journal is a basic explanation of how to implement Ecological Modernization. The weakness of this journal is that it does not discuss how changes occurring due to climate change affect the process of ecological modernization. The journal also does not discuss the policy process and only mentions what policies are already in place.

Jokinen (2000) discusses the development of environmental regulations related to the agricultural sector in Finland since the 1970s. This journal discusses how the government and society view the environment. Policy implementation is also linked to political conditions such as when Finland joined the European Union or when the farmers' party was not included in the government coalition. This article discusses more about the political side and there is quite a lack of discussion about the environment. Even when discussing the impact of a policy, this article focuses more on how environmental policy affects society rather than discussing its impact on environmental issues. However, this article also shows the roles and responses of the parties involved in environmental policy.

Ahmed and Cokinos (2017) describe the existing problems related to Bangladeshi agriculture through an analysis of the relationship between water, energy, and food. This analysis can describe the dilemma faced in overcoming existing problems. Apart from that, the article also discusses the implications of ecological modernization for the farmers' economy because ecological modernization tends to be more profitable for large companies than traditional farmers. Just like the previous article, this article also seeks to accommodate people's views regarding environmental policies other than those related to food and slowing environmental damage. This perspective can be taken into consideration for the author to include in his final assignment.

Frijns, Thuy, and Mol (2000) discuss Vietnam as it transitions from a command economy to a free market economy. Frijns sees that with this transition, the model for handling environmental problems can be addressed using ecological modernization models which are then adapted to Vietnam's characteristics. This article discusses political ecological modernization. This article's explanation can be used as an illustration of the state of institutions and parties related to environmental issues in Vietnam. However, this article does not focus on the agricultural industry and only

positions them as a group of pollutants together with textiles and manufacturing so that it does not explain the state of the agricultural industry in Vietnam.

METHODS

The planned research method that will be carried out is qualitative research with a focus on deepening information from literature that discusses government policies in Southeast Asian countries, namely Vietnam, Thailand and Indonesia in dealing with the problems faced in the rice cultivation process as a result of changes in events. climate. Literary sources such as government documents, books, journals, and news articles. The policies issued by these countries will be the basis for direct data, especially to see the policies issued regarding rice cultivation in dealing with climate change. One of the policies issued by the state government is the adoption of more environmentally friendly technology or technology that can adapt to climate change. Therefore, the technology used by these three countries in dealing with climate change was also discussed. State policies that interfere with the rice cultivation process, such as inhibiting or reducing certain actions to reduce the rate of climate change, will also be highlighted. By discussing policies that highlight technology and actions related to rice cultivation, it is hoped that this can illustrate how Southeast Asian countries are facing the problems posed by climate change.

Results and Discussion

This section explains how the governments of Indonesia, Thailand and Vietnam responded. Starting from the conditions of the agricultural sector, especially rice cultivation in the three countries, so that there is an overview of the context of the three countries. Then it was continued by discussing the impact of climate change on the agricultural sector, especially rice cultivation, both what has happened and what will happen in the future. Then we enter the main discussion, namely the responses of the three countries which focus on policies related to rice cultivation and the technology used.

Indonesia

The agricultural sector in Indonesia in 2019 used 36.8 million hectares of land (including land that is temporarily not in use). The amount of land used for rice cultivation is 7.4 million hectares (Secretariat General, 2020: 31). According to data from the Central Statistics Agency, the largest area of rice land in Indonesia in 2022 will be in the province of East Java with an area of 1,693,211 ha, followed by Central Java with an area of 1,688,670 ha, and West Java with an area of 1,662,404 ha. The yield of rice cultivation in Indonesia in 2022 will be around 54.7 million tons. Rice is also the staple food of Indonesian people. The majority of people who work as farmers are rice farmers and the majority have small scale land. The small scale of land makes them economically vulnerable if problems occur (Rondhi, et.al., 2019: 84).

One of the problems they have faced recently is climate change. Problems that arise as a result of change climate in Indonesia is a change in the frequency and intensity of rainfall, increasing temperatures, and rising sea levels. These three things influence the productivity of rice cultivation in Indonesia. Changing rainfall results in an increase in the frequency of extreme phenomena such as floods and droughts which can cause damage to plants. Rising temperatures result in an increase in the number of pests and the spread of disease (Rondhi, et.al., 2019: 84).

There are several areas that experience an increase in extreme rainfall, but there are also several areas that experience a decrease in rainfall. This change certainly resulted in disruption of the rice cultivation process because it resulted in a shift in the planting schedule. Water reserves are also affected by changes in rainfall (Surmaini, et.al., 2011: 3). According to data from the Directorate of Food Crop Protection, the number of rice plants damaged by drought and floods from 1989 to 2007 continued to increase (Surmaini, et.al., 2011: 4). Increasing the earth's surface temperature itself also affects rice cultivation, such as increasing water consumption from plants, accelerating ripening, reducing harvest quality, and increasing the number of pests. Meanwhile, rising sea levels due to climate change affect rice cultivation by reducing the area that can be used for the cultivation process. For example, this happens in the West Java region, namely in the Subang and Karawang areas. There is a reduction in rice yields of 300,000 tons due to rising sea levels (Surmaini, et.al., 2011: 4).

The Indonesian government issued a policy on Implementing Climate Change Impact Management (PPDPI) which was issued in 2017. This policy is in the form of financial assistance amounting to 3.7 trillion rupiah for cereal crop production. For the needs of rice cultivation, these funds are disbursed for the needs of seeds, fertilizer, pesticides, agricultural tools and machinery, programs *integrated pest management* (IPM), the Organic Fertilizer Processing Unit program, as well as plant protection from climate change (Perdinan, et.al, 2018: 11). IPM itself is a practice that states that chemical pesticides are only used when all pest controls have failed. The pest controllers in question are parasites, predators, pest pathogens and organic pesticides (Perdinan, et.al, 2018: 14).

Meanwhile, the Organic Fertilizer Processing Unit (UPPO) program is being implemented to provide organic fertilizer. This program itself is implemented by building UPPO facilities. In 2017, the Indonesian government built 1500 units spread across 282 districts in 33 provinces. The aim of UPPO is to provide integrated facilities to process organic materials into compost, optimize the use of livestock waste as raw material for compost, meet the need for in situ organic fertilizer, replace the need for inorganic fertilizer, improve the fertility and productivity of agricultural land, increase the livestock population, provide business opportunities and jobs in rural areas,

providing training and research media to the community, and preserving agricultural land and environmental resources. In 2017, UPPO produced 262,875 tons of cow dung. The facilities at the UPPO unit are a compost house, organic fertilizer processing equipment, livestock, communal pens, fermentation tanks, and transport vehicles (Wihardjaka and Harsanti, 2021: 58-59).

The Indonesian government is also trying to adapt to problems caused by climate change by building reservoirs through the 1000 Agricultural Embungs program. A reservoir is an artificial feature in the form of a rainwater reservoir and has various purposes. However, in an agricultural context, embungs are used as facilities to collect rainwater in the rainy season. Rainwater that has been stored during the rainy season will then be used for agricultural purposes in the dry season when water reserves run low. The construction of the embung uses funding sources from the APBN, APBD, People's Business Credit, Corporate Social Responsibility (CSR), as well as village community self-help (Ministry of Agriculture, 2022, : 4-8).

Technological adaptation in Indonesia in facing problems resulting from climate change is carried out through the provision of a Planting Calendar (KATAM). This technology itself was issued by the Indonesian government through the Ministry of Agriculture. This technology provides instructions for farmers regarding the process of cultivating rice plants in a particular year. The main objective of this program is to provide recommended dates that farmers can use to start rice cultivation in order to avoid problems caused by climate change. Apart from containing recommended dates for cultivating rice plants, KATAM also contains additional information such as ideal fertilizer doses, recommendations for types of rice seeds, weather predictions, and types of pests that are at risk of appearing during the process of cultivating rice plants. Information is provided at the sub-district level so it can be said to be quite detailed. This information can be accessed for free via the website or mobile phone application (Massagony, et.al, 2023: 1374).

The adaptation technology used in Indonesia apart from KATAM is plant seeds that can reduce the rate of climate change and can withstand the problems of climate change. As previously explained, rice cultivation produces methane gas which is a greenhouse gas which causes climate change. Apart from managing water use, using the right seed varieties can also reduce methane gas produced from the rice cultivation process. The variety of rice seeds in Indonesia that emits lower gas emissions is the Ciherang variety. Meanwhile, to adapt to drought problems, there are also varieties of rice seeds that are more drought resistant, such as Dodokan and Silugonggo. There are also varieties of rice seeds that can face the problem of rising sea levels, such as the Way Apo Buru, Margasari and Lambur varieties (Surmaini, et.al., 2011: 5-6).

Thailand

The agricultural sector cultivating rice in Thailand produced around 31.5 million tons of rice in 2018 with a total area of land used for rice cultivation of 9.5 million hectares or around 22.3% of Thailand's area. Rice cultivation is mostly carried out in the Northeast region of Thailand with an area of land used of around 5.86 million hectares, followed by the Northern region of Thailand with an area of 2.13 million hectares, the Mid-Thailand region with an area of 1.36 million hectares, and 0, 12 million hectares in the Southern region of Thailand (Jaibumrung, et.al., 2023: 79). Rice produced by rice cultivation in Thailand can be divided into three market classifications, namely fragrant rice, non-fragrant white rice and glutinous rice (Titapiwatanakun, 2012: 4).

In terms of quantity, Thailand ranks third as a rice producing country in the Southeast Asia region (Wallach, 2022). However, Thailand has become the largest rice exporting country in 30 years. This is related to the variety used. Some countries use local varieties that have low yields or use new varieties that produce higher yields. Meanwhile, Thailand cultivates rice with relatively high quality, such as Jasmine and Hom Mali types of rice which are included in the fragrant rice category (Titapiwatanakun, 2012: 4). Rice cultivation in Thailand has also changed from subsistence farming which only meets personal and local needs to commercial farming which aims to make money. Rice exports from Thailand are very diverse both in terms of destination and type of product. However, usually Thai rice exports consist of high value and processed rice (Titapiwatanakun, 2012: 6-7).

Initially, the Thai government attempted to increase production in the agricultural sector, especially rice cultivation, both in quantity and quality. Increasing production is carried out by increasing the area of land used for cultivating rice, developing the infrastructure needed for cultivating rice such as irrigation, the use of chemical fertilizers and pesticides, the use of agricultural machinery for agricultural needs, and the use of superior seeds that provide the highest yields. This policy has been implemented since the 1960s without any restrictions or supervision, making the use of natural resources such as water and land less effective. For farmers who cultivate rice, the problem they face is the decreasing number of land and water resources that can be utilized. This made the Thai government in the 1980s urge them to stop increasing the amount of land used and start trying to increase the productivity of the land they own. The Thai government is trying to achieve this goal by increasing the use of superior seeds with high yields through loans, incentives to use chemical fertilizers through subsidies and loans, and encouraging farmers to use fertilizers.organic (Saelee, 2017: 11-13). Although there have been efforts to reduce environmental damage by stopping the expansion of land used for rice cultivation, the solution provided by the Thai government raises new problems, namely the health of

soil and water polluted by the use of chemical fertilizers.

The Thai government is starting to pay attention to national environmental problems. The 7th Economic and Social Development Plan (NESDP), implemented in 1992 and valid until 1996, sought to encourage the use of organic fertilizers along with chemical fertilizers. This was done on the basis that farmers needed transition time. With this, farmers can maintain the quantity of their products and can also cut their production costs. At the 8th NESDP, the government issued a policy that reduced the number of advertisements for chemical fertilizers and pesticides. Then at the 9th NESDP, the government introduced a safe and healthy food production policy so that it could be more competitive in the international market. This is achieved by using organic materials to replace inorganic materials such as fertilizers and pesticides with more organic options. Policies are conveyed through farmer groups. And at the 10th NESDP, the Thai government issued a policy limiting the amount of chemical fertilizer imports to no more than 3.5 million tons (Kasem and Thapa, 2012: 103-106).

The Thai government has issued several policies to overcome environmental problems from rice cultivation activities. The first policy is Large Scale Farming which was issued in 2015. This policy encourages farmers to combine their land and work together to work on it. This can reduce production costs. In addition, this policy makes it easier for farmers to adopt newer agricultural technology because they can raise money to buy a new tool or technology which can then be used together. The next policy is the One Million Raise of Organic Rice Production policy which was issued in 2017. This policy encourages farmer groups to cultivate organic rice. The government provides subsidies for farmers who start cultivating organic rice because in the initial phase, organic rice yields are low in the first three years. This policy provides an initiative to reduce the use of chemical fertilizers which can affect soil and water conditions (Panyasing, et.al., 2022: 87-88).

Apart from these two policies, there is also a Good Agricultural Practices (GAP) policy. This policy is actually more international in nature and is implemented in various countries. However, the difference is that GAP in Thailand is run by the government while in other countries it is held by the private sector. This policy emerged due to market encouragement as international and domestic consumers began to pay attention to the quality of their food. However, the government's GAP usually has lower standards than the GAP in other countries. This can help small farmers to participate in the program (Amekawa, et.al., 2022: 1-2). The standards considered by GAP Thailand in 2008 were water sources, land used, use of pesticides, management in the initial phase of cultivation, harvest and post-harvest processes, transportation, storage, collection of harvests, and recording (Fakkhong and

Suwanmaneepong, 2017: 2510).

Apart from policy, Thailand also uses technology to reduce climate damage. One of the wastes from rice cultivation is husks. There are regulations that prohibit burning husks on site. Therefore, rice husks are reused. There are power plants that use rice husks as fuel (Prasara-A and Gheewala, 2017: 1021-1023). One of these practices is carried out by the Patum Rice Mill and Granary Public Company Limited (PRG) companies. Because they are a large company, they can purchase the best technology for their mills including additional technology to utilize milling waste in the form of rice bran and husks. Rice husks are used to generate electricity while the bran is processed into oil. PRG companies can build oil processing close to their mills (Thitinunsomboon, et.al., 2008: 96-98).

As part of an international agreement to reduce greenhouse gas emissions called Nationally Appropriate Mitigation Actions (NAMA), the Thai government issued the Thai Rice NAMA policy. In the Thai Rice NAMA policy, the Thai government seeks to work with farmers so that they adopt low-emission agricultural practices. They are also trying to make climate change mitigation services and technologies more affordable for farmers (InclusiveBusiness.net, 2021). Farmers are taught about AWD to face the threat of a water crisis. Thai Rice NAMA also helps farmers by testing soil so they can provide recommendations for fertilizer use, as well as encouraging farmers to use husks. The husks, which are one of the wastes in the rice cultivation process, are collected and then sold by the farmers, compared to the traditional method which is only burned by the farmers (InclusiveBusiness.net, 2021).

In dealing with climate change, there is also a leveling method that can increase the effectiveness of irrigation (InclusiveBusiness.net, 2021). This is achieved by adjusting the surface of agricultural land so that the water needed by rice plants can be spread more evenly. More even distribution makes water use more effective, thereby reducing the impact of water problems arising from climate change. Effective water use can also reduce methane greenhouse gas emissions (Hung, et.al., 2022: 1634-1635). Effective use of water also indirectly reduces electricity use, which means it also reduces greenhouse gases from electricity production such as CO₂.

One method used to level the land is Laser Land Leveling. As the name suggests, this method utilizes laser technology to make the adjustment process easier to achieve the desired slope (Root, 2023). In implementing Laser Land Leveling, the Thai government is collaborating with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) through the Thai Rice NAMA program (Chalermchai, 2021). GIZ is helping Thai farmers by providing investment funds worth 14.9 million Euros and counting. This investment assistance is then distributed to farmers in the form of subsidies through the Bank for Agriculture and Agricultural Cooperatives (BAAC)

(The Nation, 2023).

Vietnamese

The role of the agricultural sector, especially rice cultivation, in Vietnam can be said to be quite large. The area of agricultural land in Vietnam used for rice cultivation is 7.4 million ha or around 82% of the total agricultural land area. The largest rice cultivation in Vietnam is carried out in the Mekong River Delta region which produces around 52% of the national rice harvest. The Mekong River Delta is followed by the Red River Delta which produces around 18% of the national rice harvest. Vietnam's rice harvest in 2017 was around 38.7 million tons (Tam, 2018). The area of rice cultivation land in the Mekong River Delta is in the range of 1.7 million Ha (Bernardo, 2019). Rice cultivation helps support Vietnam's rapid growth. Previously, Vietnam experienced a rice deficit but later developed a surplus and provided an affordable food source that could support its population. In addition, because Vietnam experienced a rice surplus, they became a rice exporter for several countries in Africa, the Philippines and Indonesia (Demont and Rutsaert, 2017: 325).

The success of the agricultural sector, especially rice cultivation in Vietnam, can be said to rely on the strength of scale and low prices. Vietnam previously experienced a shortage of rice to feed its population. This makes Vietnam focus and try to increase the quantity of rice harvested for food purposes. Cultivation is ultimately focused on high yields without paying attention to quality. In the rice export market, Vietnam uses a strategy that can be said to be the same. They cultivate low quality rice in high quantities and then sell it at low prices (Demont and Rutsaert, 2017: 326).

Because it is trying to increase quantity, the strategy used by Vietnam is to intensify the rice cultivation system, choose variants with the highest quantity of yield, and increase the use of chemicals. They use chemical fertilizers excessively which then results in an increase in diseases and pests in rice plants which then have to be treated using pesticides (Demont and Rutsaert, 2017: 326). One way of intensifying is by manipulating natural phenomena. Farmers in the Mekong River delta region dam water to prevent seasonal flooding. However, this reduces soil nutrition. To compensate for lost nutrients, they use chemical fertilizers. Climate change is also making matters worse, causing the use of chemical fertilizers and pesticides to increase. When the use of pesticides increases, they kill living creatures that act as predators for pests so that the number of pests increases which makes farmers increase their use of pesticides (Nguyen, 2017: 45-46).

Climate change is also making the situation worse. As previously explained, excess rain causes nutrients in the soil to disappear because they can be carried away by water flows. This encourages farmers

to use more inorganic fertilizers which makes their agricultural land unhealthy. Climate change also increases sea levels. Rising sea levels threaten rice cultivation in Vietnam. One of the rice barns in Vietnam is in the Mekong River Delta region. It is estimated that if sea levels rise from 0.2 m to 0.6 m, around 100 thousand to 200 thousand land in the Mekong River Delta will be submerged. If there is an increase of 1 m, then 90% of the Mekong River Delta will experience flooding (Thach, et.al., 2023: 1-2).

Apart from the problem of sinking land, there is also the problem of salt water contamination (Saline Intrusion). Previously, the threat to agriculture in the Mekong River Delta region was flooding. However, recently salt water contamination has increased. This happens because the flow of water from upstream of the river decreases due to drought and the construction of an electric power generating dam upstream of the river. Salt water contamination is exacerbated by rising sea levels which cause sea water waves to enter deeper from the coast. In 2015-2016 there was a drought that occurred due to the El Nino phenomenon. Salt water entered land areas as far as 90 km, causing agricultural damage in 11 of the 13 provinces in the Mekong River Delta region. Around 2 million people who depend on the agricultural sector have lost their income, while around 2 million people are threatened due to drought and salt water contamination (Thach, et.al., 2023: 2).

To overcome this problem, the Vietnamese government issued various policies related to agriculture to reduce environmental damage caused by the agricultural process. The policies issued cover various types of plant cultivation. On average, the policies issued seek to reduce the use of pesticides and chemicals (Nguyen, 2017: 48-49). For rice cultivation, there is a 3 Reductions 3 Gains (3R3G) policy and a 1 Must and 5 Reductions (1M5R) policy. The 3R3G policy seeks to reduce the use of seeds, pesticides and water in the rice cultivation process and seeks to increase yields, improve rice quality and increase profits for rice farmers. This policy was implemented in the southern region of Vietnam, including the Mekong River delta, which is a rice granary for Vietnam (Nguyen, 2017: 49).

The 3R3G policy was issued in 2003. This reduction policy was issued to counter the beliefs of Vietnamese farmers who believe that the greater the input used, the greater the quantity of harvest that will be produced. This culture caused the use of seeds, fertilizers and pesticides in the 1990-2004 period to increase by 50% (Presilla, 2018: 23). The 3R3G policy started with the Integrated Pest Management (IPM) project. They tested the theory that rice plants do not need to be given pesticides for the first 40 days. They then tested it by carrying out a No Early Spraying campaign in the Mekong River delta region and succeeded in reaching around 93% of the farmers there. They succeeded in reducing pesticide use per season by 70% (Huelgas, et.al., 2008: 3).

By reducing the use of fertilizers, especially those made from chemicals and pesticides, they can

reduce the negative impact of using these two things on the environment. Apart from that, the use of pesticides also has a negative impact on the quality and safety of harvests. This could threaten Vietnamese rice on the market because consumers are certainly trying to find rice that is not only cheap but also high quality and safe for them. One example of the results of implementing this policy occurred in An Giang Province. They succeeded in reducing the use of seeds by 10%, fertilizer by 7%, and pesticides by 30%. This policy not only protects consumers but can also benefit farmers because they can reduce their production costs with this reduction (Presilla, 2018: 23).

Meanwhile, the 1M5R policy seeks to change the way Vietnamese farmers deal with climate change by reducing many things in the rice cultivation process but still trying to get satisfactory harvest results. 1M5R can be described as 1-Must-Do which can be interpreted as one thing that needs to be done, namely the use of recommended seeds. Meanwhile 5-Reductions can be described as reducing the number of seeds used, reducing fertilizer used, reducing pesticides used, reducing water used, as well as reducing losses in the post-harvest phase (Hung, et.al., 2023: 123).

Rather than using pesticides and other chemicals to deal with pests, Vietnam is trying to deal with them by increasing the resistance of rice plants to pests, such as by using seed varieties that can deal with pests. Apart from that, they also try to deal with pests by utilizing natural predators for rice pests. Pesticides are only used when the quantity of their crops is threatened by pests. Apart from dealing with pests, this policy also seeks to discuss soil nutritional needs. Fertilizers that were previously used to increase crop yields are now used only according to nutritional needs so that excessive use does not occur. We also strive to use water effectively and not excessively so that soil nutrients do not dissolve and disappear and reduce greenhouse gases from rice fields (Nguyen, 2017: 49-50). This policy can be said to be a continuation policy from 3R3G.

Based on the 1M5R policy, the use of seeds is not more than 100 kg per hectare. However, in practice farmers still use around 60 kg to 150 kg. In order to achieve this, the 1M5R standard was then updated in 2020 to 120 kg. Meanwhile, the standard for fertilizer use in the 1M5R policy uses Nitrogen as a benchmark, namely that there must be no more than 100 kg of Nitrogen per hectare. The standards for pesticide use in the 1M5R policy are divided into two types, namely insecticides and fungicides. Insecticides are used at most once a season while fungicides are used twice a season. The usage period is also regulated by the 1M5R policy. New insecticides may be used after 40 days after sowing while fungicides should not be used after the flowering phase has occurred. For water use standards, the practice of Alternate Wetting and Drying (AWD) is recommended. Finally, regarding

post-harvest losses, harvesting activities are attempted to be carried out when 80-85% of the rice grains on a stalk have turned yellow. To achieve more optimal results, the use of a harvest tractor (combine harvester) is also recommended (Hung, et.al., 2023: 125-126).

The use of water in the process of cultivating rice plants affects climate change. When agricultural land is flooded for cultivation purposes, the soil releases methane gas which is a greenhouse gas (Toan, et.al., 2021: 221). As previously mentioned, methane gas emissions from rice cultivation are quite large, even in the case of Vietnam, greenhouse gas emissions from rice cultivation can exceed greenhouse gas emissions from the transportation sector (Walsh, 2023). To reduce water use, the government recommends using AWD technology.

The government collaborates with various international organizations such as the Consultative Group for International Agricultural Research (CGIAR) and the International Rice Research Institute (IRRI) for research and implementation of AWD technology (CGSpace.CGIAR.org, 2019). AWD is a rice irrigation practice that involves a cycle of flooding and drying. This is different from what is usually done, namely that the rice cultivation land is flooded continuously during the cultivation process. Using the AWD method, rice cultivation land is only flooded after the water level reaches 15 cm below the ground surface (Le, 2021: 43). AWD technology refers to technology that can support the AWD method, one of which is a sensor used to monitor water levels (Gupta, et.al., 2023).

Reducing water use is a form of adaptation for farmers' habits to face conditions in the future when water resources are difficult to obtain, such as during drought or when water in the Mekong River Delta is contaminated by salt water from rising sea levels (Toan, et.al., 2021 : 221). Meanwhile, as previously mentioned, reducing water use can also reduce methane emissions from the rice cultivation process. So reducing water use is not only a way to adapt to climate change but is also a step that can be taken to reduce the rate of climate change.

According to the Ecological Modernization theory, dealing with climate change is by developing technology that can change the production process to be more environmentally friendly. Apart from that, Ecological Modernization in a political context is carried out by encouraging changes in society and private companies to become more attentive to environmental problems, including encouraging the development of technology that is more environmentally friendly or can deal with climate change. Therefore, Ecological Modernization steps in Vietnam, Thailand and Indonesia are seen through the technology used and government policies issued in these three countries.

Southeast Asian countries, namely Vietnam, Thailand and Indonesia, were then

compared based on these two variables. The comparison is based on the discussion previously written. By comparing the technology implemented and the policies issued, it is hoped that we can see the direction of ecological modernization of the three countries. The following is a comparison of technology and government policies from the three countries in tabular form:

Even though Vietnam and Thailand have similar efforts, namely reducing the use of pesticides and inorganic fertilizers, each country has different goals and reasons. Vietnam has historically tended to focus on quantity by producing cheap rice and large surpluses. This started from their history of being hit by famine to finally producing a surplus of cheap rice that could not only support the needs of their population but could also be sold on the international market. However, this history has also shaped the mindset of Vietnamese rice farmers who see that to get more results, more input is needed. Apart from causing environmental problems, this mindset also makes rice cultivation increasingly expensive. Therefore, the policy taken by the Vietnamese government is to try to encourage and limit input made by farmers. The 3R3G and 1M5R policies are policies that invite Vietnamese farmers to reduce inputs such as fertilizer, pesticides, seeds and water. The government also follows the mindset of farmers in Vietnam who see that a lot of input will provide a lot of harvest by proving that even though there is a reduction in input, the harvest will not necessarily decrease and farmers can also make more profits because they can save their production capital.

Meanwhile in the Thai context, as previously explained, agriculture there tends to be for commercial purposes. Thailand also exports a lot of their rice and the rice they export is of high quality. This can be said to influence the policy steps taken by the Thai government. This can be seen from the Good Agricultural Practices (GAP) certification policy which can increase the value of Thai rice on the international market. The marketability of GAP certification and organic farming encourages commercially oriented farmers to participate in Thai government policies.

In Indonesia, the policy taken by the Indonesian government in dealing with climate change is to provide assistance with facilities and infrastructure that can help farmers. The construction of an Organic Fertilizer Processing Unit seeks to ensure that farmers have easier and closer access to organic fertilizer. The construction of embungs also helps provide water reserves for farmers which helps them in dealing with dry seasons and droughts. Planting Calendar Technology (KATAM) also provides access to information for farmers. Starting from information that helps adapt to climate change directly, such as ideal planting dates so as not to be disturbed by climate and weather which are increasingly difficult for ordinary farmers to predict,

to indirect adaptation such as advice regarding seed varieties, fertilizer use, and pesticide use.

There are similarities in technology adoption between Vietnam and Thailand. Both countries receive assistance from international organizations. Vietnam is collaborating with international partners such as the Consultative Group for International Agricultural Research (CGIAR) and the International Rice Research Institute (IRRI) in implementing Alternate Wetting and Drying (AWD) technology. Meanwhile, Thailand in implementing Laser Land Leveling (LLL) technology is collaborating with international organizations such as the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in the form of funding.

CONCLUSION

It can be concluded that the governments of these three countries have issued policies that encourage their farmers to carry out practices that can reduce the rate of climate change and adapt to climate change. The Vietnamese government issued the 3R3G and 1M5R policies. The Thai government issued a Large Scale Farming policy, One Million Rai of Organic Rice Production, GAP certification, and Thai Rice NAMA. Meanwhile, Indonesia issued a policy for the construction of organic fertilizer processing units and the 1000 reservoirs program. These policies have different directions. Some policies can be linked to the context and history of each country. Farmers in Vietnam use a lot of resources such as fertilizer and pesticides, so the policy taken is an effort to reduce the use of these resources. Rice in Thailand is often an exotic export commodity and its farmers are commercially oriented, so the policy measures used by Thailand tend to be incentives that benefit farmers. Meanwhile, the Indonesian government issued a policy that provides facilities and infrastructure for Indonesian farmers to adapt to climate change.

REFERENCES

- Ahmed, S., Cokinos, C.(2017). How does ecological modernization explain agricultural adaptation in coastal Bangladesh? A critical discussion. *Environmental Hazards*, Vol. 16, no. 2 (January, 2017), p. 1-16.
- Amekawa, Y., et.al.(2022). Pesticide Use under Public Good Agricultural Practices Standard: A Comparative Study in Thailand. *Agriculture*, Vol. 12, no. 5 (April, 2022).
- Armstrong, AK, et.al.(2018). *Communicating Climate Change: A Guide for Educators*. New York: Cornell University Press.
- Bergendahl, JA, et.al.(2018). Transdisciplinarity and the food energy and water nexus: Ecological modernization and supply chain sustainability perspectives. *Resources, Conservation & Recycling*, 133 (June, 2018), p. 309-319.
- Demont, M., Rutsaert, P.(2017). Restructuring the Vietnamese Rice Sector: Towards Increasing Sustainability. *Sustainability*, Vol. 9, no. 2

- (February, 2017).
- Dobbins, J., Solomon, et.al.(2015). Choices for America in a Turbulent World: Strategic Rethink. California: RAND Corporation.
- Hung, NV, et.al.“Innovations, Technologies, and Management Practices for Sustainable Rice Production,” Closing Rice Yields Gaps in Asia, eds. Melanie Connor, Martin Gummert, Grant Robert Singleton. Cham: Springer Nature Switzerland, 2023.
- General Secretariat.(2020). Agricultural Land Statistics 2015-2019. South Jakarta: Center for Agricultural Data and Information Systems Secretariat General – Ministry of Agriculture.
- Stoker, T., et.al.(2013). Climate Change 2013: The Physical Science Basis. New York: Cambridge University Press.
- Hung, NV, et.al.(2022). Precision land leveling for sustainable rice production: case studies in Cambodia, Thailand, Philippines, Vietnam, and India. Precision Agriculture, Vol. 23 (April, 2022), p. 1633-1652.
- Jaibumrung, K., et.al.(2023). Ecological footprint, water scarcity footprint, and benefit to cost ratio analysis towards sustainable rice production in Thailand. Sustainable Production and Consumption, Vol. 39 (July, 2023), p. 79-92.
- Jokinen, P.(2000). Europeanisation and Ecological Modernisation: Agri-environmental Policy and Practices in Finland. Environmental Politics, Vol. 9, no. 1 (March, 2000), p. 138-167.
- Kasem, S., Thapa, G.B(2012). Sustainable Development Policies and Achievements in the Context of the Agriculture Sector in Thailand. Sustainable Development, Vol. 20 (2012), p. 98-114.
- Khare, P., et.al.(2019). Climate Change and Agriculture: An Information Asymmetry Approach. Climate Change and National Security: How Can Public Policy Change the World? (July, 2019).
- Le, Loan T. (2021). Alternate wetting and drying techniques in paddy production in the Mekong Delta, Vietnam: economic evaluation and adoption determinants. Journal of Agribusiness in Developing and Emerging Economies, Vol. 11 No. 1 (February, 2021), p. 42-59.
- Laforge, J., et.al.(2021). Farming the Future: Agriculture and climate change on the Canadian Prairies. Winnipeg: International Institute for Sustainable Development (IISD).
- Massagony, A., et.al., (2023). Climate change impact and adaptation policy effectiveness on rice production in Indonesia. International Journal of Environmental Studies, Vol. 80, no. 5 (August, 2023), p. 1373-1390.
- Nguyen, T.H(2017). An Overview of Agricultural Pollution in Vietnam: The Crops Sector. Washington: The World Bank.
- Panyasing, S., et.al.(2022). The Government Policy on the Organic Rice Farming Groups Embracing Sustainable Agricultural Production: Evidence in Thailand. AgBioForum, Vol. 24, no. 1 (June, 2022), p. 83-94.
- Perdinan, P., et.al.(2019). Climate Change Adaptation and Food Security: A Review of Initiatives and Policies. Indonesian Environmental Law Journal, Vol. 5, no. 1 (January, 2019), p. 60-87.
- Prasara-A, J., Gheewala, SH(2017). Sustainable utilization of rice husk ash from power plants: A review. Journal of Cleaner Production, Vol. 167 (November, 2017), p. 1020-1028.
- Presilla, M.(2018). The Development of Organic Farming in Vietnam. Journal of Regional Studies, Vol. 9, no. 1 (June, 2018), p. 20-32.
- Rondhi, M., et.al.(2019). Assessing the Role of the Perceived Impact of Climate Change on National Adaptation Policy: The Case of Rice Farming in Indonesia. Land, Vol. 8, no. 5 (May, 2019), p. 81-102.
- Saelee, W.“Environmental Efficiency Analysis of Thai Rice Farming.” Doctoral Thesis, School of Agriculture, Policy and Development University of Reading, Reading, 2017.
- Spaargaren, G., Mol, APJ(1992). Sociology, Environment, and Modernity: Ecological Modernization as a Theory of Social Change. Society & Natural Resources, Vol. 5 (1992), p. 323-344.
- Surmaini, E., et.al.(2011). Agricultural Sector Efforts in Facing Climate Change. Journal of Agricultural Research and Development, Vol. 30, no. 1 (March, 2011), p.
- Thach, KSR, et.al.(2023). Effect of saline intrusion on rice production in the Mekong River Delta. Heliyon, Vol. 9, no. 10 (October, 2023).
- Thitinunsomboon, S., et.al.(2008). Sectoral Innovation Systems in Agriculture: The Case of Rice in Thailand. Asian Journal of Technology Innovation, Vol. 16, no. 1 (July, 2008), p. 83-100.
- Titapiwatanakun, B.(2012). The Rice Situation in Thailand. Technical Assistance Consultant's Report, (2012), p. 1-24.
- Toan, TL, et.al.(2021). Agriculture in Viet Nam under the impact of climate change. Social and Economic Impacts, (2021), p. 191-228.
- Wihardjaka, A., Harsanti, ES(2021). Support for Organic Fertilizer to Improve Soil Quality in Environmentally Friendly Rice Management. Food Journal, Vol. 30, no. 1 (April, 2021), p. 53-64.
- Saelee, W.“Environmental Efficiency Analysis of Thai Rice Farming.” Doctoral Thesis, School of Agriculture, Policy and Development University of Reading, Reading, 2017.