The effect of climate change damages on agriculture, forestry and fisheries in ASEAN countries

R M Indriawati and D Prasetyani*
Faculty of Economics and Business, Sebelas Maret University, Indonesia

Corresponding author: dwiprasetyani_fe@staff.uns.ac.id

Abstract. Countries in ASEAN region have a significant potential for the impact of climate change disruption and disasters such as El Nino, La Nina, earthquakes, tsunamis, volcanic eruptions, hurricanes, floods, tropical storms, landslides, and CO2 emissions. The ASEAN Secretariat recorded a progressive increase in CO2 emission levels of around 61% from 2014 to 2025, more than 90% of transboundary haze from the expansion of large-scale commercial plantations, accumulation of plastic waste and household waste that cannot be properly recycled. The contribution of agriculture, forestry and fisheries is also relatively varied. Geographical conditions, policy orientations of each government, structure of production inputs including human resource competence and technology are thought to determine the adverse effects of climate change on the agriculture, forestry, and fisheries sectors. This study focuses on the impact of climate change on the agriculture, fisheries, and forestry sectors in the ASEAN region. The analytical framework is adapted to the ASEAN Vision 2020 and ASEAN Vision 2021. In addition, a deeper analysis of several climate change impact control instruments such as polluter pays, agricultural insurance, agri-environment climate schemes and payments for environmental services will also be studied. These instruments are directed to achieve environmental sustainability in the ASEAN region.

1. Introduction
Countries in the ASEAN region have a significant potential for the impact of climate change disruption and disasters such as El Nino, La Nina, earthquakes, tsunamis, volcanic eruptions, hurricanes, floods, tropical storms, landslides, and CO2 emissions. The ASEAN Secretariat [1] recorded a progressive increase in CO2 emission levels of around 61% from 2014 to 2025, more than 90% of transboundary haze from the expansion of large-scale commercial plantations, accumulation of plastic waste and household waste that cannot be properly recycled.

Climate change affects many countries in different ways. In ASEAN countries, explained by the World Bank that the climate change that occurs tends to vary. Large impacts occur in the agricultural, forestry, and fisheries sectors. Geographical conditions, policy orientation of each government, production input structure including human resource competence and technology are thought to determine the adverse effects of climate change on agriculture, forestry, and fisheries sectors.

The crucial orientation of environmental policy built by ASEAN countries is overshadowed by two grand visions, namely: the ASEAN Vision 2020 was called "a clean and green ASEAN" and ASEAN Community Vision 2025. In particular, the framework for anticipating climate change is directed at food security in agriculture, fisheries, and forestry sectors through sustainability measures, efficiency, and
effectiveness of utilization of land, forest, water, and aquatic resources. In theory and empirical, several instruments can be applied to control the impacts of climate change including the principle of polluter-pays, agricultural insurance, agri-environment climate schemes, and payment for environmental services [2–4].

This study focuses on the study on the impact of climate change on agriculture, fisheries, and forestry sectors in the ASEAN region. The analysis framework is tailored to ASEAN Vision 2020 and ASEAN Vision 2025. Besides, deepening analysis of several climate change impact control instruments such as polluter-pays, agricultural insurance, agri-environment climate schemes and payment for environmental services will also be reviewed. These instruments are directed to achieve environmental sustainability in the ASEAN region. Furthermore, the contribution of this study to the existence of literature is realized in several ways. The first contribution was an analysis of the impact of climate change on agriculture, fisheries, and forestry sectors in ASEAN countries during 2000-2019. The second is the analysis of various climate change impact control instruments in the ASEAN region.

The findings of this study indicate that climate change indicators have causality with agricultural, forestry, and fisheries GDP in ASEAN countries during 2000-2019. Also, the detrimental effects of some climate change indicators on agricultural GDP, forestry, and fisheries are proven. In priority there are several policy instruments of environmental sustainability that can be applied at both the country level and ASEAN level, namely: the new polluter-pays principle – recently successfully implemented in several developing countries, where people who damage the environment must bear the cost of such. Besides, a payment program for environmental services can be done in ASEAN countries based on the finding that PFES was successfully implemented with significant results with a sample of 100,000 forest rights holders in Vietnam [5]. Another instrument is agricultural insurance in Malaysia found that agricultural insurance has the potential as an agricultural risk management strategy due to Alam et al. [6].

2. Results and discussion
Several empirical studies have examined the impact of climate change on agriculture, forestry, and fisheries. For example, the case in Brazil has been projected until 2050 there is a significant decrease in agricultural production (soybeans and corn) as a result of climate change [7]. Climate change is also impacting the decline of timber supply and the increase in forest fires in Canada [8]. Other research models project a decrease in large fish biomass and an increase in fish deaths due to climate change [9].

Marza et al. [10] explain that agricultural insurance is one tool that helps agricultural producers in developing countries to switch from subsistence agriculture to sustainable agriculture. In depth, agricultural insurance helps manage risks in the agricultural food value chain, can stabilize farm incomes and encourage investment in agriculture. Therefore, agricultural insurance is an appropriate tool to mitigate the impacts of climate change [11].

Agricultural insurance frameworks need to be proposed by policy makers and implementers. However, there are several challenges of agricultural insurance in developing countries, Malaysia for example, namely lack of experience from international practice, limited products, lack of necessary data, limited financial capacity, and high administrative operational costs [6].

Research by Jorgensen et al. [12] found that in general, farmers with low soil quality who had experienced crop damage in the past were more likely to purchase agricultural insurance. On the other hand, farmers with good soil quality and have never experienced losses due to climate, feel that they can adapt to climate change without agricultural insurance, so they are less willing to buy agricultural insurance.

Regarding agri-environment climate schemes, farmers' environmental beliefs and perceptions are a key tool for understanding the concept of sustainability in relation to their preferences. Environmental opinions reviewed using the New Ecological Paradigm (NEP) scale made it possible to identify the egocentric and anthropocentric attitudes of farmers, highlighting the commitment of most farmers to the sustainable use of natural resources. Non-financial factors should be considered to design more effective schemes to encourage farmers to adopt and continue such practices in the long term. The scheme is a
development program scheme that can be considered, namely no tillage, reduction of fertilizers, reduction of water, and fertilizers [13].

Regarding payments for environmental services, Khanal and Devkota [14] research in Nepal shows that the average willingness of farmers to pay is USD 77.13 per ha per year for irrigation water. The distance of rice fields from water sources, welfare status and gender have a major influence on individual PAPs. Another finding from Liu and Kontoleon [15] suggests that PES programs are likely to have an impact on livelihoods. All respondents to the Duong and De Groot [5] study reported positive changes to the program. Respondents also highlighted that payment and clarity of boundaries were the main factors underlying this substantial impact.

Regarding polluter-pays, Tilton [16] explains that the historical polluter-pays principle — a modification of the original polluter-pays principle used to state that developed countries should pay most of the costs for climate policy — argues that the costs of recovering past pollution should be allocated according to pollution. Their past. Luppi et al. [17] conclude by suggesting that this variation of polluter-payment regime may be desirable in an environment characterized by widespread poverty, high interest rates, judicial delays and uncertainty in adjudication.

Some instruments related to environmental sustainability policies that have been implemented and continued to be developed in countries around the world are as follows:

2.1. Polluter pays principle. Countries in Europe apply this principle a lot, where the person or company that is in the environment must pay a certain amount of money to the designated state authority body. This policy is effectively used to prevent and reduce pollution.

2.2. Agriculture insurance. This policy of adaptation and risk mitigation in the agricultural sector proved effective as one of the risk reduction strategies. Agrarian countries in ASEAN began to implement this strategy and succeeded well.

2.3. Payment for environmental services. This PES implementation is often used in the forestry sector to pay for environmental services in the forestry sector. Forests with many functions and environmental benefits require to be preserved properly and appropriately so that their functions and benefits are maintained well. PES was successfully implemented in countries with a considerable area of forest coverage.

3. Policy recommendation
Climate change affects the agricultural, fisheries, and forestry sectors of ASEAN countries in the short term and is expected to have no long-term effect. The polluter pays principle (PPP) can be developed and applied consistently and continuously to all ASEAN countries. PPP is proven to be effective for addressing environmental damage.

At the Country Level in ASEAN region agriculture insurance policy has been successfully reported in Malaysia, Indonesia, Thailand. This strategy is effective for adaptation and risk mitigation in the agricultural sector due to climate change. It can be developed in the long run.

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