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MORALITY BEFORE KNOWLEDGE

Climate change and its mitigation in agricultural country

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ABSTRACT
Background: This research aims to discuss climate change and its mitigation and adaptation, especially in the agriculture sector. It will help in formulating and managing this sector if someday there are so many cases that make a mess in this sector. **Methods:** This research is conducted as qualitative research. **Finding:** Agriculture holds some important rules for a country, humans, and other living organisms. Indonesia as an agricultural country has so many sources that are impacted by climate change. Climate change is affecting so many aspects. Agriculture is one of the greatest things that will get the serious impact from climate change. In global, agriculture gives about 14% of the total emissions, and in national, it gives about 12%. Although it seems little the negative impacts are felt by the living organisms. The impacts of climate change need active efforts to anticipate it through mitigation and adaptation strategies. **Conclusion:** The mitigation technology will reduce greenhouse gas and the agriculture field by using low-emission varieties, water, and land management technology.

KEYWORDS: agriculture; climate change impact; mitigation.

1. Introduction

Agriculture holds some important rules for a country, humans, and other living organisms. In agricultural countries it is so important since the agricultural sector has a role in developing the economy, the food supply as an instrument of poverty alleviation, a job provider, and as a source of community income. According to Indexmundi, Indonesia has a field of agriculture of about 570.000 kilometer cubes. The agriculture sector is very vulnerable to climate change because it affects cropping patterns, planting time, production, and yield quality (Eka Suranny et al., 2022; Husen et al., 2022).

Climate change is a condition marked by changes in the world Climate has a close relation with weather changes and global warming can reduce the production of agriculture by about 5-20%. We know that Indonesia is a developing country that is more dependent on farming and is a sensitive sector.

Climate change is continuous. Therefore, as the mitigation and adaptations, there have to be a preparation of technology adaptation that will be the key to resilience. The impacts of climate change depend on the rate and rate of climate change itself. Therefore it needs research and studies in the agriculture sector and its resources, infrastructure, and food resilience.

Even though some predictions of climate change will have impacts on agriculture, there have been some economic studies that measure the climate change impacts on this

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country. The impacts are not only in the economic sector but also the health and welfare. Agriculture is important for food security in two ways; it produces the food people eat; and (perhaps even more important) it provides the primary source of livelihood for 36 percent of the world's total workforce. In the heavily populated countries of Asia, two-thirds of the working population still make their living from agriculture (ILO, 2000).

The agricultural sector releases a significant emission, in the form of CO2, CH4, and N2O (Cho, 2022). Half of CO2 is released by the microbes in the decay process, burning plant litter, and the organic material from soil (Zhou et al., 2023). CH4 (methane) is produced if the decomposition of organic material less oxygen supply, especially in the fermentation process. It is known that agriculture is not the only one that acts as a "victim" but it can be the one who acts as the reason why climate change could happen because of those substances mentioned above. Besides that, the use of fossil fuels, industrial, waste, farm, and agricultural are growing rapidly. Those activities cause the radiation in the atmosphere to be trapped, and then the earth's temperature gets higher.

The decrease in production because of climate change will be the greatest serious effect. So, the analysis of climate change and its mitigation and adaptation especially in the agriculture sector will help in formulating and managing this sector if someday there are so many cases that make a mess in this sector.

2. Methods

This type of research is descriptive qualitative research with the risk agents CO2, CH4, and N2O. It is carried out to see how the agriculture sector risk due to climate change. The research time is in East Java with the periodic data of 25-40 years indicating that there is a decrease in seasonal and annual rainfall, here we know that agriculture has a strong relationship with rainfall. The reason for using this method is to measure objective facts and explain a phenomenon by collecting data from research that has been done in Java.

3. Results and Discussion

It can be seen from the research that agriculture, especially for crops is very sensitive to climate change due to three main factors those are bio-physical, genetic, and management. It happens because food crops are generally annual crops that are relatively sensitive to stress. Technically, vulnerability is closely related to land use systems and soil properties, cropping patterns, soil, water, and plant management technology, and plant varieties (Alves et al., 2023). The three main factors that impact agriculture are changes in rainfall, the increase in extreme climate, and the increase in temperature and sea level (America, 2023).

The change in rainfall has happened in Indonesia since the last decade. The change in rainfall also affects the reservoir water availability, especially in Java. As an example, in Citarum River since the last decade, the average volume has decreased from 5.70 billion m^3/year becomes 4.90 m^3/year (Fitriana et al., 2023). That condition has implications for the decline in the ability of the Jatiluhur reservoir to irrigate rice fields on the northern coast of Java. With the changing rainfall, if farmers continue to apply the cropping patterns like normal conditions, crop failure will occur more frequently. With the decrease in rainfall and the availability of reservoir water, farmers also need to change the cropping pattern. This is mitigations of climate change as follows.

a. The use of low-emission rice varieties

Lowland rice is known as the main source of methane gas emission, which is between 20-100 Tg CH4/year (Almeida et al., 2016). Methane gas emissions are determined by

differences in physiological and morphological characteristics of rice varieties. The ability of rice varieties to emit gas methane depends on the area-chima cavity, number of tillers, biomass, root pattern, and metabolic activity. The farmers are used to using rice with the type IR64 more dominant. But, nowadays the farmers change it becomes Ciherang. Besides being more resistant to pests and diseases, the Ciherang variety also emits less methane gas. Thus, growing Ciherang varieties will reduce the emissions of greenhouse gases.

b. The use of ZA fertilizers as the source of N fertilizer

Sources of N fertilizers such as ZA can reduce methane gas emissions by 6% compared to urea when fertilizers are spread on the soil surface, and reduce methane emissions by up to 62% if ZA fertilizers are immersed in the soil (Lindau *et al.* 1993). However, this method cannot be practiced in all locations and should be applied to S-deficient soils and/or high pH.

c. Technology application without tillage

Dry tillage can reduce methane gas emissions from the soil compared to wet tillage or silting. This is because the breakdown of organic matter takes place aerobically so that C is released in the form of CO2 which has a lower heating rate than CH4. However, wetting the soil after drying can stimulate N2O gas emissions. Minimal tillage or no tillage can reduce the rate of methane gas emissions by around 31.50-63.40% compared to perfect tillage. Minimal tillage can be done on soil with a crumb texture and a little weed.

d. Intermittent irrigation technology

In addition to saving water, intermittent irrigation technology can reduce methane emissions from paddy fields. Irrigation water savings can be done using intermittent irrigation (irrigating the land and drying the land periodically within a certain period), and the lab systems. This method affects the physico-chemical properties of the soil (pH) which is more favorable for plant growth because it removes substances that are toxic to plants, such as organic acids and H2S, in addition to reducing methane emissions by up to 88% (Almeida et al., 2016).

4. Conclusion

Climate change affects coffee production in Indonesia. Increasing temperature degrades coffee production both in Arabica and Robusta. The flower is unable to bloom during the phase due to unpredictable weather, heavy rainfall, and droughts thus decreasing coffee production. The overall suitable area for cultivating coffee is shifting towards higher altitudes thus increasing the potential area suitable for Robusta. However, Indonesia is projected to lose more than half of the suitable area for cultivating Arabica and at the same time expand its new suitable area by 28% by the year 2050. Climate change improves coffee pests' thermal tolerance and enables them to grow in warm temperatures. Common mitigation approaches include shade plantation and soil moisturization control which both improve coffee productivity. Coffee performance at elevated carbon dioxide levels could mitigate environmental stress, for example, droughts. The last mitigation strategy suggested in this paper is called the cultivation calendar. This calendar modified the coffee life cycle with climate prediction and has the potential to be applied as a guide for more coffee productivity.

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