Analysis of the Perceptions of Non-Forestryand Environmental Students in Jabodetabek on the Role of *Moringa oleifera* in Climate Change Mitigation

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ABSTRACT

Climate change is a crucial natural phenomenon. One of the causes of climate change is global warming caused by increased greenhouse gas emissions in the Earth's atmosphere. Carbon dioxide emissions from the transportation sector are the largest contributor to greenhouse gases. The perception of students' understanding, including non-forestry and environmental students, of climate change is needed in mitigation efforts that play a role in reducing the impact of climate change in a structured manner. *Moringa oleifera* is a ground cover plant from the Moringaceae group which is a type that is fast growing and resistant to drought. This study aims to analyze the perceptions of students with non-forestry and environmental education backgrounds in Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) towards the role of *Moringa oleifera* in climate change mitigation. Data and information on student perceptions were obtained through a closed questionnaire and related journals. The sample used in this studyamounted to 213 respondents from 1.000 population with 10% error rate. This study used the Guttman Scale. The results of this study are expected to serve as a basis for further development of climate change mitigation strategies related to *Moringa oleifera* by relevant institutions.

Keywords: *climate change, Moringa oleifera, mitigation, perception, strategy, carbon dioxide emissions, greenhouse gases, globalwarming.*

INTRODUCTION

Climate change is a global climatephenomenon triggered by global warming due to increasing concentrations of greenhouse gases in the atmosphere. As a first step in preparing mitigation measures, the availabilityand access to climate information is essential to assess the impacts of climate change. The location of subtropical countries with relatively warmer temperatures compared to high latitudes, increases the vulnerability of subtropical regions to the impacts of climate change. In Indonesia, the impact of climate change is shown by the increasing frequency of weather events that can cause droughtsand floods. The climate phenomenon known as ENSO (El Niño Southern Oscillation) consists of El Niño and La Niña events. Both events have a significant impact on the distribution of rainfall in Indonesia. El Niño events are characterized by droughts, while LaNiña events are characterized by floods.

According to Villafuerte and Villafurte (2009), a research report from Japan showed that *Moringa oleifera* has a carbon dioxide (CO2) absorption rate of 20 times more than the average CO2 uptake of other vegetation on Earth. If planted on a large scale, *Moringa oleifera* not only has great potential forcarbon storage, but also for sequestration. Planting *Moringa oleifera* in various parts of the country, can reduce the impact of climate change (Daba, 2016). *Moringa oleifera* is a versatile tree, fast growing, drought resistant, and can adapt well to extreme weatherconditions. Based on the opinion of Abbas *et al*., (2018), *Moringa oleifera* is a tree that can grow in

different climates, including drought and can be harvested several times. Therefore, planting *Moringa oleifera* is a goodalternative to intensive cultivation to regulate water flow and overcome current climate change.

Many researchers have concluded that *Moringa oleifera* is a multifunctional plant with fast growth and strong adaptability. Several studies have shown that *Moringa oleifera* has direct impacts on agriculture, nutrition, health, water and environment, biodiversity, and sanitation. *Moringa oleifera* is recognized as a versatile plant that requires market and policy development strategies, as well as continued research due to its versatility and adaptability. However, research on the role of *Moringa oleifera* related to climate change mitigation in the perceptions of students, especially students with backgrounds not from forestry and the environment, has not yet been conducted. Previous studies have involved people's perceptions of climate change, especially youth groups from a background and young people in Indonesia, but did not limit the scope of the research.

This research study focuses on the perceptions of active university students from non-forestry and environmental backgrounds in Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) towards the role of *Moringa oleifera* related to climate change mitigation. The perception of active non-forestry and environmental students towards the role of *Moringa oleifera* related to climate change mitigation is important to analyze because students as the younger generation play a major role in their involvement in climate change mitigation strategies. By knowing the perceptions of non-forestry and environmental students towards the role of *Moringa oleifera* related to climate change mitigation, it is hoped thatit can be the basis for developing further strategies for climate change mitigation in relation to *Moringa oleifera* by the institutionsconcerned.

LITERATURE REVIEW

A. Climate Change

Climate change is one of the most crucial issues today. Climate change is caused by several factors, one of the main factors is global warming. Global warming is a phenomenon in which the Earth's temperature increases as a result of the release of relatively large amounts of greenhouse gases into the atmosphere. According to the Intergovernmental Panel on Climate Change (IPCC), energy use, industrial processes and product use, agriculture use, forestry use, land use, and waste are the sectors that are the main sources of CO2 emissions (Rypdal *et al*., 2006). The transportation sector is a major contributor toglobal warming because it emits large amounts of carbon dioxide.

Motor vehicles contribute 71 million tons of CO2 emissions with 179 million Barrel of Oil Equivalent of energy consumption. Based on the opinion of the Indonesian Ministry of Environment and Forestry (2010), the high CO2 content will affect global warming. The transportation sector includes cars, trucks, buses, trains, planes and ships. The modes of transportation, which include cars, trucks, buses, trains, planes and ships, use fossil fuels.When fossil fuels are burned, they release carbon dioxide and other greenhouse gases into the atmosphere. This results in a thick mantle around the Earth that traps heat and causes the Earth's temperature to rise.

B. Moringa oleifera

Moringa oleifera is a tropical tree species of the Moringaceae family. In Indonesia, *Moringa oleifera* is known as 'Kelor'. The Moringaceae family consists of about 13 tree species (Vaknin and Mishal, 2017). *Moringa oleifera* is the most well-known species among other species in the Moringaceae family. *Moringa oleifera* is native to northern India and parts of northern Europe. According to Singh *et al*., (2019) in their research, although it also grows in the Red Sea region and/or other parts of Asia and Africa, including Madagascar, *Moringa oleifera* has been distributed throughout the world, namely in the continents of Asia, Africa, Central America, and South America. *Moringa oleifera* is given other names 'aroma tree, thigh, radish, mulangai, muunga, saigan, marangu, sajna, mlonge, or Benn oil tree' (Zainab *et al*., 2020).

Villafuerte and Villafurte (2009) reported that *Moringa oleifera* contains many vitamins and nutrients that are good for human consumption and can be used as animal feed. The content of vitamins, nutrients, and chemicals in *Moringa oleifera* powder is sufficient. Villafuerte and Villafurte (2009) added, there is a content of 30-40% oil, 82% unsaturated fatty acids, and 13% saturated fatin *Moringa oleifera* seeds. The World Health Organization (WHO) has promoted *Moringaoleifera* as an alternative source of imported food to treat malnutrition (Sreelatha and Padma, 2009). *Moringa oleifera* has great potential as a prevention of various diseases including nutritional deficiencies, cancer, and anemia. In addition, *Moringa oleifera* can also play a role for water purification. According to Gedefaw (2015), this makes *Moringa oleifera* known as a cure for various diseases.

METHODOLOGY & DATA

A. Location and Time of Research

The research entitled "Analysis of the Perceptions of Non-Forestry and Environmental Students in Jabodetabek on the Role of *Moringa oleifera* in Climate Change Mitigation" took the location and object of research in the Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) area. This research was conducted in May 2023.

B. Tools and Materials

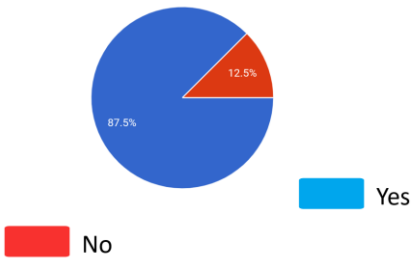
The research study entitled "Analysis of the Perceptions of Non-Forestry and Environmental Students in Jabodetabek on the Role of *Moringa oleifera* in Climate Change Mitigation" used a closed questionnaire as a research instrument with a Guttman Scale in the form of 'Yes' and 'No' and related journals and literature as references. The sample used in this study amounted to 213 respondents from 1000 population with an error rate of 10%. The research instrument has gone through a validity test in the form of a reproducibility coefficient and a scalability coefficient.

C. Research Procedure

The study entitled "Analysis of the Perceptions of Non-Forestry and Environmental Students in Jabodetabek on the Role of *Moringa oleifera* in Climate Change Mitigation" was carried out by distributing research instruments in the form of

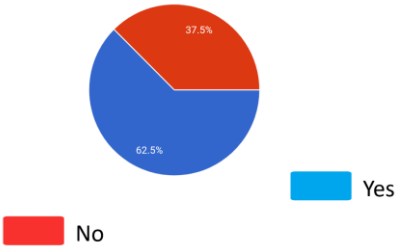
closed questionnaires online via Google Form. The research used the Guttman Scale. The research indicators were tested on 213 sample respondents from a population of 1000 with an error rate of 10%. Before the research instrument is tested on the sample, avalidity test and reliability test are carried out so that the instrument is valid and reliable. The validity test uses the reproducibility coefficient and the scalability coefficient, while the reliability test uses the Kuder-Richardson 21 formula or commonly known as KR 21.

DISCUSSION



Picture 1. A pie chart of the statements of active non-forestry and environmental students in Jabodetabek who know that Moringa oleifera can help in efforts to reduce greenhouse gas emissions.

A total of 87.5% of respondents who are active students from non-forestry and environmental education backgrounds inJakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek), know that *Moringa oleifera* can help in efforts to reduce greenhouse gas emissions. This data is supported by 90% of respondents who feel the need to get more information about the role of *Moringa oleifera*in climate change mitigation. In addition, 62.5% of respondents stated that they had participated in activities related to climate change mitigation, starting from a small scale such as planting trees in the neighborhood. Known for the efficacy and nutrition of each part, *Moringa oleifera* is easy to cultivate withlittle maintenance. The *Moringa oleifera* planting process is a water conservation approach by using 5 L of water during plantingand 250-100 mL per day afterwards, then the water application capacity decreases as the tree and roots grow (Trigo *et al*., 2021). This isalso indicated by 62.5% of respondents who said that *Moringa oleifera* grows around their home environment. According to research by Bancessi *et al.* (2020), *Moringa oleifera*'s adaptability to soil and climate change is known to be very good supported by its easy propagation. Therefore, *Moringa oleifera* is a solution to mitigate climate change while reducing the impact of climate change itself.



Picture 2. A pie chart of the statements of active non-forestry and environmental students in Jabodetabek who stated that *Moringa oleifera* grows around their home environment.

One of the causes of climate change is global warming caused by excessive production of greenhouse gases in the atmosphere resulting in an increase in temperature on Earth. Greenhouse gases are chemical gases spread in the Earth's atmospheric layer, consisting of carbon dioxide (CO2), sulfur dioxide (SO2), nitrogen monoxide (NO), nitrogen dioxide (NO2), methane gas (CH4), and chlorofluorocarbons (CFCs). Indonesia ranks sixth on a global scale in producing gas emissions or exhaust gases, which is as much as 4.47% (Aisyi, 2020). The transportation sector is one of the largest contributors to emissions. Pollution in metropolitan cities and several supporting cities in the vicinity, resulting in large-scalepollutants in the atmosphere. Emissions from motorized vehicles in Indonesia are a source of pollutants that need to be seriously addressed with mitigation.

Mitigation of global warming is part of mitigation of climate change. One of the mitigation efforts is to plant *Moringa oleifera* trees in urban areas, including in the Jabodetabek area. This is in line with research reports in Japan which show that *Moringa oleifera* is able to absorb carbon dioxide (CO2)up to 20 times more than the average ability of other vegetation (Villafuerte and Villafurte, 2009). Seeing the level of carbon dioxide absorption by *Moringa oleifera* which is able to reach 20 times more than the average of other vegetation, planting *Moringa oleifera* on a large scale becomes feasible. This is supported by 90% of respondents who agreed that the government should promote the use of *Moringa oleifera* for climate change mitigation.

CONCLUSION

Based on the results of research conductedby researchers, active students with non-forestry and environmental educationbackgrounds in the Jakarta, Bogor, Depok, Tangerang, and Bekasi (Jabodetabek) area, have a positive perception of the role of *Moringa oleifera* in climate change mitigation.A total of 87.5% of respondents knew that *Moringa oleifera* can help in efforts to reduce greenhouse gas emissions. A total of 90% of respondents felt the need to get more information about the role of *Moringa oleifera*in climate change mitigation and agreed that the government should further promote the use of *Moringa oleifera* for climate change mitigation. 62.5% of respondents stated that *Moringa oleifera* grows around theneighborhood and they have participated in activities related to climate change mitigation.

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