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The Strength of Support Big Cities in Southeast Asia as the Basis of Implementing the Sustainable City Concept to Overcome Environment Problems based on Biplot Analysis

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Abstract. *The high rate of urbanization in various cities is one of the global problems. Based on data from the United Nations (UN), almost half of the world's total population, which is 3.5 billion people, lives in urban areas. This problem has also become a major factor which causes cities experience decline in its support power. Cities exactly only used 3% of the earth's land, but they were able to spend 60 - 80 % of energy consumption, and resulted in 75% of carbon emissions. This is the source of urban environmental problems in the world. ASEAN cooperation in the environmental field to realize sustainable cities is one of the strategies in overcoming these. As a basis for implementing right policy of these efforts, a statistical analysis is needed to find out countries with the same level of sustainability and know the dominant problems in ASEAN. This study used secondary data obtained from the ASEAN Foundation which consisted of 2013 city carrying capacity data from 10 ASEAN countries, those are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam. The results are Laos, Brunei Darussalam and Cambodia have similarities in terms of the forest area and food production index; Malaysia, Myanmar and Vietnam have similarities in terms of the urban population; Vietnam, Philippine and Thailand have similarities in terms of ozone–depleting substance consumption and access to electric; Vietnam, Myanmar, Thailand and Indonesia have similarities in terms of CO_2 emission, GHG emission and agricultural land area.*

Keywords*: Sustainable cities, ASEAN, Analysis of bilpot, environmental problems, urbanization*

I. Introduction

Urbanization is still a global problem in various countries, including countries of the Association of Southeast Asian Nations (ASEAN). In 2030, urbanization in Southeast Asia will be projected to be 100 million people from the number of 280 million in 2017 to 373 million. Based on studies have been released by the Martin Prosperity Institute (MPI), Manila and Jakarta are mega cities with more than 10 million people, while Bangkok, Ho Chi Minh, Kuala Lumpur and Singapore have populations of between five and 10 million people. In 2030, Bangkok and Ho Chi Minh will be projected to have more than ten million, Kuala Lumpur will have nearly 10 million people, while Singapore will reach seven million [1].

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The increasing rate of urbanization cannot be separated from the role and position of the city as the centre of social and economic development. It is undeniable that the city has made people to advance in social and economic. It also leads to the division of labor, technological innovation and economic growth. It makes the provision of education, health and other services more efficient.

Population density and economic activities ultimately lead to disproportionate pressure on the natural environment through excessive exploitation of natural resources and waste production [2,3]. Quoted from the United Nations, cities only used 3 % of the earth's land, but were able to spend 60−80 percent of energy consumption, and they produced 75 percent of carbon emissions. These are the causes of environmental degradation at the local, national and global [4].

In the previous research related to this topic, three forms of cooperation between ASEAN and the international community could be valuable to reduce risk of environment, such as Information Systems, Capacity Building, and Innovative Financing [5]. Besides that, its cooperation on the environment, such as the development of environmentally friendly technologies, increasing public awareness about the importance of protecting the environment or making regulations on environmental protection, needed to keep the global environment and resolve environmental problems that occur.

ASEAN cooperation in the environmental field to realize sustainable cities needs to be developed more efficient through several policies. As a basis for making the right policies, a statistical analysis needed in the form of grouping ASEAN countries based on several indicators in the concept of sustainable cities to find out countries with the same level of sustainability and know the dominant problems in each ASEAN country. These strategies are resulted from data analysis using bi-plot analysis that is suitable for the aims of this research and it provides the group of object visually so it makes the analysis become clearer. It can be a basis for making policies and appropriate solutions to tackle global environmental problems. With the same problems, which are found in ASEAN countries, can raise the awareness together as a new concentration to be able solve these by new agreements.

II. Literature Reviews

Urbanization in ASEAN

Urbanization is a complex phenomenon related to capitalist unfolding, economic and polical [6]. Urbanization has become one of the important issues in ASEAN. Urbanization occurs either domestically or between ASEAN member countries. Since the ASEAN 2025 economic community agreed to release work visas in 2015, there has been an increase in labor migration to reach 6.5 million people. The majority of the workforce came from Cambodia, Indonesia, Myanmar, the Philippines and Vietnam with the aim of going to countries such as Thailand, Malaysia and Singapore. However, most job seekers lack competence and only fill the labor sector. In addition to migrant job seekers, there are around 284.949 registered asylum seekers. This amount can increase along with economic and welfare disparities between ASEAN countries.

Environmental Problems Because of Urbanization

Urbanization has a negative impact on the environment, natural vegetation cover is largely replaced by paved surfacesand and a small part of open spaces are maintainedfor recreational or ornamental purposes [7]. In 2018, Jakarta was called the city with the worst air quality in ASEAN with average annual concentration of PM 2.5 (Particulate Matter 2.5) in the very bad category. The report said the annual average concentration of PM 2.5 in Jakarta reached 45.3 $\mu g/m^3$, outperforming

Hanoi which reached 40.8 $\mu g/m^3$ [8]. This presents far exceeds the annual safe limit according to WHO which is 10 $\mu g/m^3$. The high level of pollution is estimated due to the high number of vehicles and coal-fired power plants located near the city.

Besides of that, the water pollution is not better. According to reports in 2017, most of the rivers in ASEAN are polluted, such as the Mekong River, theMarilaoin Philippines, the Citarum in Indonesia, the Irrawady in Myanmar, the Chao Phraya in Thailand and the Kinabatangan in Malaysia [9]. The pollution occurs due to people who dispose of garbage in the river and disposal of industrial waste without being treated into the river.

ASEAN Cooperation on the Environment

Based on the ASCC blueprint 2025, there are seven strategic priority plans including: 1) Nature conservation and biodiversity, 2) Coastal and marine environment, 3) Water resources management, 4) Environmentally sustainable cities, 5) Climate change, 6) Chemicals and waste and 7) Environmental education and sustainable consumption and production.

The institutional structure in ASEAN cooperation on environment includes of the ASEAN Ministerial Meeting on the Environment (AMME), ASEAN Senior officials on the Environment (ASOEN), ASEAN Working Group on Chemicals and Waste (AWGCW), ASEAN Working Group on Environmental Education (AWGEE), ASEAN Working Group on Climate Change (AWGCC), ASEAN Working Group on Natural Resources and Biodiversity (AWGNCB), ASEAN Working Group on Water Resources Management (AWGWRM), ASEAN Working Group on Coastal and Marine Environment (AWGCME), and ASEAN Working Group on Environmentally Sustainable Cities (AWGESC).

Biplot Analysis

Biplot analysis is a scatter plot that approximates and graphically display a two-way table by both its column and row factors such that relationships among the column factors, relationships among the row factors, and the underlying interactions between the column and row factors can be visualized simultaneously [10]. The interpretation of a biplot is directed towards the scalar products of lower dimensional factorial variables and designed to approximately recover the individual elements of the data matrix in these scalar products 11].

Through biplot analysis there is some important information that can be observed: proximity between objects, variety of variables, correlation between variables, and value of variable on an object.

III. Method

Data and the Source of it

This study used secondary data obtained from the ASEAN Foundation which consisted of 2013 city carrying capacity data from 10 ASEAN countries, those are Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Vietnam.

Variables

The variables used are the following eight variables.

Table 1. Variables Definition

Variable	Variable Description	Variable Definition
$\mathbf{X_1}$	Access to electric	Access to electricity is the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources.
$\mathbf{X_2}$	Ozone-depleting substances consumption	Consumption of all Ozone-Depleting Substances in ODP metric tons.
$\mathbf{X_3}$	CO_2 emission	The proportion of CO_2 emitted
$\mathbf{X_4}$	GHG emission	The proportion of greenhouse emitted
$\mathbf{X_5}$	Forest area	Forest area is land under natural or planted stands of trees of at least 5 meters in situ, whether productive or not, and excludes tree stands in agricultural production systems (for example, in fruit plantations and agroforestry systems) and trees in urban parks and gardens.
$\mathbf{X_6}$	Food production index	Food production index covers food crops that are considered edible and that contain nutrients.
$\mathbf{X_7}$	Agricultural land area	The total agricultural land area consists of areas categorized as arable land, permanent crops and permanent pasture.
$\mathbf{X_8}$	Urban Population	Percentage of population living in urban areas.

Analysis Procedures

The method to analyze the data is biplot analysis. It uses because it is suitable for the aims of this research and it provides the group of object visually so it makes the analysis become clearer. The procedures to analyze data obtained is as follows:

- Enter data in the analysis software based on the factors used
- Perform biplot data analysis
- Draw a biplot chart
- Graph interpretation

IV. Result and Discussion

Descriptive Analysis

Urbanization is still a global problem in various countries, including countries of the Association of Southeast Asian Nations (ASEAN). Environmental changes such as pollution and declining natural resources are among the impacts that occur in cities with high levels of urbanization. Each ASEAN country has a different environment problem. The following are data on several indicators of global environmental problems in ASEAN which are also indicators of sustainable urban development.

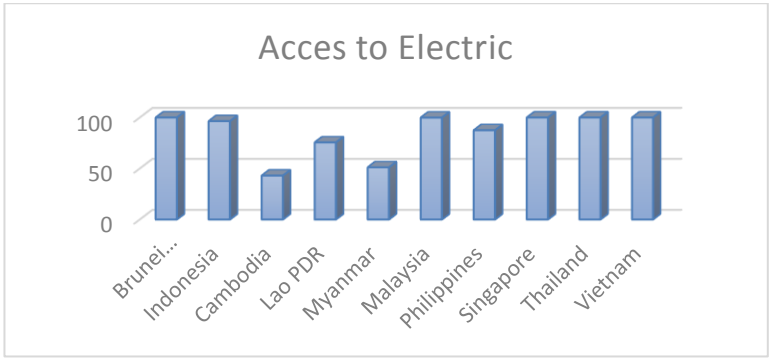

Figure 1. Graphic of access to electric in ASEAN

Based on the graph in Figure 1, the countries that have the highest access of electric were Brunei Darussalam and Vietnam with a value of 100%. While the country with the lowest access of electric was Cambodia with a value of 43.04%.

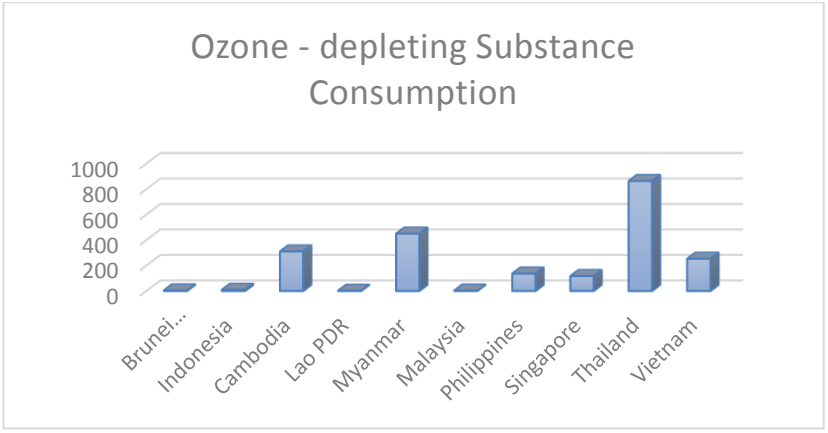

Figure 2. Factors that cause changes in the global environment

Based on the graph in Figure 2, the country that have the highest ozone-depleting substance consumption was Thailand with a value of 863.3 ODP tons. While the country with the lowest ozone-depleting substance consumption was Laos with a value of 1.6 ODP tons.

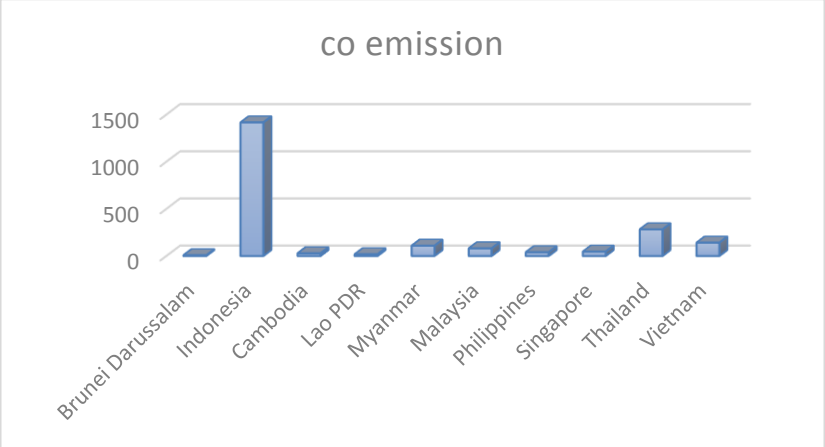

Figure 3. Factors that cause changes in the global environment

Based on the graph in **Figure 3**, the country that produces the largest CO_2 emission was Indonesia with a value 1416.3 $MtCO_2$. While the country that produces the smallest CO_2 emission was Laos with a value 1.6 $MtCO_2$.

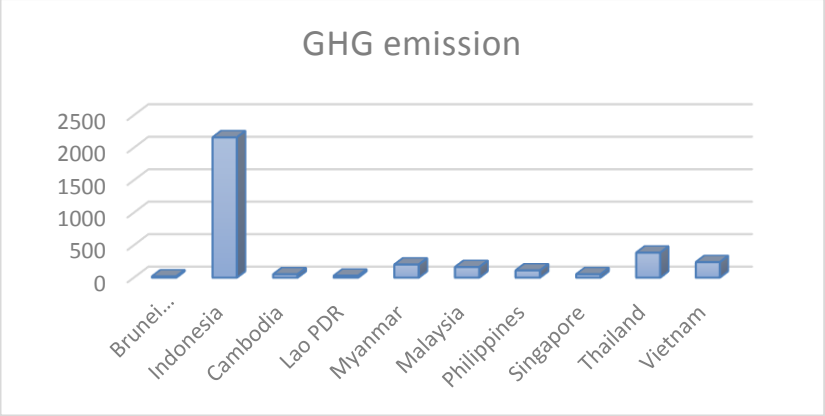

Figure 4. Factors that cause changes in the global environment

Based on the graph in Figure 4, the country that produces the largest GHG emission was Indonesia with a value 2160.6 $MtCO_2$. While the country that produces the smallest CO_2 emission was Brunei Darussalam with a value 19.4 $MtCO_2$.

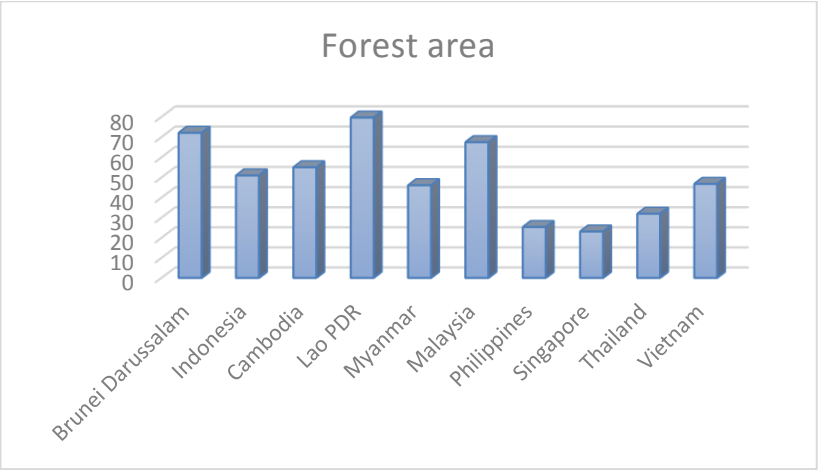

Figure 5. Factors that cause changes in the global environment

Based on the graph in Figure 5, the country that have the highest forest area was Laos with a value of 79.65%. While the country with the lowest forest area was Singapore with a value of 23.13%.

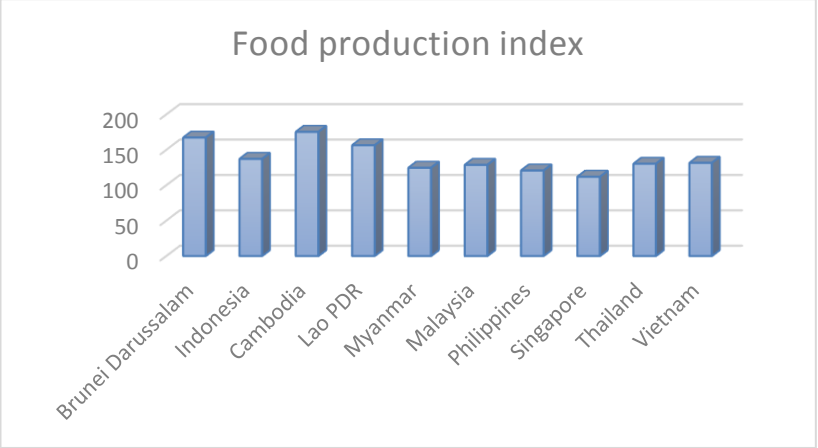

Figure 6. Factors that cause changes in the global environment

Based on the graph in Figure 6, the country that have the highest food production index was Cambodia with a value of 175.4. While the country with the lowest food production index was Singapore with a value of 112.

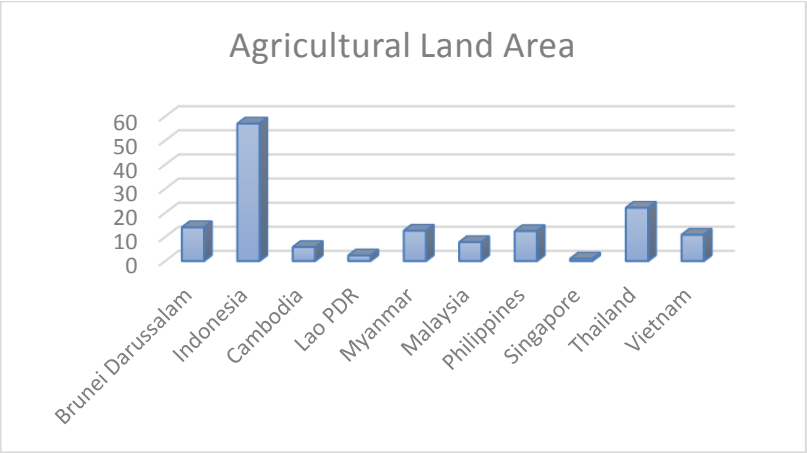

Figure 7. Factors that cause changes in the global environment

Based on the graph in Figure 7, the country that have the highest agricultural land area wasIndonesia with a value of 57%. While the country with the lowest agricultural land area was Singapore with a value of 1%.

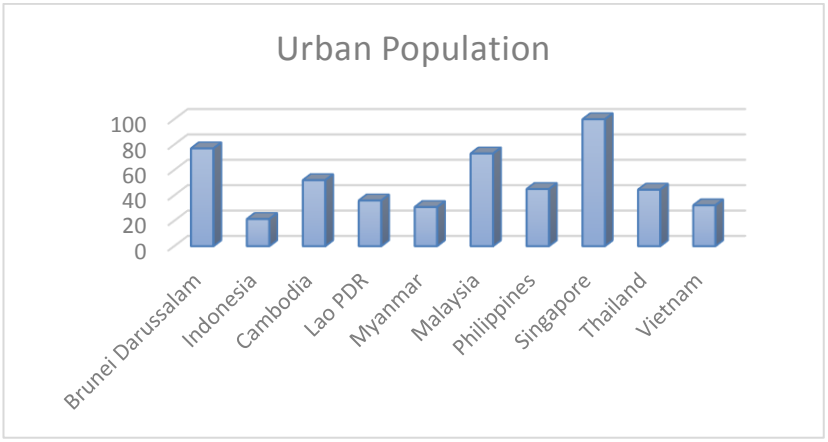

Figure 8. Factors that cause changes in the global environment

Based on the graph in Figure 8, the country that have the highest urban population was Singapore with a value of 100%. While the country with the lowest urban population was Indonesia with a value of 21.4%.

Biplot Analysis

Comparison Biplot as a graphical tool for presenting results from main component analysis. Biplot is useful for adding information about variables in the main component graph. The following are the results of biplot analysis of factors that cause global environmental problems in ASEAN countries.

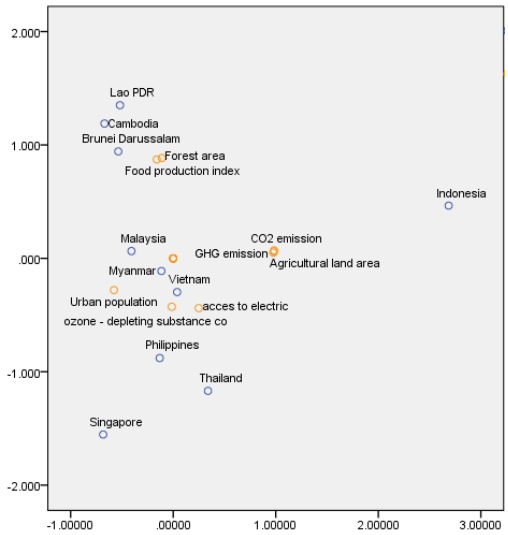

Figure 2. Results of Biplot Analysis

Based on the results of the biplot analysis in **Figure 2.** the results obtained are that Laos, Brunei Darussalam and Cambodia have similarities in terms of the forest area (X_5) and food production index (X_6). Malaysia, Myanmar and Vietnam have similarities in terms of the urban population (X_8). Vietnam, Philippine and Thailand have similarities in terms of ozone–depleting substance consumption (X_2) and access to electric (X_1). Vietnam, Myanmar, and Indonesia have similarities in terms of CO_2 emission (X_3), GHG emission (X_4) and agricultural land area (X_7).

V. Conclusion and Recommendations

Based on the results of this study it can be concluded that Laos, Brunei Darussalam and Cambodia have similarities in terms of the forest area (X_5) and food production index (X_6), but Brunei is dominant in the forest area (X_5) and food production index (X_6). Malaysia, Myanmar and Vietnam have similarities in terms of the urban population (X_8), but Myanmar is dominant in the urban population. Vietnam, Philippine and Thailand have similarities in terms of ozone–depleting substance consumption (X_2) and access to electric (X_1), but Vietnam is dominant in the ozone-depleting substance consumption (X_2) and access to electric (X_1). Vietnam, Myanmar, Thailand and Indonesia have similarities in terms of CO_2 emission (X_3), GHG emission (X_4) and agricultural land area (X_7), but Vietnam and Myanmar are dominant in the CO_2 emission (X_3), GHG emission (X_4) and agricultural land area (X_7).

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