Environmental Kuznets Curve Hypothesis: A Perspective of Sustainable Development in Indonesia

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Abstract. Sustainable development with three main pillars, namely environmental, economic, and social, is the concept of country's development to achieve inclusive economic growth, good environmental quality, and improvement of people's welfare. However, the dominance of economic factors cause various environmental problem. This phenomenon occurs in most of developing countries, including in Indonesia. The relationship between economic activity and environmental quality has been widely discussed and empirically tested by scholars. This descriptive research analysed the hypothesis called Environmental Kuznets Curve (EKC) from a perspective of sustainable development in Indonesia. EKC hypothesis illustrates the relationship between economic growth and environmental degradation forming an inverted U-curve, indicating that at the beginning of development, environmental quality will decrease along with increasing economic growth, and then reached a certain point the environmental quality will gradually improve. In this paper will be discussed how the relationship between environmental quality and economic growth in Indonesia was investigated. The preliminary results show that most of the empirical studies use the conventional approach, in which the CO_2 emission used as the proxy of environmental degradation. The existence of inverted U-curve is also inconclusive. Therefore, the extension research on the relationship between economic growth and environmental quality in Indonesia using the EKC hypothesis is required.

1 Sustainable Development

1.1 Definition of sustainable development

The term sustainable development became a familiar thing to be discussed. Sustainable development is defined as development that aims to meet the needs of the present without compromising the ability of future generations to meet their own needs. The Brundtland Report described the definition of sustainable development into two key concepts [1], namely: 1) the concept of needs that give priority to the needs of the world's poor; and 2) the concept of limitations on the ability of the environment to meet the needs of present and future. From these definitions, inter-generational and intra-generational equity are the keys to sustainable development [2].

Sustainable development has three main pillars: economic, environmental, and social that presented as three interconnected rings as shown in Figure 1 [3]. This figure shows that these three aspects should be applied in a balanced state policy to achieve sustainable development.

1.2 The dominance of economic aspect

In practice, the successful development of a country tends to be measured in purely economic indicators, such as economic growth. Per capita income is used as a measure of the country's economic growth, as it has been used by the World Bank to classify the countries level of development.

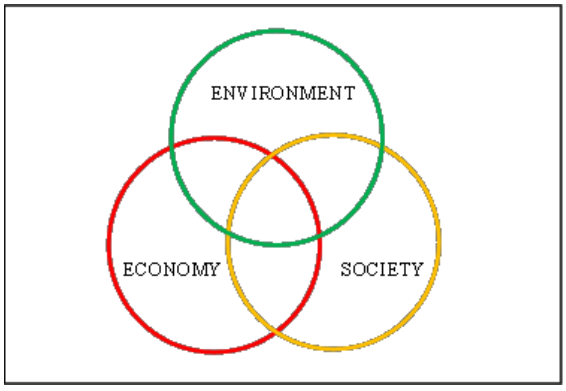

Fig. 1. Three main pillars of sustainable development [3]

Therefore, countries with low income will continue to increase economic growth in their development objectives, so that environmental and social issues to be neglected. This indicates that the economic side still dominates the practice of development compared to the social and environmental aspects. In other words, the balance of the three aspects of development has not been

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fully implemented as it was intended from the concept of sustainable development.

In addition, the existence of political factor provides the flexibility of economic aspects to continue exist [3]. Political factor and economic interest are two inseparable things. Political and economic actors need each other to maintain their existence. As a result, the environment, including the natural resources contained in it is used as capital for exploitation. Environment and society becomes victim because it used as a place to dispose of problems such as waste or disease.

In fact, economic growth requires two basic requirements, that is physical needs and social needs. Physical needs including raw materials, fuel and other natural resources. Social needs becomes very important to support the economy, in case of employment as well as developments in science and technology [4].

With only concerned with the economic aspect in the development of a country, it is no wonder if there is a wide range of environmental issues, including in Indonesia.

2 Economic and environmental conditions in Indonesia

Based on per capita income, economic growth in Indonesia tends to increase from 1970 to 2015 (Figure 2). In 1970, Indonesia's per capita income was US$ 84.09. Per capita income has increased from year to year up to 2015 to US$ 3346,487. Based on the data from the Central Bureau of Statistics (Badan Pusat Statistik) [5], manufacturing; agriculture, forestry, and fishing; mining and quarrying dominate the contribution of Indonesia's gross domestic product in 2016 (Figure 3). Therefore, Indonesia still relies on industrial sector and utilization of natural resources as capital development.

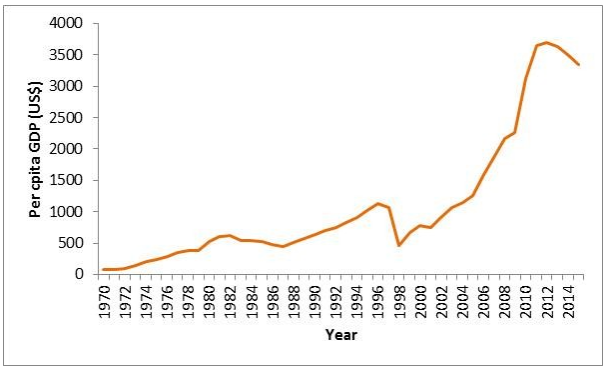

Fig. 2. Indonesia's per capita income [6]

Indonesia's economic growth was not in line with the maintenance of environmental quality. Various environmental problems in Indonesia, perhaps, produced from the development activities that are only pursuing economic growth. One is the increasing CO_2 emissions. It is the major cause global warming. According to a report from the World Resources Institute [7] Indonesia has become a top 10 contributors to global greenhouse gas emissions.

In addition, deforestation also occur in Indonesia (see Figure 4) caused by the conversion of forest lands [7]. The existence of the rate of deforestation in Indonesia is high, i.e. more than 1% per year [8] will worsen air quality and will further increase global warming.

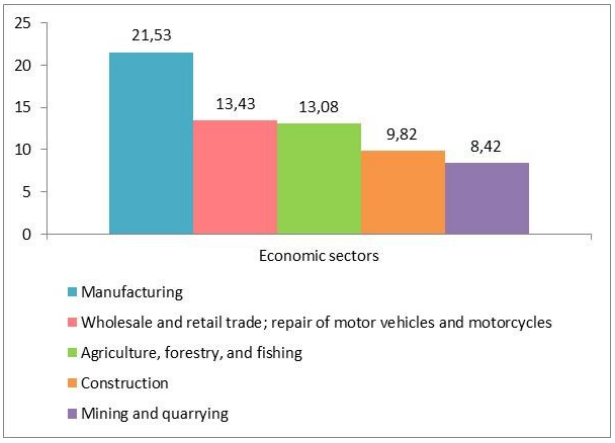

Fig. 3. Top five economic sectors contribution of Indonesia's GDP in 2016 (percent) [5]

Ecological Footprint can also be used to look at the quality of the environment. Ecological footprint illustrates the amount of land required by the human population in its activities to meet the needs [9]. In Indonesia, the ecological footprint is showed in Figure 5, in which over the years the ecological footprint in Indonesia has increased. When compared to its natural capacity (bio capacity), Indonesia had been an ecological deficit since 2002. This means that per capita consumption of Indonesian society has exceeded the carrying capacity of the natural environment as seen in Figure 5.

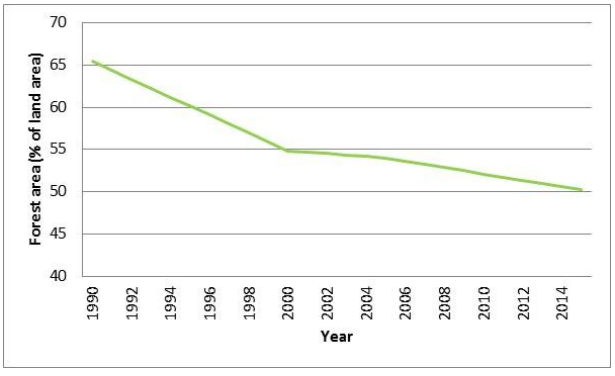

Fig. 4. Forest area in Indonesia [10]

The low quality of Indonesian environment can also be seen from the *Environmental Performance Index* (EPI). In 2016, there were 180 countries assessed in terms of its efforts in addressing environmental issues with high priority are divided into two categories, that is the protection of human health and the ecosystem [11]. Indonesia was only able to rank 107. Meanwhile, other ASEAN countries like Singapore, Malaysia, Thailand, and Philippines are ranked 14, 63, 91, and 66 respectively.

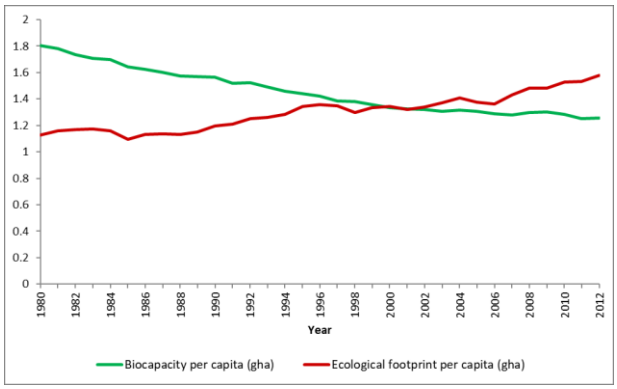

Fig. 5. Ecological footprint Indonesia 1980-2012 [12]

In terms of energy, Indonesia is still relying on non-renewable energy. Based on the data from the National Energy Council [13], nearly 50% of Indonesia's primary energy is supplied from oil, followed by coal at 31%, while renewable energy is only used less than 5% (see Figure 6). Though Indonesia has the potential of renewable energy is large enough, such as hydropower that is equal to 75 GW, but unfortunately only 8,111 MW installed. There are also geothermal energy which reached 29,475 MW and biomass by 32 GW. However, the utilization of renewable energy is far under the existing potential.

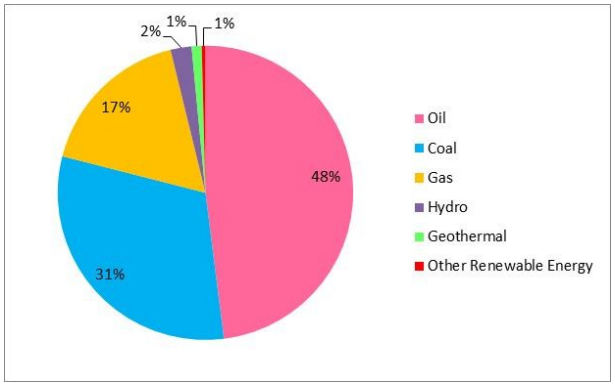

Fig. 6. Indonesia's primary energy mix 2014[13]

Based on the Figure 6, Indonesia may be experiencing a more severe environmental degradation and natural resource crisis, when the development is only concerned in pursuing the income per capita, without realizing the importance of maintaining environmental quality.

From the phenomena figured out above, there are some important questions to be addressed, whether the economic growth will always be detrimental to the quality of the environment? How is their relationship? Will it continue to contradict?

3 The relationship between economic growth and environmental quality

Economic growth and the environment have a close relationship. Economic activity consists of the production and consumption activities that can't be separated from the environment, where they are located. It is because all economic activities depend on the resources contained in the environment [14, 15]. This dependency will also have environmental impacts as a result of economic growth.

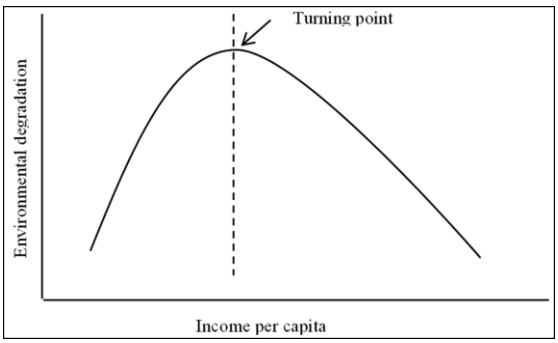

Fig. 7. Environmental Kuznets Curve [16]

The relationship between economic growth and environmental quality, becomes a concern by experts. Various studies have been conducted to determine the relationship between them. One of these studies resulted in a hypothesis called hypothesis Environmental Kuznets Curve (EKC) [16, 17].

EKC hypothesis illustrates the relationship between economic growth indicated by per capita income and environmental degradation, forming an inverted U-shape curve (Figure 7). This curve shows that at the beginning of development, per capita income will increase with increasing the environmental degradation to a certain point, and then the environmental quality will be improved along with the increase of income per capita. This is because at the beginning of development, the concern for environmental issues is still low and environmentally friendly energy is not yet available. At the higher level of development, there will be awareness about the importance of maintaining the environmental quality as a result of previous economic growth, the enactment of environmental protection regulations by the government, and the rise of science and technology so as to create an environmentally friendly technology. The existence of this development will lead to environmental degradation gradually decreases [18].

4 EKC hypotheses in Indonesia

In general, to investigating EKC hypothesis using two approaches, viz. using cross-country panel data analysis (see [19-23]) and using a single country time series analysis (see [24-28]). By using cross-country panel data analysis will only describe the general EKC hypothesis, in which suggestions and conclusions can't be applied in each country. Therefore, in order to provide advice and input to environmental policy in certain countries, the approach to single-country time series analysis is more appropriate.

The research investigation of EKC hypothesis in Indonesia itself is still fairly limited. Based on the search of scientific articles on the Science Direct, it was found three relevant articles that discuss the investigation of EKC hypothesis using single country time series

analysis. These studies were conducted by Saboori, et. al. [29], Jafari, et. al. [30], and Sugiawan & Managi [31], which briefly presented in Table 1.

These studies use CO_2 emissions as an indicator of environmental quality, and per capita income is used as an indicator of economic growth. Per capita income is used as a measure of economic growth due to, in fact, the per capita income is an fundamental indicator shows the growth or development of a country [16]. Meanwhile, CO_2 emission is used as variable that indicate the environmental degradation. This is associated with the issue of global warming that become the world's attention, and CO_2 emissions is one of the main causes.

By choosing CO_2 emissions as an environment variable, it will be able to provide input on policies relating to the reduction of CO_2 emissions in order to keep in line with the increase of economic growth. In Indonesia, CO_2 emissions reduction issue becomes government's particular concern. However, the environmental issues and problems faced by Indonesia are also increasingly complex.

Table 1. Empirical evidences of EKC hypothesis in Indonesia

Author	**Saboori, et al. [29]**	**Jafari, et. al. [30]**	**Sugiawan & Managi [31]**
Study period	1971-2007	1971-2007	1971-2010
Method	ARDL	Toda-Yamamoto (TY) procedure	ARDL
Variables	Per capita CO_2 emissions, per capita GDP, commercial energy consumption per capita, trade openness ratio	CO_2 emissions, GDP, energy consumption, urban population, capital stock	Per capita CO_2 emissions, per capita GDP, per capita electricity production from renewable sources, energy consumption, total factor productivity
Result	Do not support the EKC hypothesis	Do not support the EKC hypothesis	Support the EKC hypothesis

Need to put more deeply concern on the use of variables that able to represent the environmental quality. Choosing the proper environment variables in the EKC hypothesis will describe the relationship between economic activities and the environment better. Some aspects need to be considered in the selection of environmental variables. The main issue of the development and environment quality is an important side in the EKC hypothesis research. The research should describe the condition of the country as it is. In addition, the selection of environmental variable also needs to consider the availability of the data in a long period of time as required in the analysis of EKC.

In the study using single country time series analysis, the method of autoregressive distributed lag (ARDL) is widely used by researchers. This is because the method of ARDL has several advantages [32-34], among others, that:

1) This model uses only single equation
2) ARDL can be used on data that are integrated in different orders
3) The ARDL approach more suitable for small samples when compared with using other approaches
4) ARDL model is sufficient to simultaneously correct for residual serial correlation and problem of endogenous variables

Research conducted by Saboori, et. al. [29], Jafari, et. al. [30] does not prove EKC hypothesis in Indonesia. However, a different result was found by Sugiawan & Managi [31] that prove EKC hypothesis in Indonesia in the long-run.

EKC hypothesis verification research in Indonesia provides different results. Although all of them use CO_2 emissions and per capita income, but the explanatory variables are used differently. Saboori, et. al. [29] use commercial energy consumption per capita and trade openness ratio. Jafari, et. al. [30] use energy consumption, urban population, and capital stock. Meanwhile Sugiawan & Managi [31] use per capita electricity production from renewable sources, energy consumption, and total factor productivity. The use of different variables will produce different models, so the results will be different too. Therefore, in the research to proof EKC hypothesis, it's very important to choose the appropriate variables.

5 Conclusions

The relationship between economic activity and environment in the development of a country is an issue that has been discussed for a long time. Research to determine the relationship of the two produces the Environmental Kuznets Curve hypothesis. This hypothesis illustrates the relationship between economic growth indicated by per capita income, and environmental degradation that forms an inverted U-shape curve.

Investigation of EKC hypothesis in a country can be used to determine the extent of economic development undertaken affect the environmental quality. Environmental quality is one of the pillars of sustainable development, so that the EKC hypothesis shows a picture of the sustainability of development in a country. From the proof of EKC hypothesis, can be obtained input for policy development of a country seen from the various variables used and the resulting correlation.

From various studies to investigating the hypothesis EKC in Indonesia, need additional studies with specific updates. The variable is one of the important things in the EKC hypothesis, notably variables describing environmental degradation. Investigation of EKC hypothesis is carried out over a long period of time.

Therefore, the study should conducted in a period of time were able to describe the past historical conditions up to current conditions.

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