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Industrialization and Land Conversion in Indonesia

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Abstract Along with increasing development activities and population growth, the need for land is increasing, such as for settlements, industry and facilities and infrastructure. On the other hand, the availability of land is relatively constant, causing land scarcity or excess demand. The existence of excess demand for land availability causes land use competition, which will lead to land conversion. The study aims to empirically examine the antecedents of land use change that occurred in Indonesia in the 1981-2018 period. This study aims to determine whether industry and population growth influence land conversion that occurred in Indonesia in 1981-2018. This study uses secondary data published by World Bank for the 1981-2018 period. This study analyzes the effect of population and industrial growth with medium to high technology on land conversion in Indonesia. In this study, the ECM method used was the Engle and Granger two-stage procedure method, namely by running The Engle-Granger two-stage procedure. This study applies the Error Correction Model (ECM) dynamic model. The use of dynamic models is important in economic analysis because dynamic specifications are concerned with the formation of models of an economic system related to changes in time. In ECM estimation, all variables in the study must be stationary. These conditions must be met so that the estimation results are not biased or do not show spurious regression results. The results empirically prove that the variable of industry has a significant effect in the short term on land conversion in Indonesia. Growth with medium-high technology including construction that occurred in Indonesia (INDUSTRY) was 1.64E-05 which means that an increase in industry of 1 percent will increase land conversion by 1.64E-05 percent in the short term. The novelty in this study is to use a variable ratio of agricultural land area, which is reversed mathematically to measure land conversion variables in Indonesia.

Keywords Land Use Change, Population Growth, Agriculture, Industry

1. Introduction

Land is one of the most essential things in human life. Land is an area where people gather and live together, where they use the surrounding environment to maintain, sustain and develop their life [1]. Land is an area on the earth's surface that has the characteristics of the biosphere vertically above or below the area including atmosphere, geological soil, geomorphology, hydrology, vegetation and animals as the result of human activity both in the past and the present and the expansion of these characteristics has an influence on human land use in the present or the future.

Every living being on earth needs land to grow and develop where all the activities of living things are carried out on the surface of the land. Land management can move the economy in society. However, the land on earth is limited in number and extent. Therefore, there is a scarcity of land where the available land is unable to meet human demand for land. This scarcity of land causes problems, namely land use change or it can be referred to as land conversion. There are two problems caused by land conversion, namely direct (visible) and indirect (cannot be felt) impacts [2,3]. Direct impacts include reduced employment in the agricultural sector, reduced investment in irrigation infrastructure, and natural degradation and groundwater exploitation [4,5]. The indirect impact that

occurs is in the form of increased movement of people from urban areas to suburban areas.

Currently, the trend of land conversion, especially agricultural land, has occurred in many countries, including Thailand, China, Islamabad, Turkey, and Europe. The conversion of agricultural land function here can be interpreted as a change in the use of agricultural land which should be used for agricultural activities but is used to support non-agricultural activities. The conversion of agricultural land here is caused by socio-economic factors, including industrial activities and population growth. Industry is an economic activity carried out to process raw materials, semi-finished goods, and/or finished goods into goods with a higher use value, including industrial design and engineering activities. The world is currently entering the era of industrialization where industrialization is a process of accelerating the growth of production of industrial goods carried out in the country which is balanced by an increase in domestic and foreign demand for industrial goods. Industrialization will experience delays if there are growth constraints in one aspect, be it the production aspect or the demand aspect or growth constraints in both aspects [6]. The industrialization process has led to newer industries being built to produce goods that are used to meet daily needs. With the many new industries being built, it will increase employment opportunities for the population so that it is expected to reduce the number of unemployed. However, the increasing number of these industries also has an impact on the environment, such as increased air pollution and noise pollution that comes from production machines. In addition, it does not rule out water and soil pollution around the area caused by the disposal of production waste which is disposed directly into the surrounding environment without prior treatment.

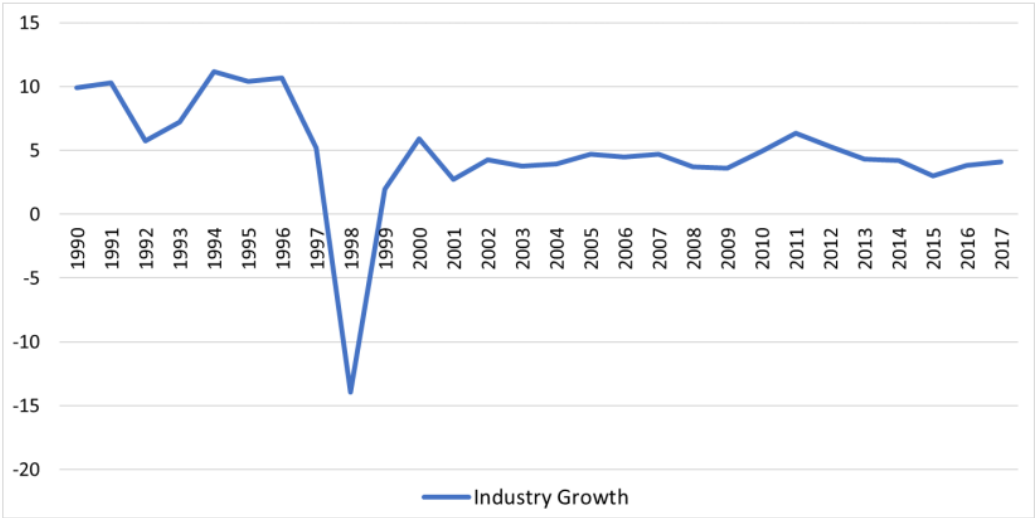
Apart from being caused by industrial activities, land conversion is caused by an increase in population. The number of existing populations continues to increase every year. The increase in population causes the demand for land to also increase. The increase in demand for land here occurs because humans need a place to live that is built on the surface of the land. The residence built on this land then forms a residential area. This has resulted in a change in the function of agricultural land where land that should have been used for agricultural activities was instead used to build housing.

In Indonesia, there is an industrial area where an industrial area is a centralized location for industrial activities, complete with facilities and infrastructure provided and managed by companies in industrial areas. Initially, industrial estates were developed by the government with BUMN intermediaries as a result of the construction of new industries with limited infrastructure, the impact of industrial activities on the environment and problems in the development of human settlements which are located close to industry. Over time and the growth of domestic and foreign investment, the government has shifted its efforts to develop industrial estates to the private sector based on Keppres No. 53 dated 27 October 1989. The fast-economic growth in Indonesia has resulted in an increase in demand for industrial land, especially in the late 1980s, since the government allowed private companies to manage industrial estates [2]. At the end of 1998, Indonesia already had 65 industrial estates, 25 of which were located in Jakarta and nine in Surabaya and by 2020, the development of industrial estates in Indonesia had increased to 108 areas, 26 of which were located in Kepulauan Riau [2].

The development of industrial estates in Indonesia in 1973 with the establishment of the Jakarta Industrial Estate Rungkut (SIER) then every year the industrial estates experienced a rapid increase. The rapid growth of industrial estates has resulted in the demand for land for the development of an industrial estate in urban areas. In addition, industrial estates are built in urban areas to attract people living in rural areas to urbanize in urban areas and to get better jobs in the industrial sector. This has resulted in a dualism of land conversion interests in which the demand for land for industry is accompanied by demand for land for residents to live in.

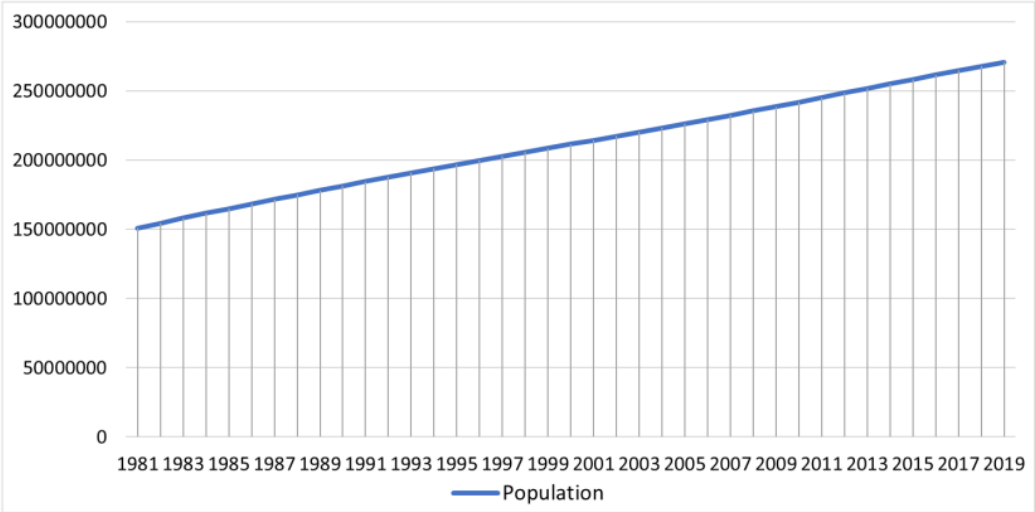
From Figure 1, industrial growth in Indonesia tends to increase from 1990 to 2017. In 1998 the industrial sector growth experienced a drastic decline where in 1998 Indonesia experienced a monetary crisis. This monetary crisis in the form of very high inflation has weakened people's purchasing power so that the profits earned by entrepreneurs are smaller than the costs incurred for the production process. This has an impact on workers because of layoffs by company owners to reduce the total cost of production so that employers still benefit.

Geographically, Indonesia is in a strategic position, namely at the cross between two continents (Asia and Australia) and two oceans (Indian Ocean and Pacific Ocean). Indonesia is the largest archipelago country in the world which has 17,504 islands with a coastline length of 81,000 km. The vast area of Indonesia also has consequences, namely the large number of people living in Indonesia. The population in Indonesia tends to increase every year where this population increase can be said to be quite high every year. This high population increase can occur due to the ineffectiveness of the family planning program carried out by the government where this program urges the population to limit the ideal number of two children per family. In addition, there is an assumption circulating in society that the more children you have, the more fortune you have. This is what causes the high birth rate every year in Indonesia.



Source: World Bank [7]

Figure 1. Industrial Growth in Indonesia 1990 to 2017



Source: World Bank [8]

Figure 2. Population Growth in Indonesia 1981 to 2019

From Figure 2, the population of Indonesia tends to increase every year. In 1981 the population in Indonesia was 15,0938,232 people, experiencing an increase to 267,663,435 people in 2018. The high population growth that occurred resulted in the high demand for land used for building homes. The construction of this residence is carried out on the surface of the land which then forms a settlement. In fact, the available land in Indonesia, especially in urban areas, is limited. This can occur because the original population who lives in urban areas plus the flow of urbanization from villages to cities causes urban areas to become increasingly densely populated. The high demand for land in urban areas causes the purchase price of land to be very expensive. The high price of this land has made urbanites, who in fact do not have a job and income, continue to choose to build houses in places where housing

is not supposed to be built, such as on riverbanks and under bridges.

Based on the brief explanation above, the study is interested in conducting a study to determine the phenomenon of land use change that occurred in Indonesia in the 1981-2018 period. This study aims to determine whether industry and population growth influence land conversion that occurred in Indonesia in 1981-2018.

2. Literature Review

Land has an important meaning for stakeholders who use the land. For the community, land functions as a means of building a place to live and a source of livelihood. According to Sumaryanto [9] explained that the benefits of agricultural land can be divided into two, namely use values and non-use values. Use values or personal use values are the benefits obtained from the results of exploitation or farming activities carried out on agricultural land. Meanwhile, Non-use values are called innate benefits. According to Yoshida & Omatu [10] in Sumaryanto [9] that from an environmental aspect, the existence of agricultural land can provide five benefits, such as preventing floods, controlling water balance, preventing erosion, confining environmental pollution from household waste and preventing air pollution from exhaust gases.

Purwowidodo [11] describes land as an environment which consists of climate, relief, soil, hydrology, and plants which to a certain extent will affect the ability of land use. Sitorus [12] explains that land is an area on the surface of the earth with certain characteristics including the biosphere, atmosphere, soil, geological layer, hydrology, plant and animal populations as well as the results of human activities in the past and present, until at a certain level, these characteristics have a significant effect on the present and future functions of land by humans.

Land conversion is a process of changing land use from certain forms of use to other uses, such as non-agricultural uses, where the impact of this land conversion is negative for the ecosystem of the natural environment itself. Land is a major asset in agricultural and economic activities [13-15]. The limited and non-renewable nature of land creates competition for land use in the agricultural and non-agricultural sectors. This has resulted in the conversion of agricultural land which threatens agricultural activities and food availability. The high rate of conversion of agricultural land tends to occur in countries with high food consumption and large populations and both criteria exist in developing countries [16,17].

The rapid population growth and the increasing demands of the community's needs for land often create conflicts of interest over land use and inconsistencies between land use and its allotment plan [18]. Whereas land is limited and cannot be added except by carrying out reclamation [19]. Limited land in urban areas has made the city develop into suburban areas where the periphery is an area that has undergone a lot of land conversion, especially the conversion of agricultural land to non-agricultural due to the influence of the development of nearby cities [20].

According to Kustiawan [21] land use change in general involves the transformation in the allocation of land resources from one use to another. Land conversion usually occurs in areas around urban areas where land conversion is used to support the development of the industrial and service sectors. This is what causes land use change. According to Barlowe [22] few factors affecting land supply include natural physical characteristics, economic factors, technological factors, habits and traditions, education and culture, income and expenditure, tastes and goals, as well as improvement in attitudes and values due to increasing age. According to Malthus [23] in his book, entitled 'Principles of Population' states that human development is faster than the production of agricultural products to meet human needs. On the other hand, the existence of agricultural land is decreasing because it is used to build housing, factories and other infrastructure. Thus, the loss of agricultural land raises a concern in human civilization [24–26].

The conversion of land functions is related to the increase in population in relation to land use for settlement. Law No.1 of 2011 explains that settlements are part of a residential environment which consists of more than one housing which has infrastructure, public utilities, and has supporting activities for other functions in urban or rural areas. According to Koestoer [27] settlement boundaries are related to the concept of the environment and spatial planning. Settlement is an area of land that is used as a residential area or a residential environment and a place for activities that support life and is part of the environment outside a protected area, both in the form of urban and rural areas. Settlement is a human settlement that has been carefully prepared and shows a clear purpose so as to provide comfort to its residents. Settlement is a process of someone reaching and settling in an area [28].

It is necessary to pay attention to the decrease in agricultural land in the periphery areas because it will have a negative impact on life in villages and cities [29]. Yunus [29] states that suburban areas are peri-urban areas where this area is characterized by a mixture of urban and rural fiscal features. In the theory of Land Use Trianglem: Continuum, Yunus [29] explains that continually the more urban land is built, the greater the proportion of urban land and the farther away from the main built-up land the greater the proportion of rural areas. This theory is considered the most appropriate to describe the condition of the peri-urban area (WPU) in developing countries, including Indonesia. Urban areas in Indonesia have developed rapidly in the period 1983-1993 where in this period there has been a function of agricultural land into non-agricultural land totaling approximately 40,000 hectares / year.

An industrial area is an area that is dominated by industrial activities with a combination of facilities consisting of industrial plants, research facilities and laboratories for development, office buildings, banks and social and public facilities [30]. Industrial development in Indonesia is very fast. According to Law Number 5 of 1984 concerning Industry, it is an economic activity by processing raw materials, raw materials, semi-finished goods, and / or finished goods into goods with a higher value for their use, including industrial design and engineering activities. The purpose of industrial development is the direction of industrial estate development policies to encourage industrial development in the form of Industrial Estates [31].

Lumbuun [32] argues that local governments need to develop the economy and investment in their regions. The development of industrial estates is important for increasing economic growth. Only one percent economic growth can absorb a workforce of around one hundred thousand people [33]. The important thing to anticipate from the development of industrial estates is to control and supervise the excessive conversion of agricultural land used to build industrial and residential locations. Industrial growth has a consequence, namely the increasing demand for land for industry, settlements and others, which previously used for agricultural areas [33].

To overcome this on Article 4 Presidential Decree Number 41 of 1996 stipulates that industrial estate development does not reduce agricultural land. This is important to anticipate the conversion of agricultural land to non-agricultural land which will reduce agricultural areas and disrupt the productivity of agricultural products, especially rice. The use of land areas must be adjusted to its main function in environmental conservation activities and must have several facilities, namely institutional facilities, funds and legal means [34]. The law has a position and interest in dealing with and resolving various environmental problems as well as being a juridical basis for the implementation of state policies that must be implemented by the government [35]. The conversion of agricultural land will have a social and economic impact on the community because the reduced agricultural area results in reduced employment in the agricultural sector and threatens the production capacity of agricultural products, especially rice commodity [36].

The relationship between population, industry, and agricultural and forestry land use has been investigated by previous researchers. Researchers in various parts of the world also pay attention to the relationship between industrialization and land use change, population and land urbanization, and industrial perspectives, land urbanization and its relation to converting agricultural land to urban land and the influence of population quality on urban industrial growth and the process of urbanization [37–40]. The analyzes described in this study focus on industrial development and conversion of agricultural and forestry lands and population growth. This research point of view uses industrial growth and conversion of agricultural and forestry land functions and population growth in Indonesia. The phenomenon of land use change in Indonesia is important to discuss because it relates to farmers' welfare, food security, economic and cultural aspects, as well as climate problems and long-term environmental damage.

3. Research Method

This study uses secondary data published by World Bank for the 1981-2018 period. This study analyzes the effect of population and industrial growth with medium to high technology on land conversion in Indonesia. Land conversion variable as the dependent variable, represented by the variable proportion of agricultural land area to the total land area in Indonesia. The percentage of land area is increasing, indicating the smaller the area of land being converted. In this regard, the measure of land conversion in this study is solved mathematically by reversing the indicator of the percentage of agricultural land area (LAND) to 1 / LAND. Indicator 1 / LAND then becomes an indicator used to represent the variable area of land conversion in Indonesia. The independent variable used is the industry variable using the percentage (%) indicator of industrial growth with medium-high technology, including construction that occurs in Indonesia. Second, is the population number variable, namely the total population in Indonesia. This study applies the Error Correction Model (ECM) dynamic model. The use of dynamic models is important in economic analysis because dynamic specifications are concerned with the formation of models of an economic system related to changes in time [41].

The ECM analysis method is a method used to estimate the effect of independent variables on the dependent variable by accommodating the lagged elements in the model. In addition, ECM is also used to represent imbalance relationships or short-term relationships from a model [41]. In this study, the ECM method used was the Engle and Granger two-stage procedure method, namely by running The Engle-Granger two-stage procedure. The first stage is to estimate long-term parameters and in the second stage, estimate parameters for the short term. Estimating the long-term equilibrium relationship can be done simply by estimating the regression of all co-integrated variables [41]. In ECM estimation, all variables in the study must be stationary. These conditions must be met so that the estimation results are not biased or do not show spurious regression results. The variable stationarity test can be done by performing the unit root test. In addition, it also requires that the variables be co-integrated with each other. The ECM model used in this study is as follows:

Long-Run Model:

$$LAND_t = a_0 + a_1 INDUSTRY_t + a_2 LnPOPULATION_t + \varepsilon_t \quad (1)$$

Short-Run Model:

$$\Delta LAND_t = b_0 + b_1 \Delta INDUSTRY_t + b_2 \Delta LnPOPULATION_t - b_3 ECT1_{t-1} + \varepsilon_t \quad (2)$$

4. Result and Discussion

The stationarity test on the long-run residuals of the structural model is carried out to identify whether the equation is co-integrated. So that the long-term model equations can be continued to be analyzed in the short-term dynamic model. The stationarity test on the residuals in each structural model was carried out using the Im, Pesaran and Shin Test (IPS). The results of the Im, Pesaran and Shin tests showed that the value of Im, Pesaran and Shin W-stat was -1.72497 with a P-value of 0.0423. This means that the long-term model based on the test is stationary which is indicated by a significant probability at α 5%.

The cointegration test is completed by applying the Kao Residual Cointegration Test (Engle-Granger Based). From the statistical value of the Kao panel data cointegration test (ADF), then it is compared with the critical value α = 5 percent and or it can be observed from the probability value. The ADF value of the Kao test in the long-term model equation is -5.946 with a P-value of 0.00. The Kao-test t-statistic value is below the critical value of α 5%, so it shows that there is a long-term cointegration of the structural equation. These results also indicate a short-term error correction model (ECM) estimation is performed.

In the long-term model, the regression estimation results show that all the independent variables show results in accordance with the hypothesis, which has a positive direction. The t-statistic and p-value also show that the two independent variables are significant in the long-term affecting land conversion in Indonesia. The F-statistic value also shows that together, all independent variables have a significant effect on the dependent variable. The level of fit (goodness of fit) of the long-term equation model is 0.96. The R^2 value means that 96 percent of the independent variables can explain the dependent variable of the long-run equation and the remaining 4 percent are explained by other variables outside the empirical model (Table 1).

The industrial variable coefficient represented by the percentage indicator (%) of industrial growth with medium-high technology including construction that occurred in Indonesia (INDUSTRY) was 8.03E-05 which means that an increase in INDUSTRY of 1 percent will increase land conversion by 8.03E-05 percent ceteris paribus. The logged population variable coefficient value is 0.007471, which means an increase of 1 percent of the population will increase land conversion by 0.007471 percent.

In the short-run model, the two independent variables show a directional agreement with the hypothesis (Table 2). However, it has a positive effect. INDUSTRY variable which is significant in the short term affects land conversion in Indonesia. The F-statistic value also shows that together, all independent variables have a significant effect on the dependent variable. The level of fit (goodness of fit) of the long-term equation model is 0.38. The R^2 value means that in the short-term 38 percent of the independent variables can explain the dependent variable and the remaining 4 percent is explained by other variables outside the empirical model.

Table 1. Estimation Result of Long-Run Model

Variable	Coefficient	t-Statistic	Prob.
INDUSTRY	8.03E-05	3.493120	0.0013
LOG(POPULATION)	0.007471	8.388029	0.0000
C	-0.127873	-7.776888	0.0000

Table 2. Estimation Result of Short-Run Model

Variable	Coefficient	t-Statistic	Prob.
C	0.000172	2.824767	0.0079
D(INDUSTRY)	1.64E-05	2.320336	0.0265
D(LOG(POPULATION))	0.003500	0.900123	0.3744

The industrial variable coefficient represented by the percentage indicator (%) of industrial growth with medium-high technology including construction that occurred in Indonesia (INDUSTRY) was 1.64E-05 which means that an increase in INDUSTRY of 1 percent will increase land conversion by 1.64E-05 percent in the short term, ceteris paribus. An ECT value of -0.17 (negative and significant) indicates that the adjustment from short land conversion value to long-term equilibrium is fulfilled by 17 percent in one period.

The estimation results using the empirical model show the conformity of the results with several previous findings regarding the study of the effect of land conversion due to economic activity. Several studies that are compatible with this research include Azadi et al. [17]; Chan [42] and Su [43], namely regarding the acquisition of agricultural land in China. The research of Affan [44] also shows that there is a change in land use for settlement and industry using the Geographical Information System method.

5. Conclusions

This research once again amplifies up some of the previous studies which stated that the potential for land conversion in Indonesia was very large, which was motivated by the increase in population, namely for the settlement partners. In addition, economic growth, and an increase in economies of scale, marked by investment and industrial growth, have also contributed to the conversion of agricultural land in Indonesia. This is evidenced by the results in this study. The novelty in this study is to use a variable ratio of agricultural land area, which is reversed mathematically to measure land conversion variables in Indonesia. The use of data on percentage (%) of industrial growth with medium-high technology, including construction occurring in Indonesia, issued by the World Bank, is also rarely used in studies that use Industry variables. The use of dynamic models that can show long-term and short-term relationships is also an advantage in this study.

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