Landuse change in Jakarta Province: trend, types, and socio-demographic factors

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Abstract. Landuse change in Jakarta Province is one of the popular issue due to urban problems. As a capital city, Jakarta has small agriculture area and large non-agriculture area. The objectives of this study are to know the landuse change trend, to know the types of landuse that change overtime, and to know the factors that cause landuse change specifically in socio-demographic condition in Jakarta. This study used secondary data from Badan Pusat Statistik or Statistic Board Center of Jakarta to derive population and landuse data. The analysis of this study used a spatial approach and by calculating land resources balancing. From this study, we find that landuse change was increased in Jakarta overtime, especially in foods crops, horticulture, and forestry area, which vary over the districts. Major socio-demographic factors that cause landuse change is high population density in Jakarta.

1. Introduction

DKI Jakarta is the one of provinces in Java Island, bounded by Java Sea in the north, West Java Province in east and south, and also Banten Province in the west (see Figure 1). Jakarta Province located at 6°12' South Latitude and 106°48' West Longitude with land area by 662,33 km² and ocean area 6,977,5 km². Jakarta Province has six districts by Kepulauan Seribu, Jakarta Selatan (South Jakarta), Jakarta Timur (East Jakarta), Jakarta Barat (West Jakarta), Jakarta Pusat (Center Jakarta), and Jakarta Utara (North Jakarta). Jakarta Timur is the district with the largest area in this province by 188,03 km².

As the capital city of Indonesia, Jakarta Province became a big city that very crowded because of high population density and high population mobility both from local societies and commuters from region surround Jakarta. Data from Badan Pusat Statistik (BPS) or Statistic Board Center of Jakarta shown that Jakarta’s total population during 2010-2017 always increased with population growth 0.9 % by 2017 and the total population is about 10,374,235. The big population has an impact on the food stocks and residential needed [1]. This condition also increases the need for a large area of land, while limited space in Jakarta caused competition for space (land) is formed in it. At one time, this condition caused a landuse change. Therefore, the existence of limited resources requires that a development plan can play more attention to proportional utilization so that optimal and sustainable environmental quality can be created [2].
Jakarta as a center of economic activity also give an impact to the socio-economic and cultural development and the implication is higher population pressure to the land. Population pressure used to assess overpopulation in the specific region [3]. The population pressure value also used to assess environment carrying capacity, with the definition is an environment capacity to spur people life, other creatures, and this balancing [4]. This concept appeared from the effect of Malthus paradigm, the population needed always increased, linear with the population growth and lifestyle change, while the resource is going to the limit.

Land use change in Jakarta Special Province leads to land use in the form of the physical construction of infrastructure facilities that are considered more economically valuable. This causes high carrying capacity of land has a high chance of land use changes. Therefore, a study is needed on the effect of population density on the acceleration of land use changes and the type of land use that had the most intensive changes, because lots of land use are not in accordance with its designation and does not meet the requirements. Even many previous studies had been done in assessment the land use change in Jakarta Province, this study give a newer data till 2017 and also cover all of the districts in Jakarta. Objectives of this study are as follows: (1) to know the trend of the land use change in Jakarta, (2) to assess the types of land use that change overtime and how fast it is, (3) to analyse the factors of land use change from socio-demographic condition in Jakarta.
2. Methods

Landuse types and socio-demographic data were derived from data publication by Badan Pusat Statistik (BPS) or Statistic Board Center, specifically from “DKI Jakarta Province in Figures”. We used time series data from 2009 until 2017 to know the trend (Figure 2). Population density analysis used to assess socio-demographic condition (Figure 4), with the formula:

\[
\text{Population Density} = \frac{\text{Total Population}}{\text{Land Area} (\text{km}^2)}
\]

(1)

Total population is the total people registered by cencus, compiled with population projection. Land area is the total area, both agriculture and non agriculture area. Landuse change analysis has been calculated by land resources balancing formula, with the Activa and Passiva tables (Table 1). This formula is a simple calculation to know the difference between present and past land resources amount. Then, all of the calculated data were compiled with spatial approach analysis with time series landuse map (2009 and 2015), derived from Kementerian Lingkungan Hidup dan Kehutanan (KLHK) or Environment and Forest Ministry of Indonesia (Figure 3).

3. Results and discussions

3.1. The trend of landuse change in Jakarta

Assessment of landuse change in Jakarta focused on agriculture and non agriculture land area. Agriculture land area during 2010-2016 tend to be decreased, from 2.386 hectares in 2010 became 1.520 hectares in 2016. But, in 2017, agriculture land area was increased 16 hectares and the result of this area is 1.520 hectares (Figure 2). This phenomenon caused by the effect of people interest in city agriculture. Major agriculture land is irrigation wetland, with the area about 483 until 1.223 hectares because this landuse type has more productivity and will increase farmer revenue.

The value of non agriculture land area in 2010 until 2016 was increased from 65,3847 hectares in 2010 became 64.729 hectares in 2017. But, a large area of non agriculture land decreased in 2017 became 64,713 hectares caused by the landuse change from non agriculture to the agriculture land, as we discussed before. The big amount of landuse change from agriculture to non agriculture land caused by the different economic value of those land. An example of rent value compares between agriculture and non agriculture land with 1:622 for housing complex, 1:500 for industrial area, and 1:14 for a tourism area. Other factors are farmer mindset that land value of non agriculture still higher

![Figure 2. Trend of Agriculture (a) and Non Agriculture (b) Land Area in Jakarta Province during 2010-2017](image-url)
and give more revenue than agriculture land value, low competitiveness of wetland, and the government policy about Jakarta development planning that focused on non agricultural sector [5].

3.2. Types of Landuse Change

Based on data publication by Badan Pusat Statistik or Statistic Board Center, landuse types are divided by wetland, agriculture dry land, horticulture, livestock, and forestry [6]. Wetland is the agricultural land where the main crop is paddy and separated by small dykes to resist water. Wetland divided by irrigation (has irrigation channel) and non irrigation (without irrigation channel). Agricultural dryland is land where the main crop is not paddy and characterized by small needed of water. This land divided by dry field, shifting cultivation, and temporarily unused land. Dry field is unirrigated land which is planted with seasonal or annual crops and without shifting method. While shifting cultivation land is dryland that cultivated for seasonal crops and used the shifting method due to fertile land diversity condition. Shifting cultivation is different with temporarily unused land in their cultivation time, which temporarily unused land means that the land is unused for more than a year but less or equal than two years. Horticulture is the landuse for vegetable, fruit, and medicine plants that give much advantages in order to supply vitamin, mineral, cosmetic, medice, and health. Livestock is for breed cultivation. While forestry is specific territory determined and or decided by government which is covered by trees and plants.

Land resource balancing is shown that the non agriculture land area increased during 2010-2015 by 770 hectares and 96 hectares during 2015-2017. The spatial approach in landuse change give the result of landuse change types in every district around Jakarta Province. In Kepulauan Seribu district, the large landuse area was increased on livestock land caused by higher land needed for an animal during 2009-2017. In Jakarta Pusat, as a center of economic and government, has significant landuse change with the decreasing of agriculture land area. The area of dry field in 2009 is 2 hectares and became 0 hectare in 2017. In the other hand, non agriculture area continues to increase until 2017.

### Table 1. Landuse types that change in Jakarta Province based on districts by 2009 and 2017

| Landuse Types | Kepulauan Seribu | Jakarta Selatan | Jakarta Timur | Jakarta Pusat | Jakarta Barat | Jakarta Utara |
|---------------|-----------------|----------------|--------------|--------------|--------------|--------------|
|               | 2009 | 2017 | 2009 | 2017 | 2009 | 2017 | 2009 | 2017 | 2009 | 2017 | 2009 | 2017 |
| **Foods Crops** |       |       |       |       |       |       |       |       |       |       |       |       |
| Wetland (Irrigation and Non Irrigation) | 0.0 | 0.0 | 0.0 | 0.0 | 425.0 | 74.0 | 0.0 | 0.0 | 294.0 | 96.5 | 593.0 | 414.0 |
| Dry Field | 175.0 | 0.0 | 541.0 | 342.0 | 78.0 | 202.0 | 2.0 | 0.0 | 203.0 | 345.5 | 0.0 | 34.0 |
| Shifting Cultivation | 0.0 | 0.0 | 75.0 | 0.0 | 0.0 | 12.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Temporarily Unused | 0.0 | 0.0 | 9.0 | 144.6 | 111.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **Horticulture** |       |       |       |       |       |       |       |       |       |       |       |       |
| Vegetables | 0.0 | 0.0 | 43.0 | 81.0 | 1051.0 | 958.0 | 9.0 | 0.0 | 1638.0 | 300.0 | 426.0 | 278.0 |
| Medicinal Plants | 0.0 | 0.0 | 14.3 | 5.6 | 11.2 | 7.7 | 0.1 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 |
| Livestock | 0.2 | 0.3 | 28.6 | 28.5 | 41.9 | 26.0 | 2.2 | 0.8 | 1.3 | 9.6 | 8.0 | 10.9 |
| Forestry | 0.0 | 0.0 | 388.6 | 62.3 | 121.9 | 73.2 | 13.6 | 1.1 | 17.5 | 17.9 | 30.3 | 28.1 |
| Others | 694.8 | 869.7 | 13027.5 | 13463.1 | 16963.0 | 17450.0 | 4786.2 | 4811.0 | 10800.2 | 12179.5 | 13593.4 | 13901.0 |
From Table 1 we know that non agriculture sector developments increase rapidly from 2009 to 2017. The district that still has more foods crops landuse types are Jakarta Selatan, Jakarta Timur, Jakarta Barat, and Jakarta Utara. But, foods crops landuse type in 2017 decreased rapidly became non agriculture landuse. We can see wetland condition in Jakarta Timur, Jakarta Barat, and Jakarta Utara, that decreased rapidly in 2017. The same condition also happened in horticulture landused type that decreased rapidly in 2017 especially for vegetables in Jakarta Timur, Jakarta Barat, and Jakarta Utara. While the trend of forestry area in Jakarta is irony, which is decreased rapidly in Jakarta Selatan from 388.6 hectares became 62.3 hectares in 2017. This phenomenon also happened in other districts, such as Jakarta Jakarta Timur, Jakarta Pusat, and Jakarta Utara. Landuse change in Jakarta also affected by service sector rapid growth, service sector in Jakarta continue to grow and give a big contribution on GDP [7], especially in the financial, assurance, accommodation, and trade sector. This phenomenon is affected by land development to spur many activities and one of the investments model to increase land economic value.

Figure 3. Landuse map of Jakarta Province by 2009 (a) and 2015 (b)
Source: Kementerian Lingkungan Hidup dan Kehutanan
Based on the landuse map of Jakarta (Figure 3), we can see that from 2009 until 2015, landuse change was happened, especially in wet land and dry land, became housing (black colour). On the northwest side, housing was built in the brackish and on the northeast side, housing was built in the dry land. Not only in two sides described before, but housing coverage also happened in southwest and southeast side, changing dry land coverage in 2009. From the map, we know that at least eight years, Jakarta’s landuse changed rapidly and allocated for housing needed.

3.3. Socio-Demographic Factor of Landuse Change

The amount of population in Jakarta was increased every year, from 2012 to 2017, with fluctuating population growth. Increased population caused by fertility increasing and migration. Total Fertility Rate (TFR) of Jakarta is 1.82 in 2010 and became 1.83 in 2015 [8,9]. But, the netto migration in 2010 until 2015 decreased, from 1,077,434 became 946,183. The positive value of the netto migration means that in-migration still high in Jakarta than out-migration. So, the data from statistic publication give evidence that the population amount in Jakarta also affected by fertility and migration.

Variety facilities such as offices, modern housing, market, and transportation utilities e.g. in circle toll and out circle toll can absorb more manpower and give an easy way to other people from other regions to move to Jakarta, both permanent migration or circular/comuting. Besides this, increased regional minimum wage or UMR rate continously in Jakarta also pushes the people to migrate to Jakarta [10]. High population growth and in-migration cause high population density in Jakarta (Figure 4).

The high population density has happened because Jakarta is the capital city of Indonesia and dominated by flat area, alluvium material, and include in alluvial flat geomorphology. This morphology gives the Jakarta’s availability to built housing, government building, economic center, and other facilities. Population density gives the effect to the decreasing agriculture land in Jakarta because all people need the place to built their houses.

![Figure 4. Trend of population density in Jakarta during 2009-2017](image)

![Figure 5. Correlation between population density and agriculture land area in Jakarta](image)
Figure 5 shown that population density and agriculture land area have a negative correlation. It means that the increasing population density cause decreasing the agriculture land area. Increasing in population amount cause massive development and cause landuse change, which is dominated by building space and pressure natural space to change in other appearance [11].

Previous studies shown that high population density and massive landuse change in Jakarta give negative impacts such as land subsidence and create slum area [12,13]. Other study also found that urban development give massive impacts on landuse change caused by roads, settlements, and other facilities needed [14]. Nowadays, Jakarta is considered to have been unable to support the sustainability of economic and government activities because of massive landuse change. Various derive problems such as overpopulation, low carrying capacity, slum area, floods, and land subsidence as we discussed before, are among the considerations in the plan to move the capital of Indonesia in Palangkaraya, Kalimantan Tengah. The consideration used in selecting the new capital city is the centralization of its geographical location so this realization will make equity for development over islands in Indonesia. The other consideration is about location of Palangkaraya in Kalimantan Island which is relatively safe from earthquake. This plan is expected can develop new areas that can reduce concentration of activities in Jakarta so the problem of landuse change in Jakarta can be solved. In the other hand, landuse planning is needed in order to develop sustainable city of Jakarta and must have discipline implementation.

4. Conclusion
The result of this study shows that landuse change in Jakarta Province tends to increase overtime. Agriculture land was decreased rapidly and changing to non agriculture land. The agriculture land area in 2010 was 2.386 hectares and in 2016 became 1.520 hectares. Landuse types that dominant to change are foods crops, horticulture, and forestry. Only one district that still has large area of wetland, Jakarta Utara. Rapid forestry change was happened in Jakarta Selatan and followed by another district. Changed agriculture land caused by high needed for the housing of Jakarta’s people. Increasing population density makes decreasing the area of agriculture land. As the capital city of Indonesia, Jakarta has many people from other regions and pushed to migrate to this city. Finally, the landuse change overtime and Jakarta was dominated by housing area so the government should give an alternative solutions to reduce this problem.

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