Trend Analysis of Land Cover Changes, Population and Settlement Distribution to Land use Assessment in Kebumen Regency

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Article Info	Abstract
	The condition of population growth in Kebumen Regency tends to increase every year. This dynamic population condition can also change the land cover trends. Based on this background, identification of trends in land cover changes is quite interesting to study which aims to facilitate land use planning for stakeholders in the relevant region. The objectives of the study include (1) analyzing the dynamics of the population of Kebumen Regency, (2) analyzing the pattern of land cover changes, and (3) analyzing the population pressure on agricultural land. This study used aerial photography data from 2006 to 2016 to determine land cover types and the GIS conditional functions were used for settlement distribution mapping. The data processing results was done by quantitative descriptive analysis. The results showed that (1) Kebumen Subdistrict is an area with the highest population among other sub-districts and it has high population pressure towards land uses around 2,478 people/Km2, (2) mixed gardens each year tend to decrease in area of 98.39 km2, while settlements and paddy fields increase by 43.55 km2 and 235.95 km2. (3) Increase in population numbers and density in some districts of Kebumen are directly proportional to the level of pressure on agricultural land which is also high.

INTRODUCTION

Kebumen Regency is one of the regions in Central Java Province, Indonesia, which located astronomically at 7°27'-7°50' Southern Latitude and 109°22'-109°50' Eastern Longitude (Figure 1). Geographically, Kebumen Regency borders with Banjarnegara and Wonosobo Regencies in the North; Indian Ocean in the South; Cilacap and Banyumas Regencies in the West; and Purworejo Regency in the East. Kebumen Regency, consists of 26 districts, has a total area of 1281.12 km², with the smallest district as Gombong (19.48 km²) that forms 8% of the total area, while the largest area is Karanggayam with 109.29 km² or 8.53% of the total area of Kebumen Regency (BPS, 2018).

Overall, the population of Kebumen Regency tends to decrease every year. It was proven in 2005 that the population of Kebumen was 1,212,274

people and decreased in 2017 to 1,192,007 (BPS, 2018). This is caused by the habits of several regions where some people used to migrate out of town with economic factors as a main reason (Neimark, Toulmin and Batterbury, 2018). However, if reviewed more specifically, increase of population occurs in several districts, such as Gombong, Karanganyar and Kebumen. For example, Kebumen District in 2005 (BPS, 2014) had a population of 120,524 people and became 123,567 in 2017 (BPS, 2018). This dynamic population conditions can also change land use trends (Putri, Bayuaji, Sumantyo, and Kuze, 2013). Based on this background, identification of trends in land use change is quite interesting to study which aims to facilitate land use planning for stakeholders in the relevant region. Land use change is driven by a combination of socioeconomic, political and biophysical factors, the so-called land use drivers (Sitompul, Brouwer, Sopaheluwakan, and van Beukering, 2016). Furthermore, main causes of land use change are hypothesized as population growth and construction activities.

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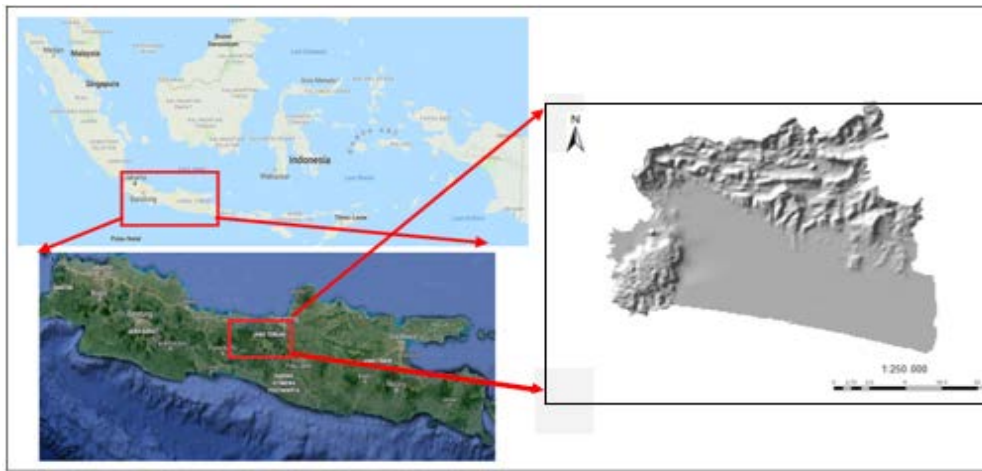
Figure. 1 Administrative Location of Kebumen Regency
(Sources: Google Earth and Data Calculation, 2019)

Changes in land use also occur in watersheds near the center of development growth (Edwin et al, 2015). Spatial analysis of land use changes can help to observe areas that have different spatial dynamics and pattern changes of land use (Melo, Rocha, Manabe, and Lamparelli, 2018) ; (Putri, Wibirama, and Giyarsih, 2018). That also can help to develop a safeguard strategy for land availability (Rafiuddin, Widiatmaka and Munibah, 2016). The objectives of the study include (1) analyzing the dynamics of the population of Kebumen Regency, (2) analyzing the pattern of land cover change, and (3) analyzing population pressure on agricultural land. The results will provide information which further be used as a basis to determine the level of land priority of each region in conducting proper management.

METHOD

Image interpretation through aerial photograph can be done to identify land cover changes that can be integrated with spatial information. Analysis of changes every year in land use/land cover through GIS can be done by creating a matrix of land use/land cover changes (Edwin and Yuzirwan, 2016).

Collection of data that used as a base for analysis comes from secondary data. Population density is calculated by total of population on each sub district area per square kilometer. Each data is further processed to answer each research purposes.

Population density

The amount of population density can be counted through the following mathematical formulas :

$$PD = NP / A \qquad (1)$$

Where :
PD : Population Density
NP : Number of Population
A   : Area Sie

Population pressure on agricultural land

Population pressure on land is a comparison between the total population and the minimum land area to be able to live properly. This study used Ottosoemarwoto Model, which the population is considered to live only from cultivated agricultural land. The population pressure formula based on this model is,

$$TP = Z \, X \, ((f \, X \, Po \, (1 + r)^{\,t}) / L) \qquad (2)$$

Where

Tp   = population pressure
Z   = Minimum land area for decent living
f   = Faction (%) of farmers against population
Po   = number of population in the beginning of the year
r   = Population growth rate
t   = Duration
L   = total area of agricultural land.

Settlement patterns

The settlement pattern mapping can be done more thoroughly by using aerial photographs delineation. The elements of interpretation are hues, textures, shapes, sizes, patterns, sites, shadows, associations, and convergent evidence. The settlement pattern determines the characteristics of the region, where the linear pattern characterizes urban areas and the disperse patterns are for moun-

tainous settlement areas.

Initially, people choose the area for settlement in their regions based on their needs to ensure their living. However, due to the increasing population growth and economic limitation to determine place to live, resulted in unsuitable residence areas (Pigawati, Yuliastuti, and Mardiansjah, 2018).

RESULT AND DISCUSSION
Condition Dynamics of Kebumen Regency's Population

Population dynamics in each district of Kebumen tend to vary periodically in population amount for every district, which either increase, decrease, or fluctuates. The discussion is focused only on the population of region that has increased. It is hypothesized that changes would affect land cover patterns, hence also affect the increasing pressure especially on food crops, namely paddy fields.

Based on the bar diagram related to the number of population in 2005-2017 (Figure 2) shows that Kebumen Subdistrict is an area with the highest population (around 100,000 people) among other sub-districts and increasing during that period. Gombong and Petanahan are sub-districts with regional categories designated as urban residential areas (Bappeda, 2012) The increase of population numbers occurs generally for urban areas that set to be the center of the economy, government, education and other sectors. Thus affects various form of land cover and attracts people around the area.

The mapping results on population density indicate that Kebumen District has the largest density compared to other regions (Figure 3). The presence of new migrants from other areas around the sub-district is indicated to be the cause of it. Thus impact the pressure on the land by constructing new buildings or settlements or other uses for living which are predicted to also produce economic benefits.
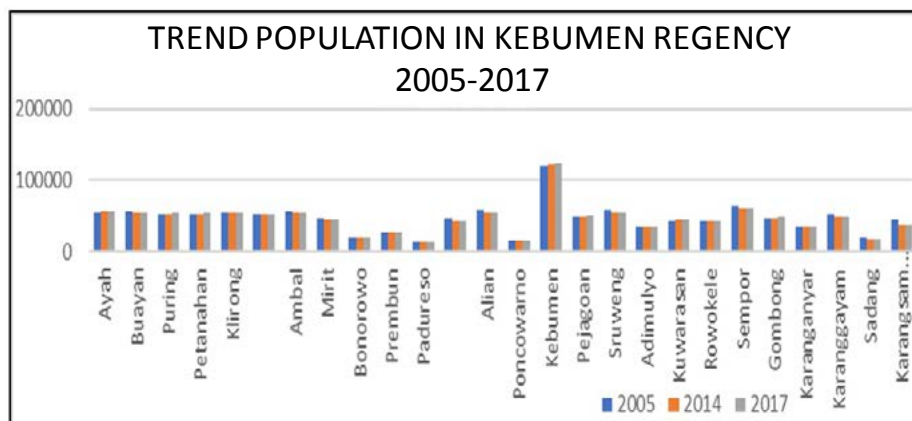

Figure 2. Number of Population in Kebumen Regency
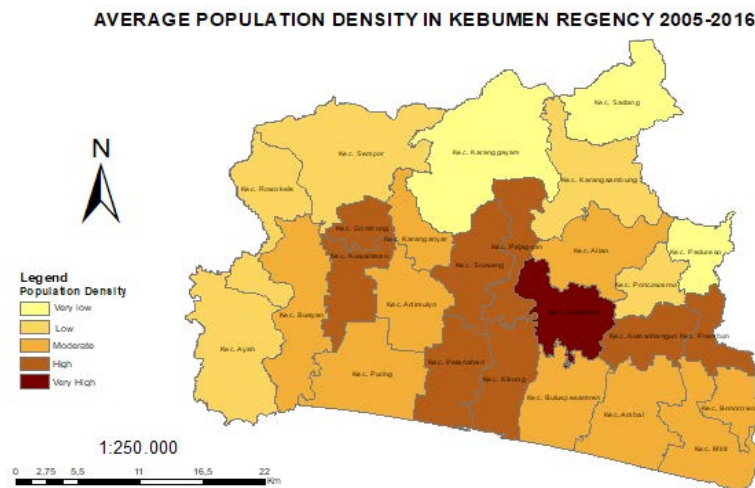(Sources : Data Calculation, 2019)

Figure 3. Spatial distribution of the average population pressure of Kebumen Regency, (Sources: Data Calculation, 2019)
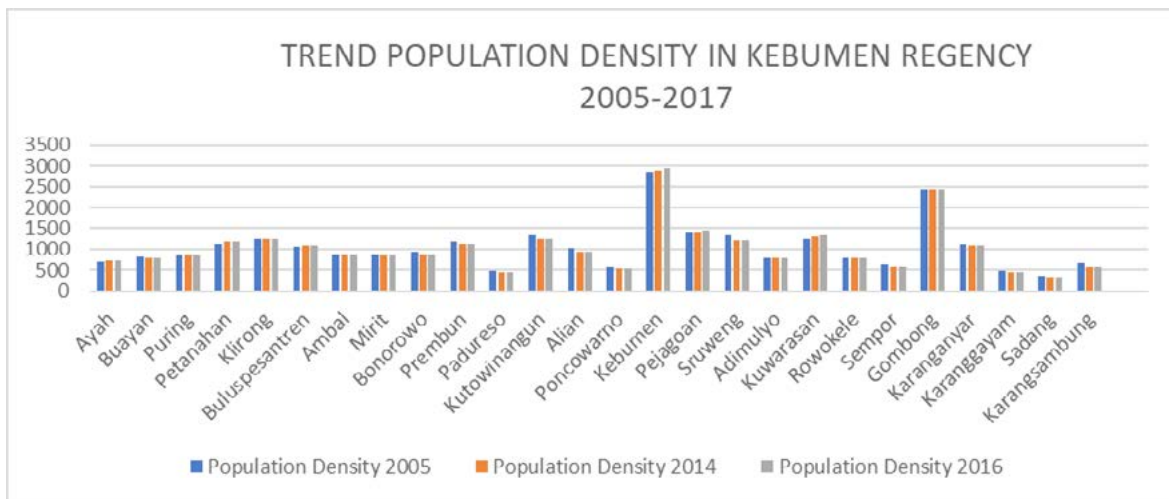
Figure 4. Pattern of population pressure in Kebumen Regency
(Sources : Data Calculation, 2019)

The characteristics of population density can be viewed through the 2005-2017 period by the results of the formula (Figure 4). It is known that Kebumen and Gombong population density tend to increase. Relevant to the average distribution of population density, Kebumen District has the highest population pressure, followed by Gombong District.

Trend of land cover change in Kebumen Regency

Land cover changes in 2006, 2011 and 2016 are presented in Figure 5, Figure 6, and Figure 7. The figure also shows that there is no population pressure on agricultural land, which is proven by the increase in the amount of paddy fields along with the area of settlement every year because of the increasing number of people who own and manage agricultural land.

Based on identification result of land cover through delineation of Kebumen Regency portrayed on the aerial photographs, it can be known the trend of land cover changes every year: mixed gardens each year tend to decrease in area of 98.39 km^2, while settlements and paddy fields increase by 43.55 km^2 and 235.95 km^2. This result strengthen the fact that an increase in the number of population has an impact on the number of settlements and further on land conversion, namely gardens. which are decreasing for the conversions into paddy fields
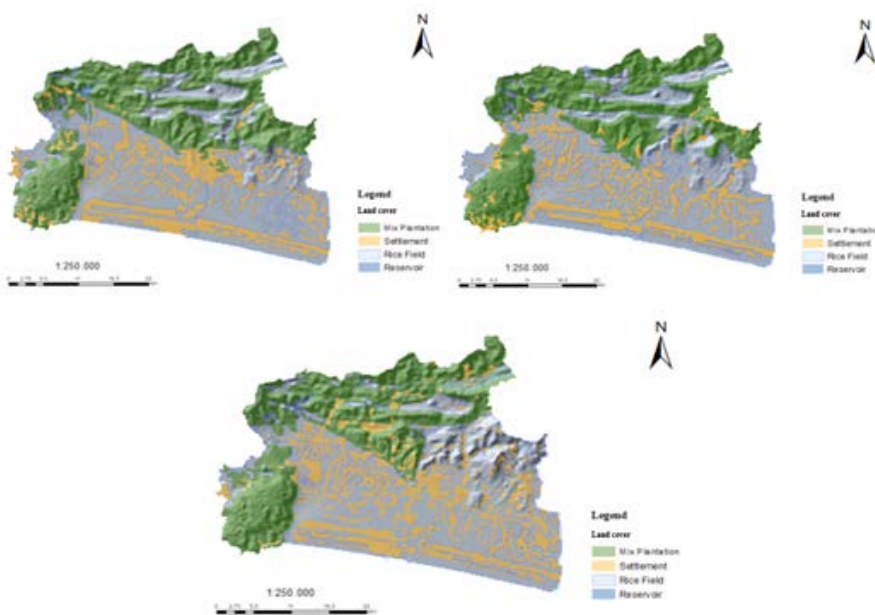

Figure 5. Land cover changes on 2006, 2011, and 2016 in Kebumen Regency
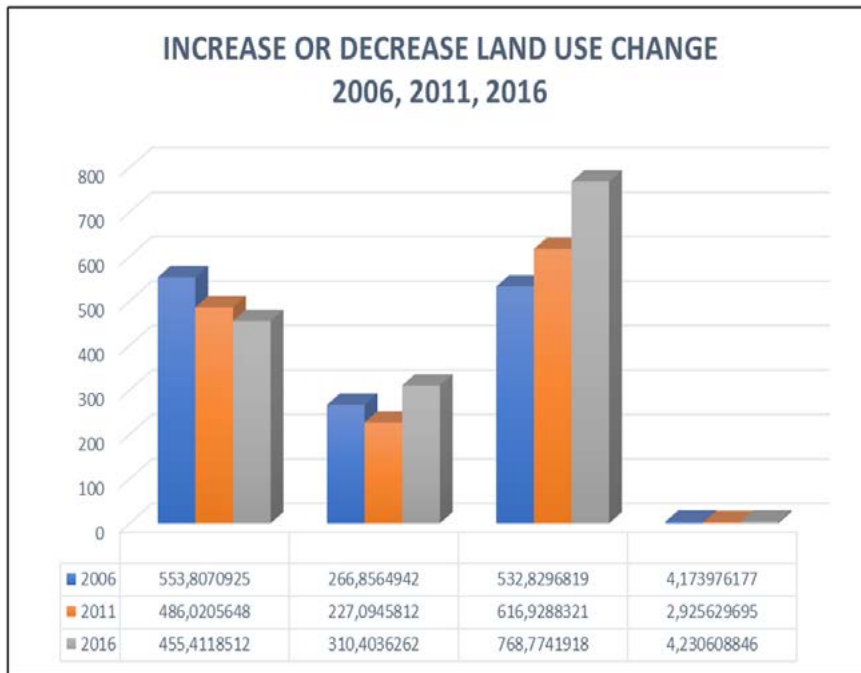(Sources: Data Calculation, 2019)

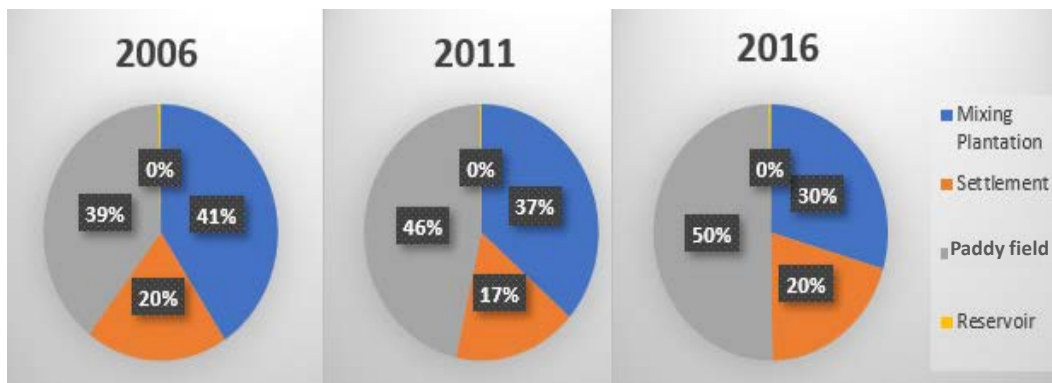**Figure 6.** Land cover change in Kebumen Regency
(Sources: Data Calculation, 2019)

Figure 7. The percentage of land use area in Kebumen Regency
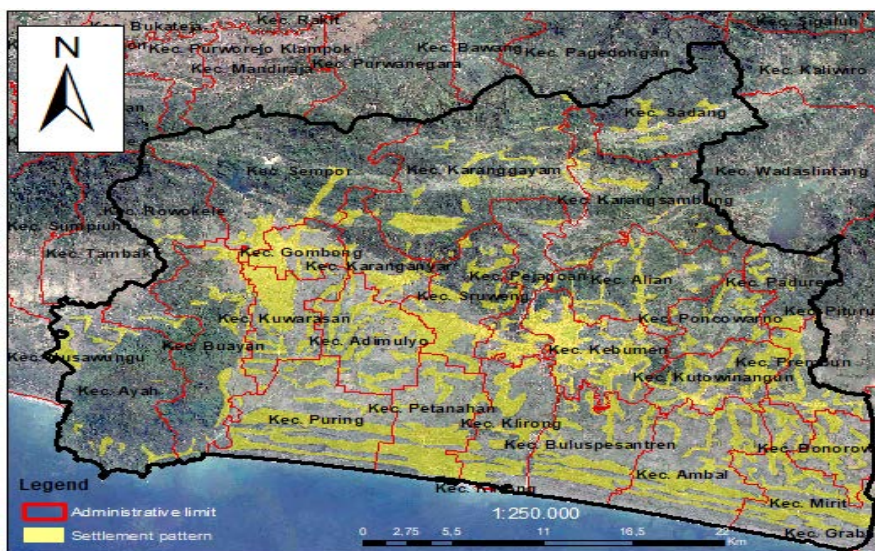(Sources: Data Calculation, 2019)

Figure 8. Settlement pattern of Kebumen Regency
(Sources: Data Calculation, 2019)

or settlements.

Settlement distribution tends to concentrate in the central part of Kebumen Regency, which is influenced by several factors, such as morphology of slope. It is also geographically strategic, so the community would be attracted to then settle around the area. Kebumen Regency settlement patterns is shown in Figure 8. It can be observed that the concentrated part indicate a possibility that in previous conditions the settlement pattern was still linear along the road or river, but population growth eventually caused the decrease of land availability. So, limited area of buildings were constructed even though was unsuitable for decent living settlements.

Furthermore, settlement patterns in coastal areas are more suitable to linear along the coastline. This also shows that the area is developing, especially in terms of economy, agricultural and tourism sectors, indicated by the occupation of residents in the area, such as fishermen, coastal farmers and others.

Settlement patterns in hilly areas such as Karanggayam, Karanganyar, and Sempor Subdistrict are disperse but also clustered due to the fact that the topography in the area certainly varies more (not just flat), thus the community indirectly forms a settlement block that is suitable for living.

Population Pressure on Agricultural Land

Result of population pressure calculation on agricultural land shows that increase in population number and density in some districts, such as Kebumen and Gombong sub-districts, are equal to the level of pressure on agricultural land, which is also high (Figure 9). Thus it can be concluded that there is a significant influence between population growth on agricultural land. Increased population pressure has led shifting cultivation into continuous cultivation, generally in Kalimantan. This may develops to massive land conversion to to increase the need for residential, economic, and other land use.

Based on comprehensive identification results elaborated with patterns of land cover change and also pressure on agricultural land, then can be chosen prioritized areas to optimize management that can be done through various policies from the Kebumen Regency government, such as regulations for new buildings, determining the ideal use of land cover and other more. These efforts need to be done to anticipate future conditions, which will be more difficult to control as has happened in areas, such as Jakarta, Surabaya, Semarang and others.

CONCLUSION

Kebumen Subdistrict has the highest population and grows more during the period. Furthermore, mixed gardens area each year tend to decrease, while settlements and paddy fields increase. Settlement patterns that tend to indicate influence of population growth in the area. Increase in population number and density in some districts are equal to the high level of pressure on agricultural land. Results of comprehensive identification can
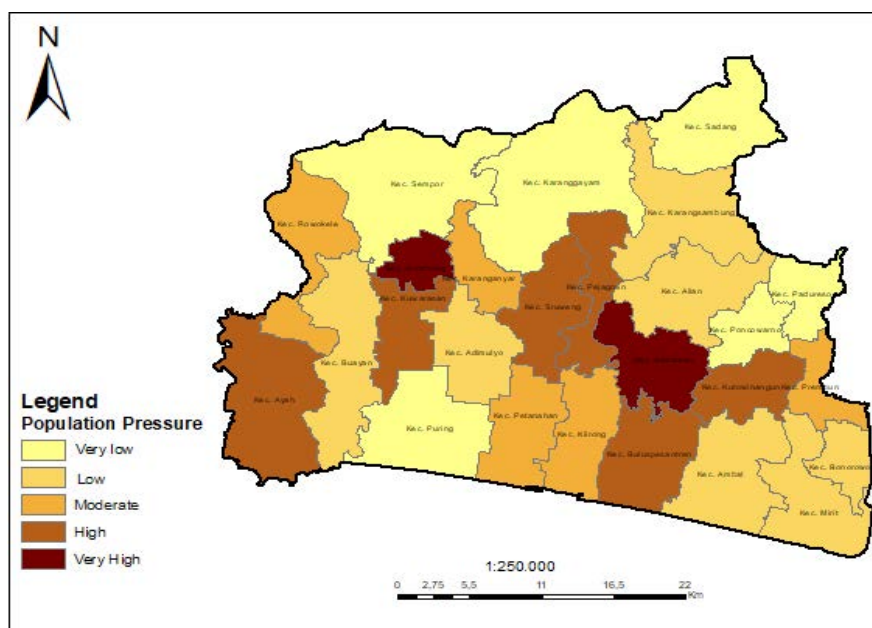

Figure 9. Distribution of level of population pressure on agricultural land
(Sources: Data Calculation, 2019)

be used to optimize management of the availability of areas that are prioritized.

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