ANALYSIS TREND OF LANDUSE CHANGE AND SETTLEMENT DISTRIBUTION TO ASSES LAND PRIORITY MANAGEMENT USING SPASIAL DISTRIBUTION ANALY

Ratih Fitria Putri[1], Sunu Wibirama[2]

[1]Department of Environmental Geography, Faculty of Geography, Universitas Gadjah Mada, Yogyakarta, 55281, Indonesia, Corresponding E-mail: ratihfitria.putri@ugm.ac.id
[2]Department of Electrical Engineering and Information Technology, Faculty of Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia

ABSTRACT

Kebumen Regency is one of the regions in Province of Central Java. Overall, the population of Kebumen Regency tends to decline every year. This dynamic population condition can also changes land use trends. 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. The objectives of the study include (1) analyzing the dynamics of the population of Kebumen Regency, (2) analyzing the pattern of land use change, and (3) analyzing population pressure on agricultural land. Image interpretation through GIS information systems (GIS) can be done to identify land use changes. Analysis of changes in land use / land cover through GIS can be done by creating a matrix of land use / land cover changes. The results showed that (1) Kebumen Subdistrict is an area with the highest population among other sub-districts and always has population growth during that period, (2) Mixed gardens each year tend to have a decrease in area quantity, while settlements and rice fields have an increase. Settlement patterns in the central part of Kebumen Regency tend to centralize and form a block. These conditions indicate influence of population growth in the area, (3) increase in population and population density in some districts are directly proportional to the level of pressure on agricultural land which is also high.

Keywords— Landuse change, Settlement Distribution, Dynamic population, GIS.

INTRODUCTION

Kebumen Regency is one of the regions in Province of Central Java, Indonesia, which is astronomically located at $7^{o}27' - 7^{o}50'$ South Latitude and $109^{o}22' - 109^{o}50'$East Longitude. 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, with a total area of 1281, 12 Km^2. The Smallest District area is Gombong Subdistrict with 19.48 Km2 and has 8% of the total area of Kebumen, while the largest area is Karanggayam with 109.29 km2 or 8.53% of the total area of Kebumen Regency.

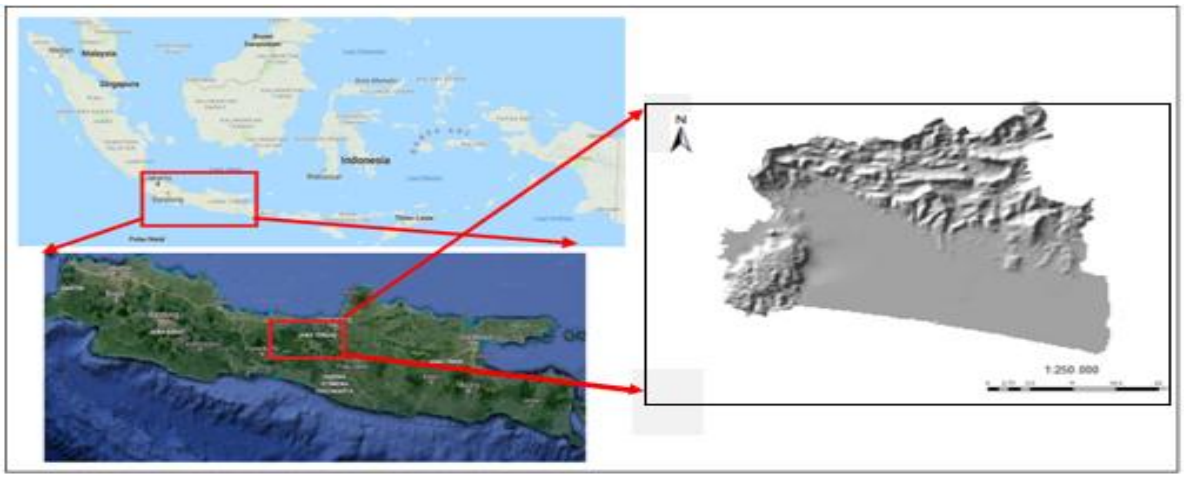


Fig. 1 Administrative Location of Kebumen Regency

Overall, the population of Kebumen Regency tends to decline 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. This condition is caused by the habits of several regions, some people used to migrate out of town with economic factors as a main reason [1]. However, if reviewed more specifically, the increase in population also continues to occur in several districts, such as in Gombong, Karanganyar and Kebumen. For example in Kebumen District in 2005 [2] had a population of 120,524 people and became 123,567 in 2017 [3]. This dynamic population condition can also changes land use trends [4].

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 [5]. Furtheremore, main causes of land use change are hypothesized because of population growth, and development of construction activities. Changes in land use also occurs in watersheds close to the center of development growth [6].

Spatial analysis of land use changes can help to produce patterns of land use change over time and see areas that have different spatial dynamics of land use [7][8]. That also can help to develop a safeguard strategy for land availability [9]. The objectives of the study include (1) analyzing the dynamics of the population of Kebumen Regency, (2) analyzing the pattern of land use change, and (3) analyzing population pressure on agricultural land. The results of the study will provide information related to the influence of population's dynamics conditions in Kebumen Regency, especially on land use (agricultural land) around it which is further used as a basis for assessment to determine the level of land priority of each region in conducting proper management.

THE MATERIAL AND METHOD

Image interpretation through GIS information systems (GIS) can be done to identify land use changes that can be integrated with spatial information. Analysis of changes in land use / land cover through GIS can be done by creating a matrix of land use / land cover changes [10]. Matrix of Land cover changes can be seen as major changes occur every year.

Collection data used as a basis for analysis comes from secondary data. These data include DEM data, information on population changes in 2005, 2014 and 2017, administrative area of each sub-district, area of agricultural land in each sub-district, and landuse image of Kebumen Regency in 2006, 2011 and 2016. Each data is further processed to answer each research purposes.

Data related to population combined with area is used as basic data to produce population density information [9,10,11]. Furthermore, the number of population every year, 2005-2017 which is elaborated with the area of agricultural land, produces information related to population pressure on agricultural land, and the land use image series is processed to specifically identify the trend of land use change in Kebumen District in several years (2005-2017) and knowing settlement patterns in each sub-district (for more detailed description of the characteristics of the area). The results of each core processing are used to support descriptive analysis of land use changes that are primarily associated with the dynamic conditions of Kebumen population.

Furthermore, the research method used is a mixing method between quantitative and qualitative. Some of the methods used later include,

A. Population density

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

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

Where :

PD : Population Density

NP : Number of Population

A : Area size

B. Percentage of land use change

The amount of land use change is obtained from the interpretation of the series image (2005-2017). Furthermore, interpretative results of land use change data also identifies a large percentage of the change. The percentage of each land use can be known through the following formula,

$$\text{Percentage of land use change:} \quad \frac{\text{wide area of each land use}}{\text{total area of various land uses}} \times 100\% \quad (2)$$

C. 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 [12,13]. In this model, the population is considered to live only from cultivated agricultural land. The population pressure formula on this model is,

$TP = Z \times ((f \times po (1 + r)^{t}) / L)$ (3)

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

D. Minimum Land Size for Decent Life (Z)

The value of Z is obtained by using a formula

$Z = (0.25 \times LSI2) + (0.50 \times LSI1) + (0.50 \times LST) + (0.16 \ LLK)$ (4)

Where

Z = Minimum land area for worth living

LSI2 = area of irrigated rice fields> 2x / year

LSI1 = area of irrigated rice fields harvesting 1x / year

LST = the area of rainfed rice fields

LLK = area of dry land

E. Population Growth Rate (r)

The growth rate formula used is a geometric formula, which is mathematically

$Pt = Po (1 + r) t$ (5)

Where

Pt = Total population in year t

Po = number of population in the beginning of the year

r = population growth rate

t = Duration, stated in years.

F. Settlement patterns

The settlement pattern descriptively is produced from the interpretation of the image. The settlement pattern determines the characteristics of the region, the longitudinal pattern characterizes urban areas and the patterns spread as well as centralize characterize rural areas as well as people living in mountainous areas. Initially, people choose the area for settlements in their areas with their needs and ensure them lives. However, due to the increasing population growth and economic limitation for people to choose places to live, it results unsuitable areas that are their residence [14,15,16].

RESULTS AND DISCUSSION

A. Condition Dynamics of Kebumen Regency's Population

Population dynamics in each district of Kebumen tend to vary. Periodically, there are several conditions in the population in each region, there are areas that tend to experience a decline, fluctuations and also experience an increase in population. The discussion is only focused on the condition of the region that has increased population. The background of it is an increasing population is hypothesized to affect changes in land use patterns, it will also affect the increasing pressure on land, especially on food crops, namely rice fields.

Based on the bar diagram related to the periodic population in 2005-2017 shows that Kebumen Subdistrict is an area with the highest population among other sub-districts and always has population growth during that period. Gombong and Petanahan are sub-districts

with regional categories designated as urban residential areas [13] which subsequently also have an increase in the population in that period. This condition certainly occurs as general, an area that is an urban area also tends to be the center of the economy, government, education and other strategic activities. Thus it produces a pulling factor [14] for people around the area.

Same with Kebumen District, the area is the capital of Kebumen Regency which is the center of government, economy and education. Thus the existence of these conditions certainly affects various portions of each land use.

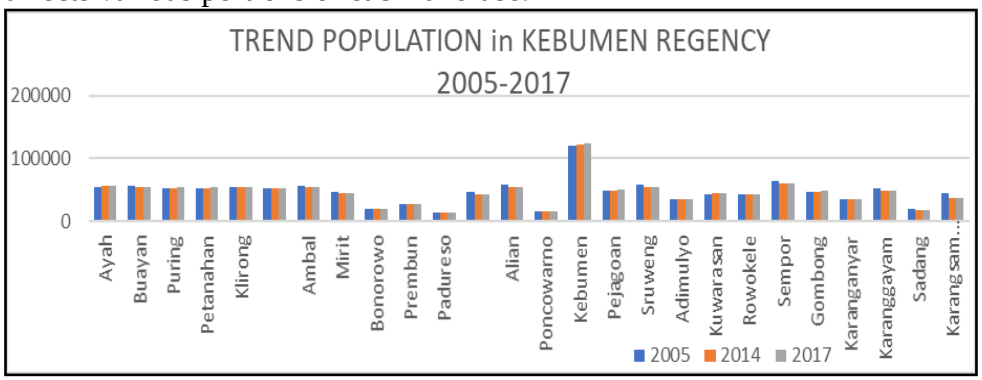


Fig. 2 the Pattern of Population in Kebumen Regency

Furthermore, an analysis of population growth can be strengthened through the results of calculating trends in population density. The mapping results on population density indicate that Kebumen District has the largest density compared to other regions. The presence of new migrants from other areas around the sub-district is indicated to be the cause of the high population density in Kebumen District. Thus, these conditions have an impact on the pressure on the land, because the character of the land area that tends to be static. Pressure on land as a result of an increase in population density can be in the form of building new buildings such as buildings or settlements or other uses which are predicted to produce economic benefits.

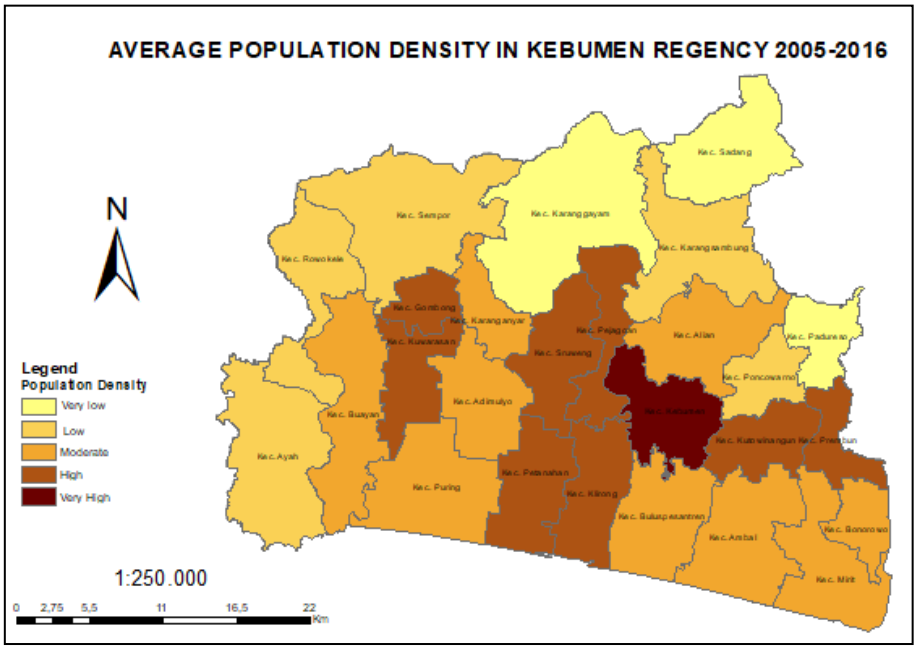


Fig. 3 Spatial Distribution of the average population pressure of Kebumen Regency

More specifically, the characteristics of population density can also be reviewed through the mean in the period 2005-2017. Based on the calculation results of the average population density, it is known that Kebumen and Gombong sub-districts also always have an increasing population density. Thus the condition is relevant to the average distribution of population density, namely categorizing Kebumen District as an area with very high population pressure, while Gombong District is categorized with high population pressure.

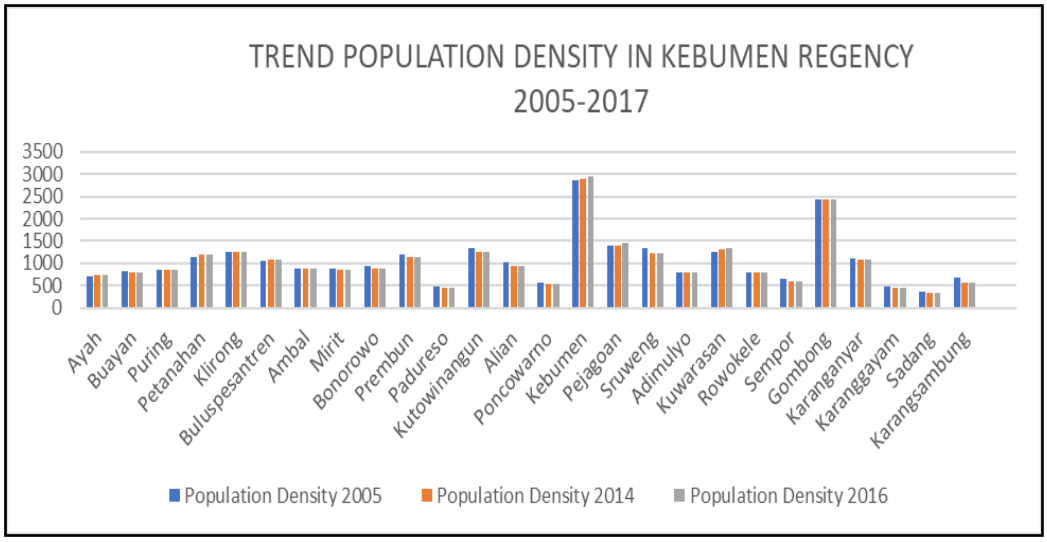


Fig. 4 Pattern of population pressure in Kebumen Regency

B. Trend Of Land Use Change In Kebumen Regency

The pattern of land use change can be identified through delineation of land use series in an area. The results of identification of land use changes in 2006, 2011 and 2016 in Kebumen Regency are presented as follows,

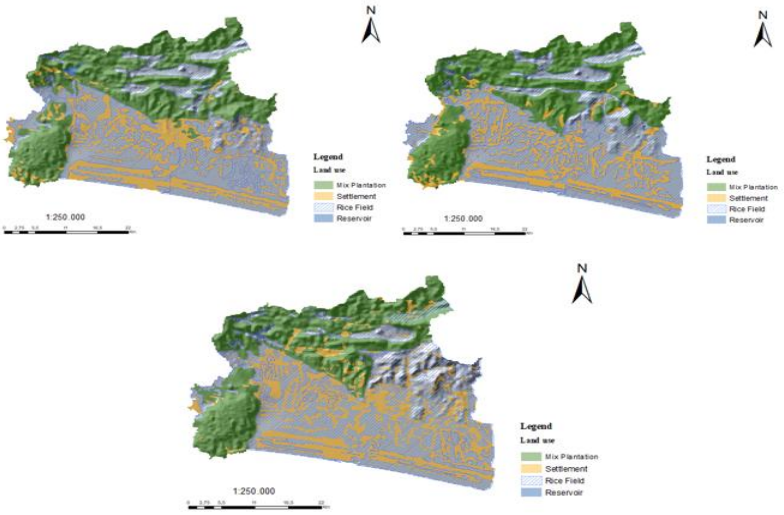


Fig. 5 Land Use Change In 2006, 2011, 2017

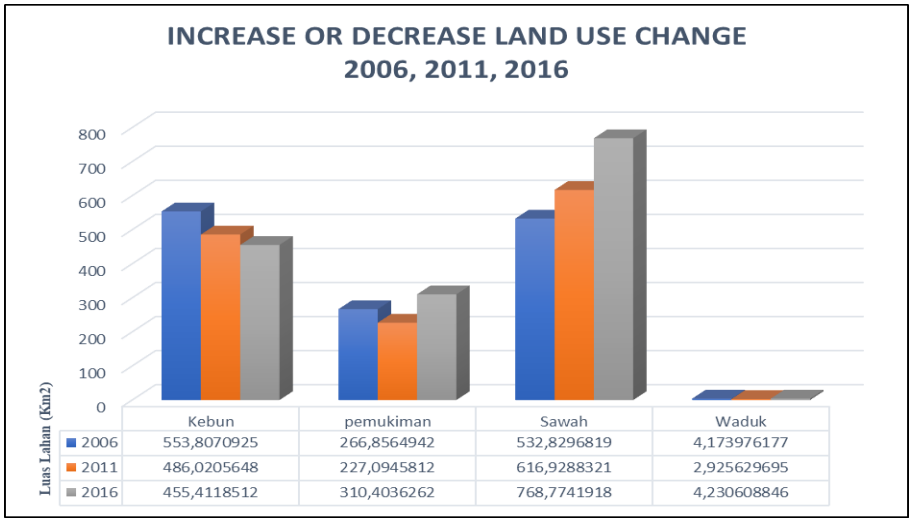
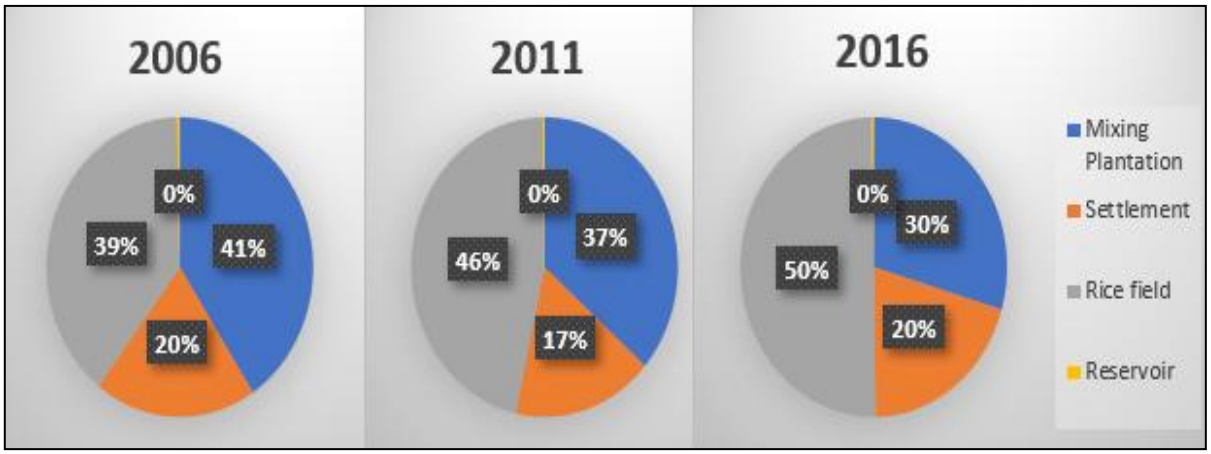


Fig. 6 Fluctuations in land use change in Kebumen Regency



Picture 7 Presentation Between Kebumen District Land Use

Based on identification result of land use in series, it can be known the trend of land use changes every year. Mixed gardens each year tend to have a decrease in area quantity, while settlements and rice fields have an increase. This condition further strengthens the fact that there is an influence between an increase in the number of population which in turn has an impact on the increase in the number of settlements and further impacts on land conversion, namely gardens. There is a decrease in the area of the garden every year, maybe in several things, those are converted gardens into rice fields or converted into settlements and other buildings.

Identification related to the relationship of population growth with the needs of land designated as settlements, one of which can be approached through an analysis of the distribution patterns of residential settlements. Based on delineation result of land use as a settlement in series, it shows that settlement distribution tends to increase and is concentrated in the central part of Kebumen Regency, compared to the other side. This condition is certainly influenced by several factors, among physical factors in the form of geomorphological aspects that tend to be slope and flat, making it easier for all access. Other conditions that also support the geographical location are also strategic, so that both conditions attract the community to then live around the area. There is a centralized settlement pattern, spreads and also extends (linearly) following roads, rivers and beaches

The analysis result of settlement patterns found in Kebumen Regency can also be used to further strengthen the pattern of land use change due to population growth. Settlement patterns in the central part of Kebumen Regency tend to centralize and form a block. These conditions indicate a possibility, that in previous conditions the settlement pattern was still linear following the road or river, but with the influence of population growth in the area, it was possible to convert the land into settlements, and eventually the demand for the settlement also increased, resulting in availability of land also increasingly limited. Thus other alternatives can be chosen, namely establishing settlements with limited land even though they do not meet the criteria of a decent living community, thus forming a pattern of settlements that seem to centralize and form large blocks.

A little bit different from settlement blocks in the central part of Kebumen Regency, settlement patterns in coastal areas are more linear (longitudinal) and seem parallel to the

coastline. These conditions certainly occur because the land area is still large so that it is possible to build settlements linearly. The existence of settlements around the coast also shows that the area is developing, especially in terms of the economy in the agricultural and tourism sectors. Generally, people who live around the coast also have links with their work, such as fishermen, pond owners, coastal farmers and service providers to support coastal tourism.

Settlement patterns in hilly areas such as Karanggayam Subdistrict, Karag Sub-District, Sempor Subdistrict are clustered and spread. This condition is the same as the pattern in general which represents settlement patterns in hilly or mountainous areas. This condition is due to the fact that the topography in the area certainly has more varieties (not flat), thus the community indirectly forms a settlement block that is considered to have sufficient strategic and environmental conditions that can support their lives.

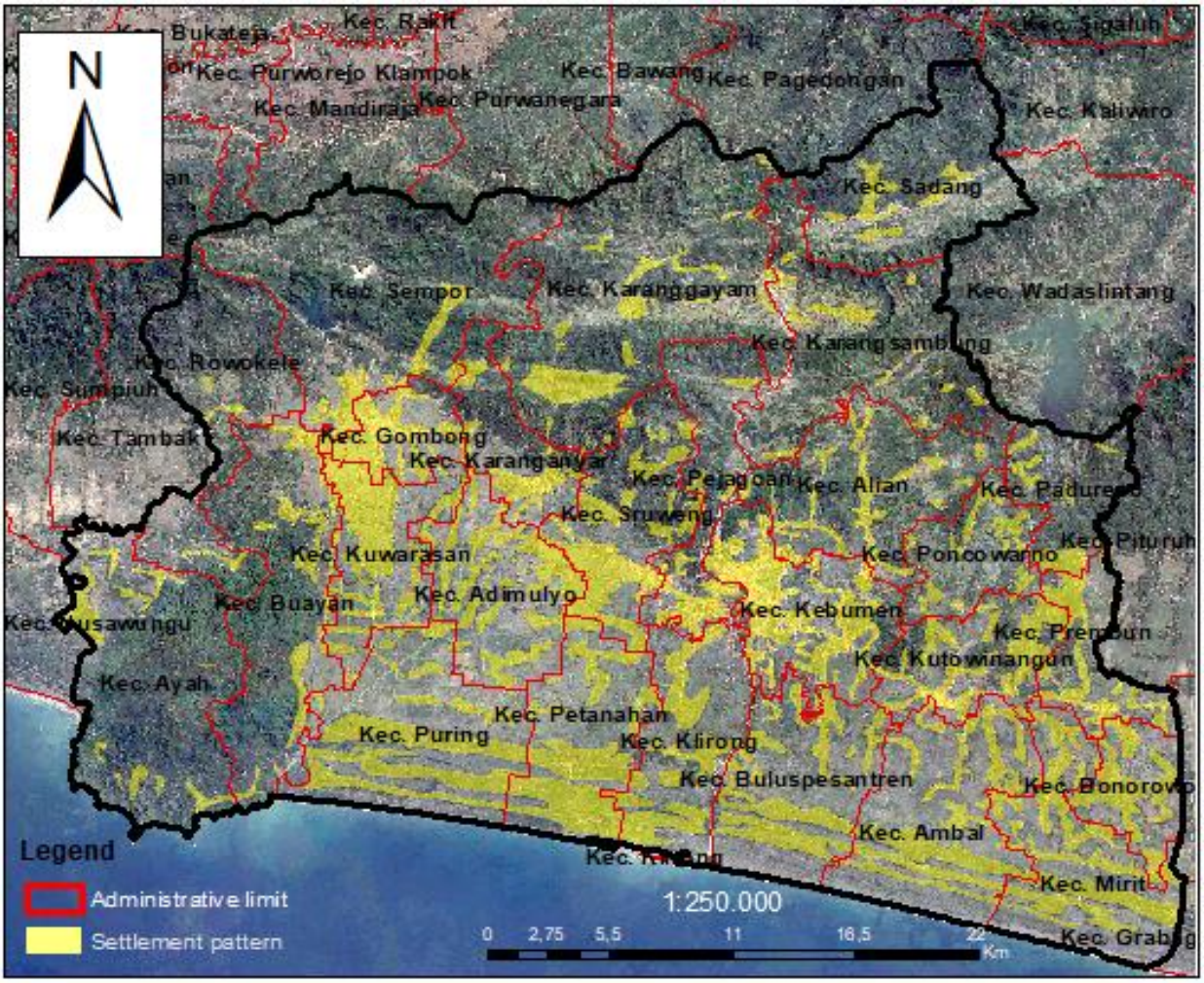


Fig. 8 Population Settlement Pattern of Kebumen Regency

Furthermore, if reviewed on a district scale, the graph shows that there is no population pressure on agricultural land. This condition is proven by the increase in the amount of rice fields along with the increase in the area of settlement in each year. This condition is possible because of the increasing number of people who own and manage agricultural land (rice

fields). Nevertheless, these conditions need to be reviewed through identification of population pressure on agricultural land at the scale of each district, to get more detailed results.

C. Population Pressure on Agricultural Land

Whether there is an influence of population growth or not on agricultural land pressures, it can be more specifically proven through the calculation of population pressure on agricultural land. The results show that an increase in population and population density in some districts, such as Kebumen and Gombong sub-districts are directly proportional to the level of pressure on agricultural land which is also high. Thus it can be concluded that there is a significant influence between population growth on agricultural land conversion. Increased population pressure has led to a paradigm shift in shifting cultivation into continuous cultivation in Kalimantan in general. This perception then develops into the application of massive land conversion to meet the needs of the population. The existence of this increasing population is certainly also possible to increase the need for land, namely for residential land, economic use and other supporting land uses.

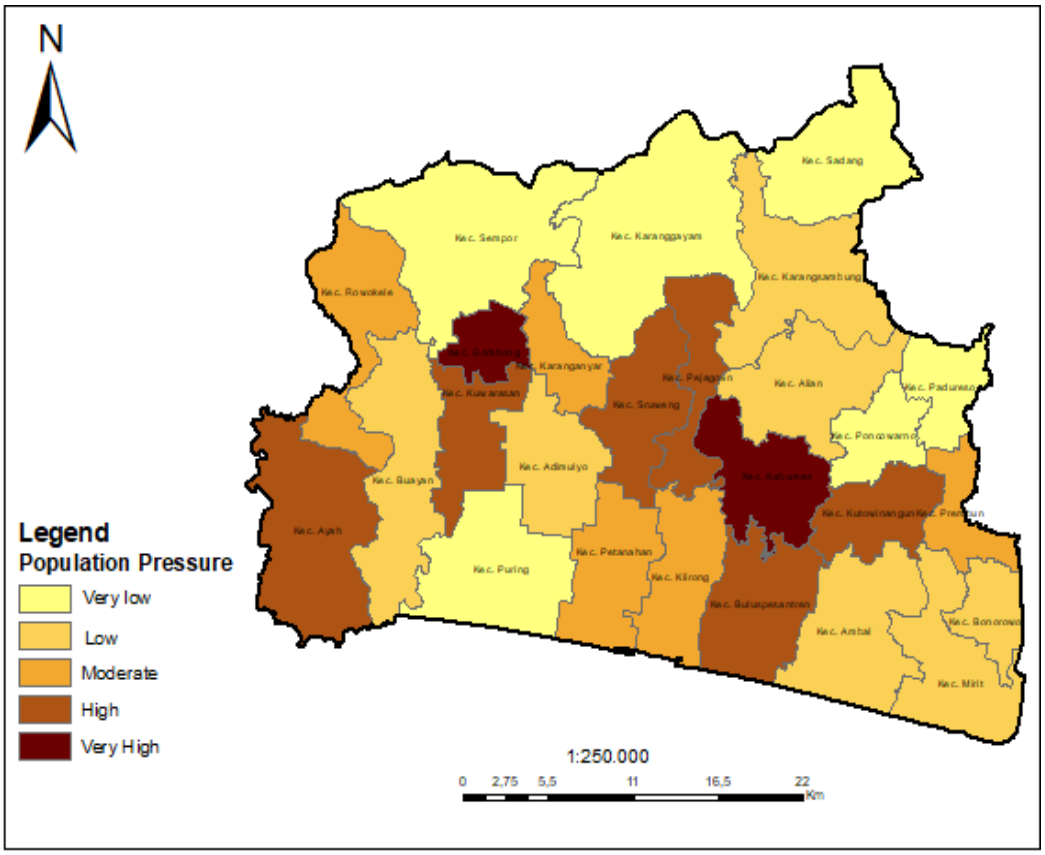


Fig. 9 Distribution of Level of Population Pressure on Agricultural Land

Based on comprehensive identification results related to population conditions which include increasing population numbers and densities that are elaborated with patterns of land use change and also pressure on

agricultural land, then it can be determined in areas that are prioritized to optimize management of the availability of land in it. Management can be done through various policies from the Kebumen Regency government, such as regulations governing new buildings, determining the ideal portion of land use and other more. These efforts need to be carried out from now foe anticipation of future conditions, which are increasing population and later it can be more difficult to control, as has happened in other areas, such as Jakarta, Surabaya, Semarang and others.

CONCLUSION

Kebumen Subdistrict is an area with the highest population among other sub-districts and always has population growth during that period. Furthermore, Mixed gardens each year tend to have a decrease in area quantity, while settlements and rice fields have an increase. Settlement patterns in the central part of Kebumen Regency tend to centralize and form a block. These conditions indicate influence of population growth in the area. Increase in population and population density in some districts are directly proportional to the level of pressure on agricultural land which is also high. Based on comprehensive identification results related to population conditions which include increasing population numbers and densities that are elaborated with patterns of land use change and also pressure on agricultural land, then it can be determined in areas that are prioritized to optimize management of the availability of land in it.

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