Agriculture land management in Gorontalo Province

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Abstract. Gorontalo is the smallest province in Sulawesi Island with the higher population density than three other provinces. But, it has large agriculture area with the corn as the highest exported commodity in 2019. Most of people in Gorontalo Province are working in agriculture sector. Although the number of population are increasing every year, the agriculture land are still existing in Gorontalo Province. This study focuses on population dynamic and agriculture land management in Gorontalo. Secondary data from Statistic Board Center of Indonesia are used to assess the population dynamic, such as population growth rate, population density, and population pressure on the agriculture land. We used time series data from 2008 until 2017. The data then analyzed with descriptive quantitative method by discussing the results of data calculation. The results show that although there is an increasing of population density in Gorontalo Province, but the population pressure is low. The optimum development on agriculture sector in Gorontalo Province affect the high productivity on many agricultural commodities, especially for corn crop. So, the agriculture land area are still prioritized in this region.

1. Introduction
Gorontalo is one of the provinces in Indonesia, established since 2001 as the result of expansion from North Sulawesi (Figure 1). These region has lowest population and smallest area in Sulawesi Island by number 1,20 million people and 11,257 km2 in 2019 [1]. But, the population density is higher than other provinces, such as Central Sulawesi, West Sulawesi, and Southeast Sulawesi.

High population density is related to the land use change [2,3] and land degradation [4]. The phenomenon of land use change is usually happened from agriculture land to non agriculture land. Non agriculture land is needed in providing settlements and business buildings areas in the cases of high population. Nevertheless, agriculture land is very important in Gorontalo. Most of people in Gorontalo are working in agriculture sector, by 30,7% in 2018. Agriculture land in Gorontalo is dominated by estate crops, such as corn, cacao, and coffee. Corn is the highest exported commodity in Gorontalo by the number 90.000 ton at 2018.
Gorontalo Province is the region with the rapid of economic development, especially in the agriculture sector [5]. The government of Gorontalo is successfully introduced the agriculture land management besides the massive urban development. In the increasing of the number of population every year, Gorontalo is still has large agriculture land by 40% from the total number of land area in 2017.

This study focuses on the population dynamic and agriculture land management in Gorontalo. The population dynamics we want to explore are population growth, population density, and population pressure to the agriculture land. We know that population aspects are related to the land because land is the place where people live and gain many advantages.

2. Methods
This study used secondary data from Statistic Board Center of Indonesia. We used many statistic publication, both national and province level. Time series data are the suitable type of data we choosed because it can present the dynamic and whole analysis. The time series data we used are from 2008 until 2017 (10 years). The analysis of this study is used descriptive quantitative with presenting many values as the results of calculation data. There are three types of parameters we calculated, that are population growth rate, population density, and population pressure to the agriculture land.

First, we calculated the population growth rate with the formula:

$$r = \left[ \frac{(P_t)}{(P_o)} \right]^\frac{1}{t} - 1$$  \hspace{1cm} (1)

Formula 1 is the geometric population growth formula with the “r” is population growth rate, “Pt” is the number of population in the last year, “Po” is the number of population in the beginning year, and “t” is time.

The second data we calculated is population density, with the formula:

$$\text{Pop. Density} = \frac{\text{Tot. Population}}{\text{Land Area (km}^2\text{)}}$$  \hspace{1cm} (2)

And the third is population pressure to the agriculture land with the formula:

$$\text{TP} = Z \times \frac{[f(P_o)((1+r)^t)/L]}{L}$$  \hspace{1cm} (3)
This formula is introduced by Soemarwoto in 1983 with the “TP” is population pressure to the agriculture land, “Z” is optimal land needed by people, “f” is farmer percentage, “Po” is population in the beginning year, “r” is the rate of population growth, “t” is time, and “L” is total agriculture land area. The meaning of TP values are as follows:
TP < 1, there is no population pressure;
TP = 1, there is an optimum land carrying capacity; and
TP > 1, there is population pressure.

3. Results and Discussions
Agriculture land management is important to practice in the region with the large agriculture land area such as Gorontalo Province. The land has certain number of carrying capacity threshold. So, if there is bad land management, the land carrying capacity will be low and disturb the sustainability of life. The discussions in this study divided into two focuses. The first one is the population dynamic in Gorontalo Province and the second one is agriculture land management there.

3.1. Population Dynamic in Gorontalo Province
The number of population in Gorontalo Province increased over time. In 2008, the population number is 972.208 inhabitants. These number rose in 2017 became 1.168.190 inhabitants. Gorontalo District is the region with highest population number, followed by Gorontalo City (Figure 2). But, the highest number of increasing is happened in Gorontalo City. These fact caused the increasing of population density by the average 91.13 inhabitants/km² in Gorontalo Province.

![The Number of Population Map of Gorontalo Province](image)

Figure 2. The Number of Population Map in Gorontalo Province

Although there is an increasing of the number of population, the population growth rate in Gorontalo Province was decreased from 2013 until 2017 (Figure 3). The higher population growth rate is happened in Boalemo District, followed by Pohuwatu, Gorontalo City, Bone Bolango, Gorontalo Utara, and Gorontalo as the district with lowest population growth rate.
The increasing of population density can be seen in Figure 4. The number of people in certain areas have many impacts to the land. One of this impact is land degradation or we can say that the carrying capacity of the land is low. The carrying capacity assessment is the determination of the maximum number of people in the certain area of land that can be supported without environmental degradation [6].

The land use map of Gorontalo Province (Figure 5) shows that Gorontalo is dominated by forests area (green color). We also can see that residential area is small and centered on Gorontalo City (orange color). Gorontalo City became the region with the highest population density because of the large population number and narrowed land area. It caused the low carrying capacity of land. But, the average of carrying capacity of land in Gorontalo Province are still below the threshold. It means that the land area in Gorontalo City are still supported the life of the people there.
But, if there is no good land management policy in Gorontalo Province, the land carrying capacity in these regions will decrease. Population pressure to the land will increase and finally the land degradation is massive. In this decade, the average of population pressure value to the agriculture land in Gorontalo Province is 0.89. It means that there is no population pressure caused the damage for land. But, in the range of years by 2008 until 2017, Gorontalo Province met the population pressure experienced by 2011 until 2013. The average of this number is 1.64. Figure 6 shows the trend of population pressure value in Gorontalo Province.

The previous study explained that the high population pressure is depend on population growth rate [7,8]. If there is high population growth rate, the population pressure will high too. In the case of Gorontalo Province, the population growth rate is decreased over time, so the population pressure is low.
3.2 Agriculture Land Management in Gorontalo

The lower population pressure in Gorontalo is related to the land management, especially in the land use management. Population pressure value is affected by the amount of agriculture land area and number of farmer in the certain region. The number of farmer in Gorontalo Province was decreased over time from 2008 until 2017. Figure 7 shows that all of the districts in Gorontalo faced the farmer decreasing. But, the decreasing number is relatively small. The average number of farmer decreasing is six people per year.

![Figure 7. The Number of Farmer Map of Gorontalo Province](image)

The total agriculture land area in Gorontalo Province is 499.235 hectare by 2017. These number is lower than the agriculture land area in 2008 by 637.652,3 hectare. So, the land use change in the ten years (2008 to 2017) is 138.417 hectare, from agriculture to non agriculture land area. But, the land use in the form of wetland and dry field are increased in this decade.

The government of Gorontalo Province realized this problem and with the document of “Rencana Pembangunan Jangka Menengah Daerah (RPJMD)” or regional medium-term development planning, gave the strategic planning to manage the sustainability of the agriculture land in Gorontalo. The document of revision on regional medium-term development planning 2012-2017 in Gorontalo Province showed that development orientation in Gorontalo Province by 2012 until 2017 is to increase the economic condition of society. In the agriculture sector, Gorontalo was introduced as the agropolitan region with the corn as a branding image.

Corn is the superior crop in this region, especially in Pohuwatu Regency with the highest of harvested area by 63.806 hectare in 2011. Besides corn, the cow livestock is also integrated to make Gorontalo’s branding image. The government hope that agriculture sector can accelerate the economic development of society.

In the land use change analysis from 2008 until 2017, only three from six districts that have the positive land use change from non agriculture to agriculture land, especially in the form of wetland. These districts are Pohuwatu, Gorontalo Utara, and Gorontalo City. These fact shows that the government are implemented the development planning seriously. Although there is still found the
land use change from agriculture to non agriculture land in many districts, but nowadays Gorontalo Province became the region with high productivity of many crops, such as corn and petsay as a superior vegetable in there.

4. Conclusion
Gorontalo Province has the high population density, especially in Gorontalo City. There is an increasing population density in Gorontalo Province (2013-2017). But, the population growth rate was decreased. With the large agriculture land area and high productivity, there is no population pressure in Gorontalo City. The concept of agropolitan with the corn and cow livestock as a Gorontalo’s branding image, make the agriculture sector in Gorontalo are still exist and rapidly developed. The government are serious to develope agriculture sector in Gorontalo. But, the improvement of agriculture development in Gorontalo is still needed in the effort to minimize land use change.

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