



# PROCEEDING

## INTERNATIONAL CONFERENCE ON CONSERVATION FOR BETTER LIFE 2015



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ON CONSERVATION FOR BETTER LIFE**

**11 - 13 September 2015**

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# THE PRESSURE OF CARRYING CAPACITY OF AGRICULTURAL LAND TOWARDS THE CONSERVATION OF NATIONAL PARK OF MOUNT MERBABU IN GETASAN SEMARANG

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## ABSTRACT

The purpose of this study is to determine the carrying capacity of agricultural land and its influence on changes in the conservation area of the National Park of Mount Merbabu. The research was done in Getasan district of Semarang Regency. Research analysis techniques included population pressure index calculation, calculation of the carrying capacity of agricultural lands and image interpretation to determine changes in land use. The results showed that the population pressure on agricultural land in the district Getasan tends to increase although relatively light, which in 2010 amounted to 0.346 and in 2014 reached 0.502. Carrying capacity of agricultural land in the district Getasan Semarang in 2010 and 2014 have entered the phase of deficit. The availability of agricultural land in 2010 was 352.96 ha of land needs 2014 4825.4 ha and 325.07 ha land availability with the needs of 4486.6 ha of land. The deficit of carrying capacity of agricultural land leads to the tendency of society in Getasan to expand the agricultural land. When it was observed through satellite images in 2010 and 2014, there had been a change of land use around the conservation area of Mount Merbabu National Park, although in a quite small area.

**Keywords - Pressure of Population, Carrying Capacity of Land, National Park**

## Introduction

Land is a natural resource that is vital to human survival because of land resource is the input (input) necessary for every human activity such as agriculture, industry, housing and so forth. Extensive land is used for agriculture sector which includes food crops, agricultural crops, forestry and herd as well as freshwater fisheries (Fitriany, 2005: 13).

In order to meet the needs of the increasing number of living population, land requirements have also increased and has led to shifts in land use that are less favorable for the realization of environmental conservation efforts. Kusumawati (2013: 8) stated that the agricultural sector has been increasingly displaced by the industrial sector, with the high conversion of the vast agricultural land and degraded land. This shows that the agricultural land will continue to decrease, driven by population growth and the advancement of development

in Indonesia. The higher the population density per km<sup>2</sup> or per hectare, the less agricultural land available.

The area around Mount Merbabu is designated as national park area by the Minister of Forestry's decree No. 135 / Menhut-II / 2004 on Function Change of Protected Forest Areas and Ecopark on Merbabu forest area of 5,725 hectares. This area is considered important because it has high conservation value as water sources, erosion prevention and habitat for protected flora and fauna. Like other forest areas in Java, the Merbabu National Park is not inevitable from the damages caused by the illegal activity of the surrounding community. Among those recorder activities are the activities of unlicensed sand and stone mining, illegal logging and forest clearing to grow vegetables.

To explore the issue of land use change on protected areas, it needs a calculation of the carrying capacity of agricultural land.

Calculation of carrying capacity of agricultural land is useful for estimating whether the agricultural land in the Getasan is still capable of supporting life and is there a viable farmers influence on changes in protected areas and conservation areas (Merbabu National Park). It is getting common recently that the areas which are supposed to be protected area are converted into agricultural areas. As described earlier, this is caused by the constantly increasing need for agricultural land, while agricultural land itself continues to decrease because of being pressured by the continued increase of the population using agricultural land for other purposes.

### Research Methods

The location study on the carrying capacity of agricultural land is in District Getasan, which is one of the districts in Semarang. The study focused on the area around the Merbabu National Park which is an important conservation area in the preservation of living creatures, water resources and erosion prevention. The objects in this study are residents of Getasan, agricultural land, and the land area of the National Park of Mount Merbabu. The determination of sample is done by using purposive sampling method, which is carried out with the aim that the sample points are chosen to represent the population in the study area.

This research includes studies of causative correlation. This study aimed to determine whether there is a correlation between population pressure on agricultural land to land changes in Merbabu National Park. Researchers assume that population pressure on agricultural land led to agricultural land decreasing, while the food needs of the population increases, so that the population would open agricultural land other than the existing agricultural areas, in this case devoted to the conservation area of the National Park of Mount Merbabu.

#### 1. Calculation of Population Pressure

Formula II model was used to calculate the population pressure on land. Population pressures formula II model is as follows:

$$TK_t = (1 - \alpha_t) \cdot z_t \frac{f_t \cdot Po(1 + r)^t}{L_t}$$

Description:

TK: population pressure on agricultural land.

t : The period of time of calculation.

$\alpha$  : Fraction of agricultural income or a percentage. Contribution outside the agricultural sector average magnitude of X is 35% (Mantra, 2003)

z : The land area required to support the life of a farmers at a decent level of life (ha / person).

f : The percentage of farmers in the population.

Po: The size of the population at the time of the reference time t0 (people).

r : The average annual rate of population growth.

L : Agricultural land in the area concerned.

The critical level of population pressure in an area can be seen from the value of TKT. If the value is greater than one, the region has been critical (Mantra, 2003: 76-78). Then the results are included in the standard evaluation (TK < 1 = mild pressure; TK ≤ 1-2 = moderate pressure; TK ≥ 2 = high pressure).

#### 2. Calculation of Agricultural Carrying Capacity

To determine the carrying capacity of an area, the stages are as follows:

a. Calculation of the availability (supply) of land the formula:

$$SL = \frac{\sum (Pi \times Hi)}{Hb} \times \frac{1}{P_{tvb}}$$

Description:

SL: The availability of land (ha).

Pi : Actual production of each type of commodity (units depend on commodities) Reckoned commodities



cover agriculture, farming, forestry, animal husbandry and fishery.  
 Hi: The unit price of each type of commodity (USD / unit) at the level of manufacturers.  
 Hb: rice price (USD / kg) at the producer level.  
 Ptvb: Productivity of rice (kg / ha).

b. Calculation of needs (demand) of land using the formula:

$$DL = N \times KHLL$$

Description:

DL: The total land requirement of rice equivalent (ha).  
 N : Total population (people).  
 KHLL: The land area needed for a decent life needs per population.

c. Determination of the status of the land carrying capacity

Status of land carrying capacity is obtained from the comparison between the availability of land (SL) and the land requirement (DL). If  $SL > DL$ , the carrying capacity of the land is considered surplus, when  $SL < DL$ , the carrying capacity of the land is considered as deficit or exceeded.

3. Image Interpretation to Find Out the Shift of Land Use

a. Classification results of interpretation  
 Classification of the results of interpretation is aimed at grouping or segmenting the homogeneous appearances which are then delineated (giving the boundary between one use and another) directly on computer monitors (digitation on screen).

b. Analysis interpretation validity  
 This analysis method is obtained from a field survey by means of the form validity table. The table contains the locations of interpretation, the survey location and coordinates (Adyatama, 2010: 26).

In this study, the overlay is used to determine the rate of change of protected area in time series. Overlaid map is a map of protected areas and land use maps. In this study the technical analysis of the data used is descriptive analysis which includes descriptive qualitative and quantitative descriptive.

## Results And Discussion

1. Population Pressure on Agricultural Land  
 One of the factors that affected the carrying capacity of agricultural land was the index of population pressure on agricultural areas were calculated based on the formula II model that added a number of off-farm income. This formula was used because the study area was an area that has developed so that farmers were not dependent fully on the farm.

Under these conditions, the population pressure on agricultural land in Getasan in 2010 were:

$$TK_{2010} = (1 - 35\%) \cdot 0,10 \frac{43,5\% \cdot 48.254 (1+1,09\%)}{3.983,5}$$

$$TK_{2010} = 0,346$$

In 2014, population pressure on agricultural land in Getasan were:

$$TK_{2014} = (1 - 35\%) \cdot 0,09 \frac{65,54\% \cdot 49.851 (1+1,77\%)}{3907,07}$$

$$TK_{2014} = 0,502$$

Based on the above calculation, the pressure of Getasan residents in 2010 was 0,346 and in 2014 reached 0,502. This value was still below 1. Therefore, it could be stated that the population pressure was relatively light.

2. Agricultural Land Carrying Capacity

Land carrying capacity was calculated in accordance with the Regulation of the Minister of Environment Number 17 Year 2009 on Guidelines for Determination of Carrying Capacity of the Environment in Spatial Planning.

a. Calculation of the availability (supply) of land.

In 2010 the availability of land in the District Getasan were as follows:

$$SL_{2010} = \frac{Rp5.336.828.780,00}{6.300} \times \frac{1}{2.400} SL_{2010} =$$

$$\frac{\Sigma (Pi \times Hi)}{Hb} \times \frac{1}{Ptvb}$$

$$SL_{2010} = 352,96 \text{ ha}$$

Whereas in 2014 the availability of land in the District Getasan were as follows:

$$SL_{2014} = \frac{Rp6.587.496.920,00}{7.100} \times \frac{1}{2.854,2}$$

$$SL_{2014} = 325,07 \text{ ha}$$

b. Calculation of the demand of land.

Calculation of level land requirement in 2010 and 2014 are as follows:

$$DL_{2010} = N \times KHLL$$

$$DL_{2010} = 48.254 \times 0.10$$

$$DL_{2010} = 4825.4 \text{ ha}$$

$$DL_{2014} = N \times KHLL$$

$$DL_{2014} = 49.851 \times 0.09$$

$$DL_{2014} = 4486.6 \text{ ha}$$

c. Determination of the status of the land carrying capacity

Based on the calculation of the availability of the land needs of the District Getasan, the obtained data on the level of availability and the needs of the District Getasan land in 2010 and 2014 according to the Table 1.

Based on the results of the calculation of the carrying capacity of agricultural land, it can

Table 1. Level of Land Availability and Requirements in Getasan in 2010 and 2014.

Year	Agricultural Land Availability (SL)	Agricultural Land Demand (DL)	Agricultural Land Carrying Capacity
2010	352,96 ha	4.825,4 ha	SL < DL
2014	325,07 ha	4.486,6 ha	SL < DL

Source : Calculation data, 2015.

be concluded that the carrying capacity of agricultural land in the district Getasan was deficit.

### 3. Changes in Land Use

Based on the results if the satellite image by means of digitization on a screen, in the area around the Merbabu National Park, there were some changes in land use during the period of 2010-2014. These changes had not reached the National Park area, but tended to approach the area. It can be seen from the appearance of the image results of 2010 and 2014 were overlay with the boundary of Merbabu National Park.

In Figure 1, there were 12 changes including vegetated shrubs land which turned into agriculture as well as changes in vegetation density. All changes covered less than 1 hectare, but more than 100 m<sup>2</sup>. This related to the carrying capacity of agricultural land in the district Getasan in 2010 and 2014 which revealed a deficit because the availability of land was smaller than the needs of the public land. From these calculations, it can be seen that the needs of the agricultural land in the district Getasan had not met properly. It raised a tendency in society in District Getasan to expand the farm. When seen in satellite images in 2010 and 2014, there was a change in the surrounding area of Merbabu National Park, although still in a small percentage (Figure 1).

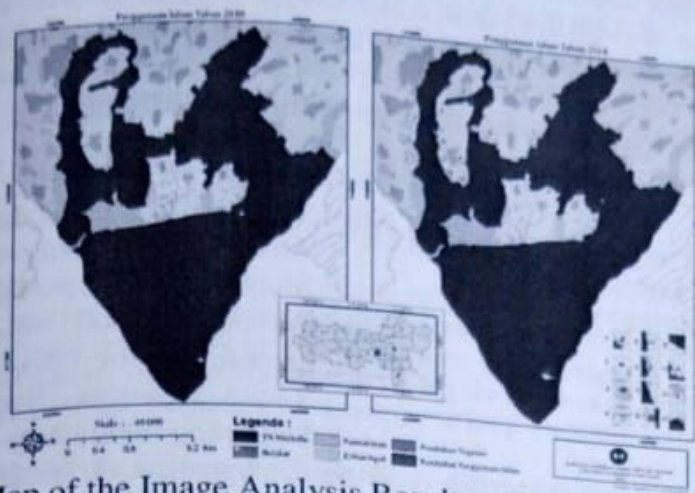


Figure 1. Map of the Image Analysis Result to find out the changes in land use

Factors that affected the population pressure on agricultural land in the district Getasan is a decrease in the amount of agricultural land, the ratio of production, farming systems, the number and population growth, and the minimum land area. Those five factors were the factors that affected the population pressure in the District Getasan. In further observation, there might be many more factors that affected the population pressure in the District Getasan.

As mentioned earlier, population pressure on agricultural land will affect the carrying capacity of agricultural land. Factors that affect the population pressure also affects the carrying capacity of agricultural land. The higher the population pressure on agricultural land, the lower the carrying capacity of agricultural land in an area. Deficit carrying capacity of agricultural land in the district Getasan signifies farmland inability to meet the needs of the population lives, although agricultural land in the district Getasan is still widespread. This is due to the lack of agricultural management, so that the amount of agricultural production is still lacking, production costs is raising and farmgate prices is plummeting.

The influence of the carrying capacity of the farm is visible from the occurrence of non-agricultural land use change to agriculture.

Changes in agricultural land due to the increasing needs of land in District Getasan due to the increased number of people who are mostly working in the agricultural sector. Based on survey data and satellite image processing, it is identified the change in non-agricultural land into agricultural land. However, the numbers are still very small compared to the total number of farms in the District Getasan. Changes in land use have not threatened the existence of the National Park of Mount Merbabu because the changes only occur in the surrounding area. But the population increase from year to year will occur, which will result in increasing demand for life and the need for land for a living. So it will have an impact on the functioning of the national park area.

In addition to changes in land use for agriculture, a decrease in the density of vegetation also occurred in a traditional zone of the national park and around the national park area. Vegetation decline is the impact of land uses, most of whom were gardens / moor, while the garden / moor cannot meet the needs of the firewood population. The lack of land that to meet the needs of firewood caused people to go deeper into the national park to look for firewood. A decrease in the density of vegetation may lead to increased risk of critical land in Getasan. It was due to the lack of absorptive

capacity of land to absorb the rain water, so that much water moving at the surface and little was absorbed into the ground. If the situation occurred on the land such as in mountainous area, then the risk of erosion will increase, even landslides could happen. It was feared to impair the function of Mount Merbabu National Park area, such as reducing water sources, increasing the risk of soil erosion, losing wildlife habitat and increasing other damages.

### Conclusion

Based on the calculation, the carrying capacity of agricultural land in the district Getasan is classified as deficit. The main influencing factor is the unstable production value of agricultural land, causing ups and downs of the farmers' income. This is compounded by the increasing number of people who influence the increase in land demands, so that the carrying value of agricultural land in the district Getasan also declined. Carrying capacity of agricultural land in the district Getasan turns to affect the forms of land use. Changes in land use are not yet threaten the preservation of Mount Merbabu National Park, because it is still relatively small and mostly occurs in the surrounding area. However, the decrease in the density of vegetation is feared would damage the function of the conservation area of the National Park of Mount Merbabu.

Suggestion for relevant government is the need for better agricultural system, given this involves the carrying capacity of agricultural land in the district Getasan. For

the managers of Merbabu National Park, it is necessary to clarify the boundaries of a national park to the community and increase surveillance system towards the boundary of Merbabu National Park.

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