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CARRYING CAPACITY OF AGRICULTURAL LAND IN MOJOLABAN SUBDISTRICT, SUKOHARJO – CENTRAL JAVA

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ABSTRACT

Analysis of the carrying capacity of agricultural land is one of the evaluation tools for sustainable development that can provide an overview of the relationship among population, agricultural land and the environment. This research aims to analyse the carrying capacity of agricultural land in each village in Mojolaban Subdistrict. Analysis of the carrying capacity of land in this research uses a concept developed by Sumarwoto (1985) where the magnitude of the carrying capacity of agricultural land is inversely proportional to population pressure. The results show that the carrying capacity of agricultural land in Mojolaban Subdistrict is inversely proportional to the population compressive pressure on agricultural land. Generally, the carrying capacity for agricultural land in Mojolaban Subdistrict is low level. There are 11 villages (73%) which have low carrying capacity for agricultural land and only 4 villages (27%) which have high carrying capacity of agricultural land.

Keywords: *Carrying capacity, Agricultural land, Mojolaban, Sukoharjo, Central Java*

A. INTRODUCTION

Mojolaban Subdistrict is one of 6 in Sukoharjo Regency which has a paddy field area of more than 2000 hctares (Central Bureau of Statistics, 2018). This condition has made Mojolaban subdistrict to be the one of the granaries for Sukoharjo Regency. Sukoharjo Regency itself is nationally designated as one of Regencies in Central Java which become a national rice granary (Sadali, 2018). One of the problems faced by regions that have been designated as national rice granary is the pressure of the population on agricultural land. For example, there was a reduction of 536 hectares of paddy fields in 2011-2018 in Sukoharjo (Central Bureau of Statistics, 2018).

The population growth becomes the one of causes of the conversion of agricultural land to non-agricultural land. According to Sudargono et al. (2020) population growth will increase the need for housing, foodstuffs, clean water and public transportation. The conversion of agricultural land becomes inevitable when the population continues to increase. There should be the way to prevent the conversion of agricultural land functions by carrying out development in accordance to the regional spatial planning.

Apart from being a national rice granary, Sukoharjo Regency is also a satellite area for the city of Surakarta. As the satellite area, Sukoharjo Regency gets a lot of developments in the city

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of Surakarta. Many areas in Sukoharjo Regency now rapidly developing into urban areas. Furthermore, there are areas in Sukoharjo that support the various needs of the people in Surakarta, and this is that happens in Mojolaban Subdistrict which is administratively close to and directly adjacent to the city of Surakarta.

Mojolaban Subdistrict is interesting to be investigated regarding the carrying capacity of agricultural land because this area was a rural area with the agricultural products as the main commodity. Physically, Mojolaban Subdistrict seems to be underdeveloped when it is compared to Kartasura, Colomadu, and Solo Baru. However, Mojolaban is currently a hinterland area which has rapid development. The factor of the high price of land for housing in the city of Surakarta and the distance which is not too far makes Mojolaban Subdistrict become a place to live for people who work in Surakarta.

The intensity of development in Mojolaban Subdistrict is increasing day by day. In recent years, many housing developers have developed housing in Mojolaban Subdistrict. Housing that is built is only to accommodate commuters who work in Surakarta and its surroundings. Development intensity in satellite area will certainly have an impact on land conversion, especially non-built into built-up land (Sadali, 2018). If this is allowed to do so, it will probably appear the landscape change that will have an impact on decreasing the carrying capacity of agricultural land.

There had been many researchers on population dynamics in a broad spectrum. Some of them researched on carrying capacity of land which were researched by Ernamaiyanti, dkk., 2016; Tola, et al., 2007; Widiastuti, et al., 2016. Research about population pressure by Soemarwoto, 1985; Ruhimat, 2015; Rohman and Hayati, 2015; Wuryanto and Susanti, 2015; Ariani and Harini, 2012. However, the research on population dynamics, especially the carrying capacity of agricultural land, is still relevant to be carried out because of dynamics nature. This research aims to analyse the variation of the carrying capacity of agricultural land in each village in Mojolaban Subdistrict in 2019.

B. METHOD

This research method discusses location and research object, materials and research tools, research variables, data collections, data analysis, and research outputs.

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1. Location and research object

The research location was conducted in Mojolaban Subdistrict, Sukoharjo Regency. This subdistrtict is the one of areas designated for food crop agriculture in Sukoharjo Regency based on Regional Regulation of Sukoharjo Regency number 14 of 2011 concerning the Spatial Planning for Sukoharjo Regency in 2011 – 2031. Spatially the research location can be seen in figure 1.

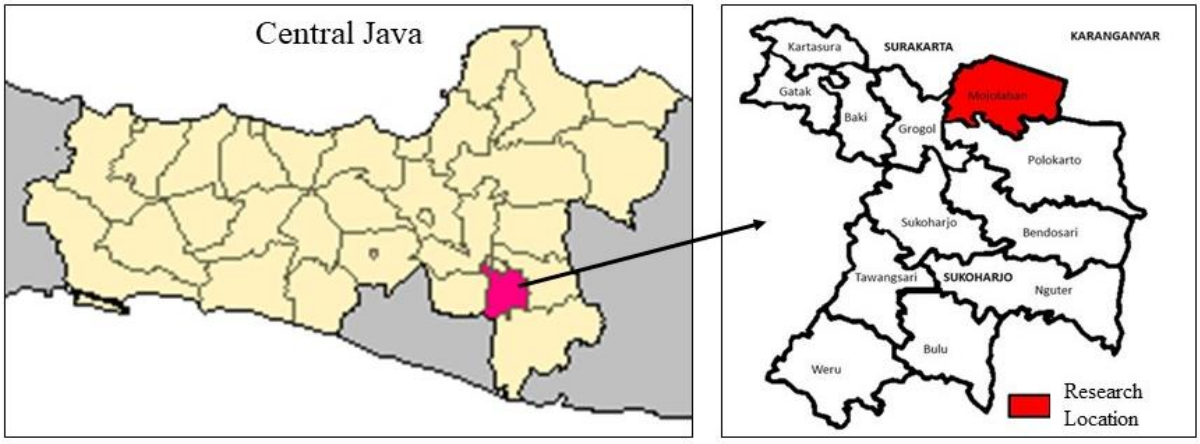

Figure 1. The research location in Mojolaban Subdistrict, Sukoharjo Regency, Central Java (Sudargono et al. 2020)

2. Materials and research tools

Materials which were used to analyze the carrying capacity of agricultural land in Mojolaban Subdistrict included:

a. Population data in Mojolaban Subdistrict
b. The data of paddy fields use in Mojolaban Subdistrict
c. An administrative map in Mojolaban Subdistrict that can spatially depict village administrative boundaries.

Tools that were being used for spatial analysis of population pressure on agricultural land in Mojolaban Subdistrict included:

a. Global Positioning System (GPS)
b. Digital camera
c. Stationery
d. A laptop with *ArcGIS, Google Earth, Microsoft Office, and Corel Draw* installed

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3. Data collection technique

Population data and the area of the use of paddy fields were obtained from publication of the Central Bureau of Statistics of Sukoharjo Regency 2019. Spatial datum included data on administrative boundaries, road networks, and river networks. Mojolaban Subdistrict was obtained from Rupa Bumi Indonesia Map published by Geospatial Information Agency.

4. Data analysis method

a. Population pressure on agricultural land

The calculation of population pressure used the population pressure formula model I (Soemarwoto, 1985):

$$Pp = Z \frac{f.Po(1+r)^t}{L}$$

Pp = Population pressure

Z = Minimum land area for proper living

F = Percentage of farmers in the population

Po = The amount of population at the reference time

r = Population growth level

t = Calculation time period

L = The agricultural land area in the relevant region

According to the Pp formula, the value of population pressure on the land area can be interpreted as follows:

Pp>1, there was a population pressure, and the carrying capacity of agricultural land was exceeded.

Pp=1, there was an optimal use of agricultural land according to the carrying capacity of the land.

Pp<1, There was no population pressure, and the agricultural land was still able to support the existing population.

b. The carrying capacity of agricultural land

Land Carrying Capacity (LCC) is the ability of land to support human life. The carrying capacity of agricultural land is the ability of agricultural land to support the life of formers and their family (Widiastuti, et al., 2016). According to Soemarwoto (1985), the carrying capacity of agricultural land is the percentage of agricultural land and the amount of agricultural output in the area and time. The greater percentage of cultivable and productive agricultural land will have the greater outcome of carrying capacity of agricultural land for farmers. The value of the carrying

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capacity of agricultural land is the inverse value of population pressure (Muta'ali, 2015). So, the carrying capacity of the land used the formula:

LCC = $^{1}/_{Tp}$

Value

LCC > 1 = Carrying capacity of land was high

LCC = 1 = Carrying capacity of land was optimum

LCC < 1 = Carrying capacity of land was low

C. RESULT

1. General description of Mojolaban Subdistrict

Mojolaban Subdistrict is part of Sukoharjo Regency, Central Java. The area is around 3.554 hectares or around 7.62% of the total area of Sukoharjo Regency (46.666 hectares). The location is in the north of subdistrict capital with approximately 11 kilometers. North and East border on Jaten Subdistrict, Karanganyar Regency. The South borders on Polokarto Subdistrict and the East borders on the city of Surakarta. Most of the area is plains with an average elevation of 104 masl.

Administratively, Mojolaban Subdistrict is divided into 15 villages, the names of and their respective area are presented in Figure 2.

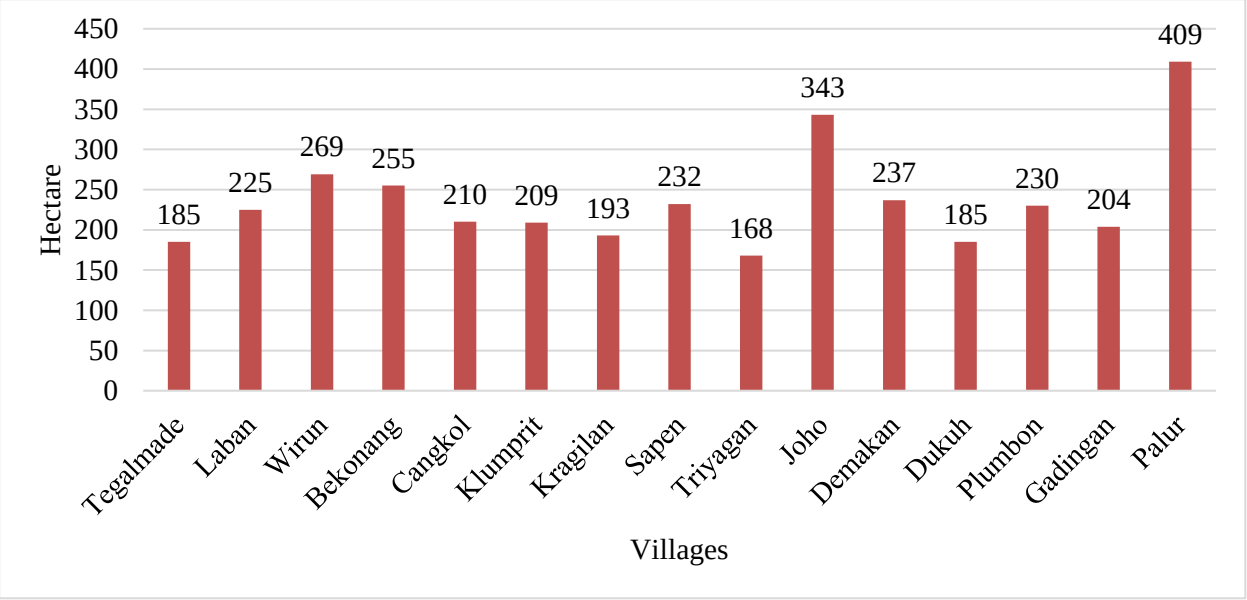

Figure 2. Villages and an Areas in Mojolaban Subdistrict

Source: Central Bureau of Statistics of Sukoharjo Regency 2018

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From Figure 2 it can be seen that the village with the largest area is Palur Village which is 409 hectares while the village with the narrowest area is Triyagan Village with 168 hectares.

2. Population pressure concerning agricultural land

Population pressure on the land on this research was analysed by Type I Soemarwoto's Mathematical Model (1985) which considered the farmers to only live from agricultural land they cultivated. The consideration in using model I was the limitation of farmer income data outside of farming per unit analysis used in calculating the model.

Population pressure concerning agricultural land occurred because of the imbalance between the standard necessity of life and the availability of resources in the area. According to Soemarwoto (1985) population pressure on the land was a ratio between the population and the minimum land area to live properly in an area. This opinion became the basis for calculating the population pressure at the research location. Based on the calculation of the variables that were considered as explained in the previous discussion, most of the villages in Mojolaban Subdistrict were classified as high population pressure on agricultural land with Pp value > 1. Some of villages had Pp value < 1 which meant that population pressure on agricultural land was low. In detail, the results of the calculation of population pressure in each foreign village can be seen in table 1.

Table 1. Population pressure concerning agricultural land in Mojolaban Subdistrict

No	Villages	Z	f	P	r	L	Pp	Class
1	Tegalmade	0,25	0,05	3364	1,46	141	0,69	Low
2	Laban	0,25	0,09	5325	1,41	144	2,08	High
3	Wirun	0,25	0,07	7459	1,37	166	1,73	High
4	Bekonang	0,25	0,04	5890	1,24	178	0,76	Low
5	Cangkol	0,25	0,05	6782	1,40	130	1,47	High
6	Klumprit	0,25	0,08	5261	1,35	136	1,78	High
7	Kragilan	0,26	0,10	4194	1,23	130	1,82	High
8	Sapen	0,26	0,03	5151	1,48	134	0,80	Low
9	Triyagan	0,25	0,03	5989	1,39	69	1,35	High
10	Joho	0,25	0,04	7884	1,44	219	0,83	Low
11	Demakan	0,25	0,06	4361	1,22	125	1,10	High
12	Dukuh	0,25	0,06	3919	1,11	118	1,14	High
13	Plumbon	0,26	0,08	6065	1,37	146	1,82	High
14	Gadingan	0,26	0,08	6711	1,40	123	2,63	High
15	Palur	0,26	0,04	16740	1,65	202	2,32	High

Source: Analysis results, 2019

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Based on Table 1 above, it is known that 27% of the villages in Mojolaban Subdistrict have low population pressure. Villages that have low carrying capacity include Tegalmade, Bekonang, Sapen, and Joho. There are about 73% of villages in Mojolaban Subdistrict have high population pressure concerning agricultural land include Laban, Wirun, Cangkol, Klumprit, Kragilan, Triyagan, Demakan, Dukuh, Plumbon, Gadingan and Palur.

3. Carrying capacity of the land

Carrying capacity of the land is the inverse value of population pressure concerning agricultural land. The value of carrying capacity in Mojolaban Subdistrict varies from one village to another. The carrying capacity of the land in Mojolaban Subdistrict is presented in Table 2.

Table 2. Carrying capacity of the land in Mojolaban Subdistrict

NO	Village	LCC	Classification
1	Tegalmade	1,45	High
2	Laban	0,48	Low
3	Wirun	0,58	Low
4	Bekonang	1,31	High
5	Cangkol	0,68	Low
6	Klumprit	0,56	Low
7	Kragilan	0,55	Low
8	Sapen	1,25	High
9	Triyagan	0,74	Low
10	Joho	1,20	High
11	Demakan	0,91	Low
12	Dukuh	0,88	Low
13	Plumbon	0,55	Low
14	Gadingan	0,38	Low
15	Palur	0,43	Low

From table 2 it can be seen that there is no significant difference in the value of carrying capacity of agricultural land in each village in Mojolaban Subdistrict. There are 27% of villages in Mojolaban Subdistrict have high carrying capacity agricultural land. The villages that have high carrying capacity of agricultural land are Tegalmade, Bekonang, Sapen, and Joho. The majority of villages in Mojolaban Subdistrict that have low carrying capacity of agricultural land is about 73%. The villages that have low carrying capacity of agricultural land include Leban, Wirun, Cangkol, Klumprit, Kragilan, Triyagan, Demakan, Dukuh, Plumbon, Gadingan, and Palur. Spatially, the carrying capacity of agricultural land in each village is presented in Figure 3.

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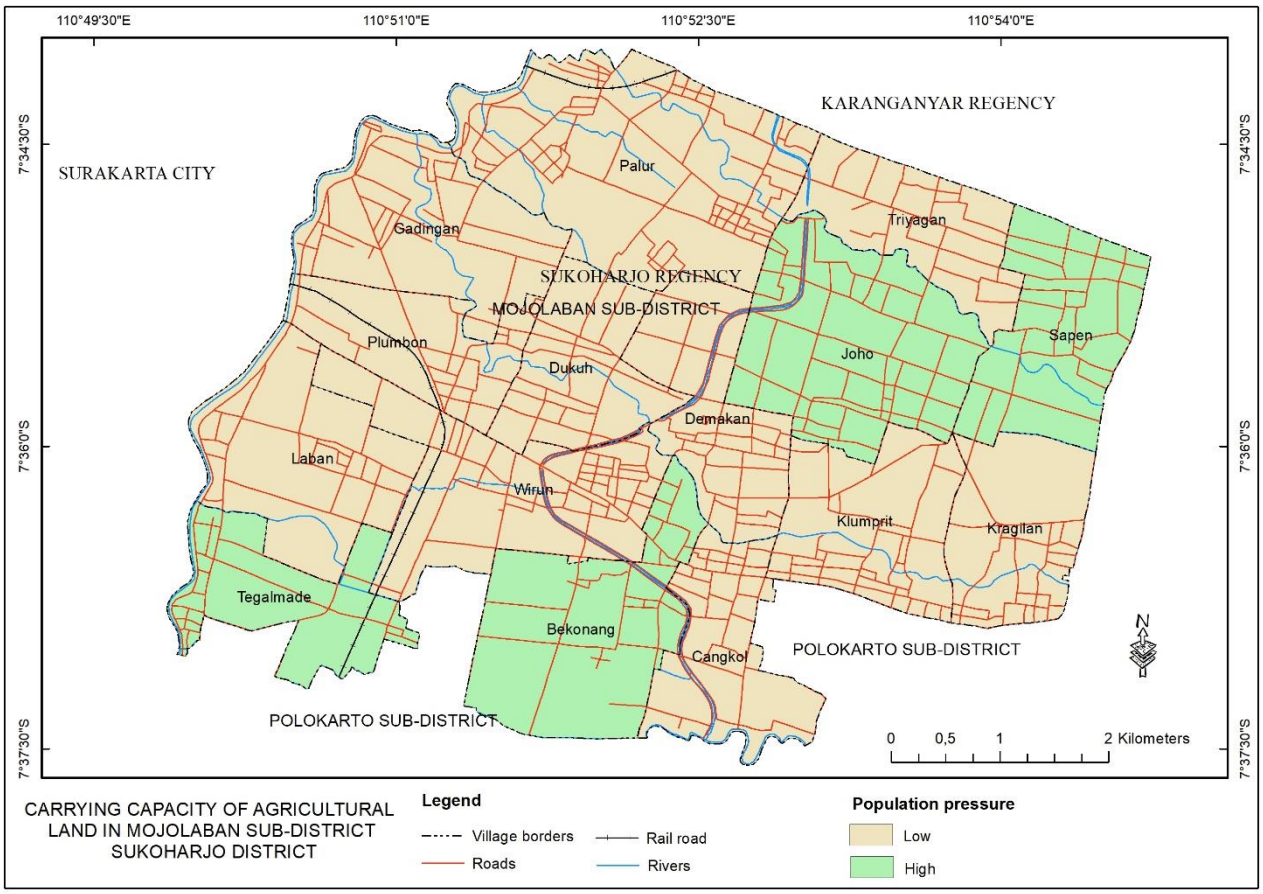

Figure 3. Carrying capacity of agricultural land in Mojolaban Subdistrict

D. CONCLUSION

Based on the research which is conducted as described on the previous discussion, it can be concluded that the carrying capacity of agricultural land is inversely proportional to population pressure on the land. As many as 73% of villages have low carrying capacity agricultural land in Mojolaban Subdistrict. Furthermore, there are only 27% of villages that have high carrying capacity of agricultural land in Mojolaban Subdistrict.

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