



A STUDY OF POPULATION PRESSURE TOWARD AGRICULTURE LAND IN MOJOLABAN SUBDISTRICT, SUKOHARJO – CENTRAL JAVA

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Abstract

Indonesia is an agricultural country in a tropical area with a high potential for agricultural land. This condition becomes a good ecosystem for human, animal, and plant life. With all those potentials, the population in Indonesia has reached more than 260 million people currently. Surely, such a large population brings logical consequences in which a large amount of land must be provided by the State to support the housing needs and to meet the food and clothing needs. As a matter of fact, the population of Indonesia continues to increase over time. The increase of population in many areas has caused the conversion of agricultural land into residential land. Therefore, agricultural land continues to have pressure constantly. The Population pressure toward agricultural land is a comparison between the number of people and the minimum land area to be able to live properly. This study aims to analyze the variations of population pressure on agricultural land in each village in Mojolaban Sub-District. The research method used to analyze the population pressure was by utilizing the formula of Otto Sumarwoto I, where residents are considered to only live on cultivated agricultural land. The results showed that population pressure toward agricultural land in Mojolaban Sub District was high. There were 11 villages and 4 villages that were categorized as having high and low population pressure on agricultural land respectively.

Keywords: Population Pressure, Agricultural land, Mojolaban, Sukoharjo, Central Java.

A. Introduction

Sukoharjo is one of the regencies in Central Java that is designated as the national rice barn (Sadali, 2018). This determination is caused by the availability of wide rice fields over the district area. Based on the statistical data from the Central Bureau of Statistics (Table 1) the area of paddy fields in Sukoharjo Regency in 2018 reached 20,518 ha (44% of the total area), and the area of non-paddy fields reached 26,148 ha (56% of the total area). As the population grows, the utilization of the land resource continues to increase, caused by the increasing need for life support facilities such as shelter, food, air, services, and other public facilities.

Sukoharjo is also known as a satellite area for Surakarta (Figure 1). Sukoharjo, with all its resources, has become one of the sustainability supporters for the city of Surakarta. From the perspective of city development, Surakarta as an old city that continues to experience development but has regional limitations, its development will extend to the surrounding areas. Looking from the spatial perspective, the dominant physical development of Surakarta nowadays tends to head south to the area of Solo Baru, Sukoharjo Regency.

Nevertheless, the development of Surakarta also gives influence to the development of adjacent areas such as sub-district of Palur and Mojolaban in the East and Kartasura and Colomadu in the west. Particularly to Mojolaban sub-district, it is interesting to conduct a depth study in terms of the population pressure on agricultural land since the main commodity of this rural area is from agricultural products. Physically, Mojolaban sub-district is less developed compared to Kartasura, Palur, Colomadu, Kartasura, or Solo Baru. However, currently, Mojolaban becomes a hinterland area with rapid development.

Table 1. The Area of Rice and Non-Rice Fields by District in Sukoharjo Regency in 2018

No	Sub-District	Area (Ha)	The Area of Rice and Non-Rice Fields		
			Percentage	Rice Fields (ha)	Non-rice Fields (ha)
1	Weru	4.198	9,00	2.031	2.167
2	Bulu	4.386	9,40	1.131	3.255
3	Tawang Sari	3.998	8,57	1.672	2.326
4	Sukoharjo	4.458	9,55	2.363	2.095
5	Nguter	5.488	11,76	2.418	3.070
6	Bendosari	5.299	11,36	2.528	2.771
7	Polokarto	6.218	13,32	2.453	3.765
8	Mojolaban	3.554	7,62	2.161	1.393
9	Grogol	3.000	6,43	934	2.066
10	Baki	2.197	4,71	1.199	998
11	Gatak	1.947	4,17	1.189	758
12	Kartasura	1.923	4,12	439	1.484
		46.666	100,00	20.518	26.148

Source: Central Bureau of Statistics of Sukoharjo, 2018

The development of the built area, especially for settlements and services is inseparable from the development of the City of Surakarta. The significant development of Mojolaban Sub District is due to its location that is close to Surakarta while the land price for housing in Surakarta is relatively high. Consequently, many workers in Surakarta preferably choose to live in Mojolaban that makes many housing developers try to develop housing in that area to accommodate commuters to work in Surakarta and surrounding areas.

The intensity of development in Mojolaban is constantly increasing. This intense development in the satellite area will certainly have an impact on the conversion of land, especially non-developed land into built-up land (Sadali, 2018). If it slowly happens, then it can change the natural landscape and give impact to human living and the environment. Looking at the statistical data from BPS Sukoharjo in the period 2011 - 2017 there has been a change of function of paddy fields to non-paddy fields about 536 ha.

Mojolaban is one of the sub-districts in Sukoharjo that suffers the change of agricultural land in the satellite area, and it will continue to depress agricultural land if it is not anticipated. Consequently, citizens who rely on their lives in the agricultural sector will no longer be able to

meet their needs. The population pressure toward land is a popular term for such phenomena that has meaning as a comparison between the population and the minimum land area to be able to live properly (Soemarwoto, 1985).

The research on population dynamics in a broad spectrum has been carried out. Some of them were researched on population pressure by Soemarwoto, 1985; Ruhimat, 2015; Rohman and Hayati, 2015; Wuryanto and Susanti, 2015; Ariani and Harini, 2012. Research on land carrying capacity was carried out by Ernarnayanti et al., 2016; Tola et al., 2007; Widiastuti et al., 2016. Nevertheless, research on population dynamics, especially population pressure toward agricultural land is still very relevant to do regarding its dynamic nature. Besides, there is a human interest to protect their agricultural land from supporting the availability of sustainable food. This study aims to analyze the variations in population pressure on agricultural land in each village in Mojolaban Sub District in 2019.

B. Methodology

1. Research Design

This research used a quantitative method. Data was collected from secondary data and field survey. Spatial data, including administration border, road networks, river networks, and land use in Mojolaban Sub District were obtained from Indonesian Topographical Maps issued by Geospatial Information Agency. The renewal of geospatial information that is not available in the topographic map will be visually interpreted through Google Earth imagery. After obtaining a tentative map of the road network, river network, and land use, then a field survey was carried out with the help of GPS to validate the interpretation results of the tentative map. This research was conducted in Mojolaban Sub- District, Sukoharjo Regency. This location, based on Regulation Number 14 of 2011 concerning Spatial Planning for Sukoharjo Regency in 2011 – 2031 was one of the crop agriculture areas for food stock in the Sukoharjo Regency. The research location can be seen in Figure 1.

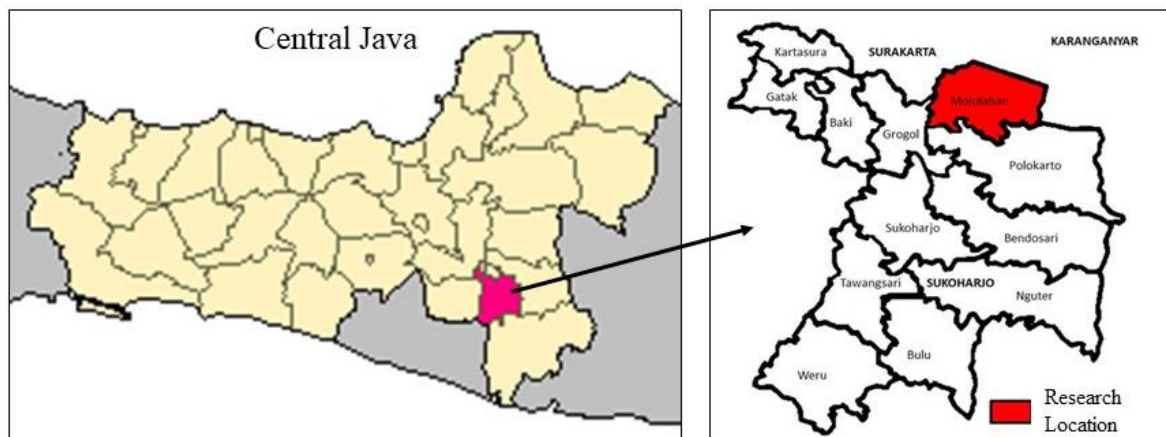


Figure 1. The research location in Sukoharjo, Central Java (without scale)

2. Instruments

The instruments used in this research include:

- a. Garmin *Global Positioning System* (GPS)
- b. Digital camera
- c. Tentative map of land use
- d. A Personal Computer with ArcGIS, Google Earth, Microsoft Office, and Corel Draw software installed.

3. The technique of Data Analysis

The calculation of population pressure was using the formula of population pressure model I (Soemarwoto, 1985), namely:

$$T_p = Z \frac{f \cdot P_o(1+r)^t}{L} \dots\dots\dots (1)$$

With :

T_p = Population pressure

Z = Minimum land area for a decent living (ha / person)

f = Percent of farmers in the population

P_o = The size of the population at the time of reference

r = population growth rate

t = Period of calculation

L = Area of agricultural land in the concerned area

The Z value is calculated using the formula:

$$Z = \frac{(0,25LSI2) + (0,50LSI1) + 0,50LST + 0,76LLK}{(LSI1+LSI2+LST+LLK)} \dots\dots\dots (2)$$

$LSI2$ = area of irrigated rice fields harvested > 2 times a year,

$LSI1$ = area of irrigated rice fields harvested once a year,

LST = area of rain-fed rice fields,

LLK = dry land area.

The value for farmer percentage in the population is calculated by the formula:

$$F = \frac{\text{The number of farmer \wedge farmworkers}}{\text{The number of people}} \times 100\% \dots\dots\dots (3)$$

Population growth rate (r) is calculated by the geometric population growth rate formula, namely:

$$r = \left(\frac{P_t}{P_o} \right)^{\frac{1}{t}} - 1 \} \times 100 \dots\dots\dots (4)$$

r = rate of population growth

P_o = population in the initial year

P_t = population in the years that follow

t = difference in years P_t and P_o

Based on T_p formula, the value of population pressure on land can be interpreted as follows:

$T_p > 1$, there is population pressure, and the carrying capacity of agricultural land is exceeded.

$T_p = 1$, optimal use of agricultural land occurs in accordance with the carrying capacity of the land.

$T_p < 1$, there is no population pressure, agricultural land is still able to support the existing population.

C. Findings and Discussion

1. Findings

Mojolaban is part of the Sukoharjo Regency in Central Java Province. The location is to the north of the district capital with an approximate distance of 11 kilometers. Its area is 3,554 Ha or about 7.62% of the total area of Sukoharjo Regency (46,666 Ha). Most of the area is plain with an average height of 104 meters above sea level. North and east are bordered by Jaten District and Karanganyar Regency. The south is bordered by Polokarto District in Sukoharjo Regency. The Eastside is bordered by Surakarta City. Administratively, Mojolaban is divided into 15 villages. The names of villages and their respective area are presented in Table 2.

Table 2. Villages and Area in Mojolaban Sub District

No	Village	Area (ha)	%
1	Tegalmade	185	5,21
2	Laban	225	6,33
3	Wirun	269	7,57
4	Bekonang	255	7,18
5	Cangkol	210	5,91
6	Klumprit	209	5,88
7	Kragilan	193	5,43
8	Sapen	232	6,53
9	Triyagan	168	4,73
10	Joho	343	9,65
11	Demakan	237	6,67
12	Dukuh	185	5,21
13	Plumbon	230	6,47
14	Gadingan	204	5,74
15	Palur	409	11,51
Jumlah		3554	100

Source: Central Bureau of Statistics of Sukoharjo, 2018

Population pressure toward land in this study was analyzed with the model of Soemarwoto Type I (Equation 1), which considers farmers only live on the agricultural land that they cultivate. The consideration to use this model is the data limit of farmer's income beyond farming per unit of analysis used in calculating the model.

a. The Number and Rate of Population Growth

The population in this study is a group of people who reside in an administrative area. Population data were obtained from Mojolaban in Numbers from the Central Statistics Agency of Sukoharjo Regency. A population growth rate is a number that shows the rate of population growth each year in a certain period. The growth rate is expressed as a percentage of the basic population. To calculate the rate of population growth requires a range of population development data affected by births, deaths and migration. In this analysis, initial data on population numbers in 2010 and population data at the end of 2018 were used. The rate of population growth in Mojolaban Sub District was calculated using geometric method. The highest population growth rate was in Palur Village, which is 1.65, while the lowest population growth rate occurred in Dukuh Village, which is 1.11. The rate of population growth per village in Mojolaban is presented in Table 3.

Table 3. Population Growth Rates per Village In Mojolaban

No	Village	Population in 2010	Population in 2018	Population Growth Rate
1	Tegalmade	2010	3364	1,46
2	Laban	4200	5325	1,41
3	Wirun	6477	7459	1,37
4	Bekonang	5267	5890	1,24
5	Cangkol	5667	6782	1,40
6	Klumprit	4332	5261	1,35
7	Kragilan	3579	4194	1,23
8	Sapen	3713	5151	1,48
9	Triyagan	4909	5989	1,39
10	Joho	6624	7884	1,44
11	Demakan	3761	4361	1,22
12	Dukuh	3522	3919	1,11
13	Plumbon	5082	6065	1,37
14	Gadingan	5612	6711	1,40
15	Palur	14284	16740	1,65

Source: Analysis Result, 2019

b. The minimum standard for a decent living (Z)

One of the variables to calculate population pressure is the minimum area of land to live properly. The minimum land area for a decent living is the minimum land area to support farmers living properly for one year that is calculated from the weighted average of each type of land use which is equivalent to 650 kg of rice/capita/year (Soemarwoto, 1985). Types of land use used to calculate the minimum land area to live properly include paddy harvesting twice a year, paddy harvesting once a year, rain-fed rice fields, and dry fields. Each area of land use is then multiplied by a coefficient that has been determined based on the calculation of Soemarwoto (1985). The calculation results can be seen in Table 4.

Table 4. Index of living standards for each village in Mojolaban Sub District

No	Village	Land Criteria				Z
		Rice Fields (>2x harvesting)	Rice Fields 1x harvesting	Rain-Fed Rice Fields	Dry Fields	
1	Tegalmade	141	0	0	0	0,25
2	Laban	144	0	0	0	0,25
3	Wirun	166	0	0	0	0,25
4	Bekonang	178	0	0	0	0,25
5	Cangkol	130	0	0	0	0,25
6	Klumprit	136	0	0	0	0,25
7	Kragilan	130	0	0	3	0,26
8	Sapen	134	0	0	2	0,26
9	Triyagan	69	0	0	0	0,25
10	Joho	219	0	0	0	0,25
11	Demakan	125	0	0	0	0,25
12	Dukuh	118	0	0	0	0,25
13	Plumbon	146	0	0	2	0,26
14	Gadingan	123	0	0	2	0,26
15	Palur	202	0	0	2	0,26

Source: Analysis Result, 2019

c. Percentage of farmers in the population (f)

Residents who work in the agricultural sector are divided into two, namely farmers whose their land and farmers who have no their land (farm labourers). The percentage of farmers in the population is the ratio of the number of people who have a livelihood as farmers in an area with the total population in the area (Soemarwoto, 1985). Therefore, to find out the fraction of farmers in a village, it needs to compare the number of farmers in a village with the total population. The fraction of the farmer population in each village is presented in Table 5.

Table 5. Farmer population fraction in Mojolaban

No	Village	Total Population	Total Farmers	% Farmer
1	Tegalmade	3364	158	0,05
2	Laban	5325	505	0,09
3	Wirun	7459	514	0,07
4	Bekonang	5890	244	0,04
5	Cangkol	6782	321	0,05
6	Klumprit	5261	428	0,08
7	Kragilan	4194	415	0,10
8	Sapen	5151	180	0,03
9	Triyagan	5989	167	0,03
10	Joho	7884	319	0,04
11	Demakan	4361	259	0,06
12	Dukuh	3919	254	0,06
13	Plumbon	6065	462	0,08
14	Gadingan	6711	534	0,08
15	Palur	16740	743	0,04

Source: Analysis Result, 2019

d. Agricultural Land (L)

Agricultural land is a field of land that is used for agricultural business. Agricultural land used to calculate population pressure is paddy fields and dry fields. The area of agricultural land in Mojolaban is presented in Table 6.

Table 6. Agricultural land in Mojolaban Sub District

No	Village	Rice Fields (Ha)	Dry Fields (Ha)
1	Tegalmade	141	0
2	Laban	146	0
3	Wirun	176	0
4	Bekonang	179	0
5	Cangkol	131	0
6	Klumprit	141	0
7	Kragilan	130	3
8	Sapen	142	2
9	Triyagan	74	0
10	Joho	234	0
11	Demakan	131	0
12	Dukuh	118	0
13	Plumbon	152	2
14	Gadingan	124	2
15	Palur	215	2
Jumlah		2234	11

Source: Analysis Result, 2019

2. Discussion

Population Pressure toward Agricultural Land

Population pressure toward agricultural land occurs due to the imbalance between life necessities by the desired standards and the availability of resources in the area. According to Soemarwoto (1985), population pressure toward land is a comparison between the number of residents and the minimum land area to live properly. This statement forms the basis line for calculating population pressure at the study site. Based on the calculated variables from previous discussion, the population pressures on agricultural land in most villages in Mojolaban was classified high with a TP value > 1. Some villages that possessed a TP value <1 means the population pressure on agricultural land is low. The detailed results of the calculation of population pressure in each village can be seen in Table 7.

Table 7. Population pressure on agricultural land in Mojolaban Sub District

No	Village	Z	f	P	R	L	TP	Category
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 Result, 2019

Based on Table 7, it is known that villages with low population pressure are Tegalmade, Bekonang, Sapen, and Joho while other villages such as Laban, Wirun, Cangkol, Klumpit, Kragilan, Triyagan, Demakan, Dukuh, Plumbon, Gadingan, and Palur are classified having high population pressure. The population pressure on agricultural land in each village is spatially presented in Figure 2.

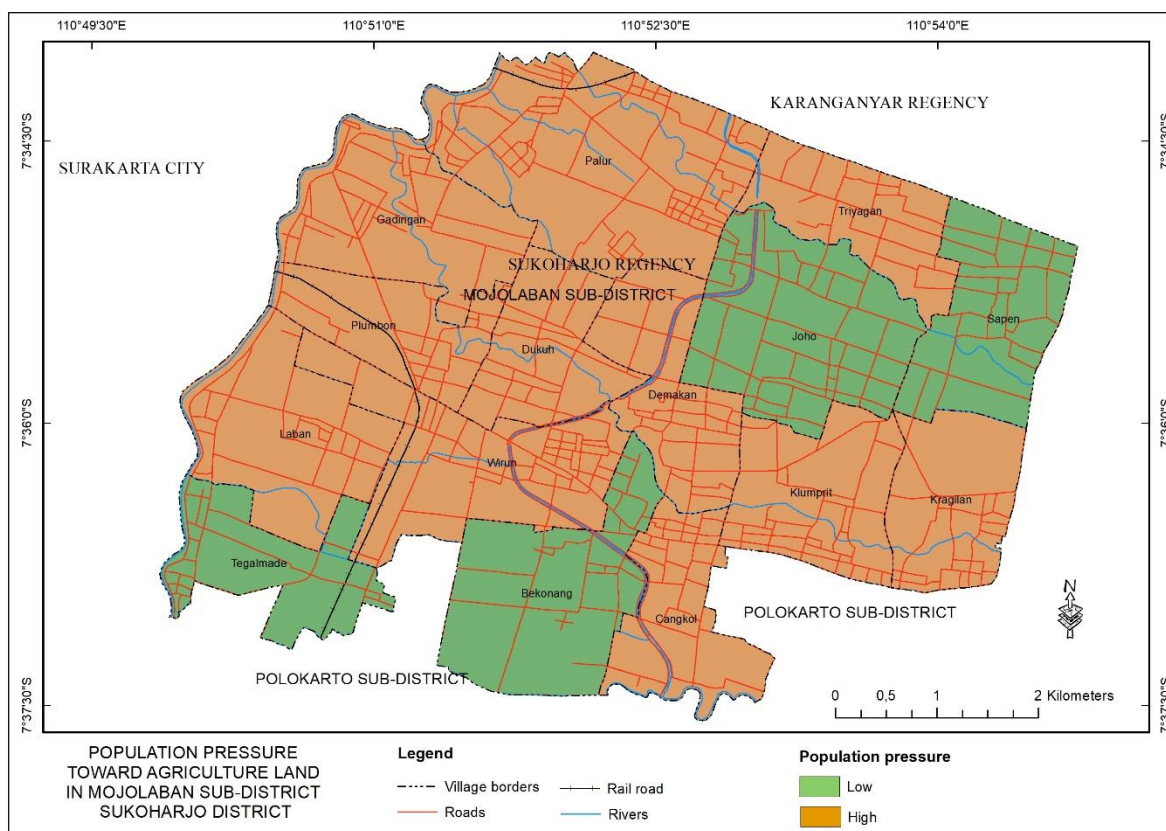


Figure 2. Population Pressure toward Agricultural Land in Mojolaban Sub-District

D. Conclusion

To conclude, the population pressure on agricultural land in Mojolaban was relatively high, based on the calculation of the number and the rate of population growth, the minimum standard for a decent living, the percentage of farmer population, and the total area of agricultural land that were calculated using the formula of Soemarwoto I model. It was found that there were 11 villages categorized as high pressure and 4 villages categorized as low pressure from the research. The high pressure of the population against agricultural land can threaten food security in the future. Therefore, an effort to prevent the land-use change from agricultural to built land is needed to respond to this issue.

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