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Magnitude and Spatial Distribution of Bioecological Carrying Capacity in Sleman Regency

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Abstract

The objectives of the research were (1) to analyze the value of the biocapacity and ecological footprint in Sleman Regency; (2) to measure and analyze the value and spatial distribution of bioecological carrying capacity in global hectare units (global hectare); and (3) formulating the direction of development and control of development based on the class of bioecological carrying capacity. The research was conducted using a quantitative approach through processing and analyzing secondary data from various sources. Secondary data that is processed is data at the village level. The determination of the bioecological carrying capacity is based on the calculation of the ecological footprint as a manifestation of the level of consumption that reflects the population's needs, and biocapacity which is the embodiment of the aspect of land use in providing resources. Based on the current conditions and land use composition, the Sleman Regency area only has a biocapacity value or can only support each resident with a land area of 0.20 hectares global/person. On the other hand, the value of the ecological footprint or the level of need reaches 0.279 global hectares/person. Thus, the bioecological carrying capacity in Sleman Regency has a value of 0.87 or a deficit of 0.078 hectares globally per capita. That shows that the Sleman Regency area has experienced an overpopulation with current productivity and land use. The low carrying capacity of bioecology in Sleman Regency is also reflected in the fact that most villages are classified as having low carrying capacity, reaching 68%. However, many villages still have a high bioecological carrying capacity (>1.2), especially in the northern and western parts of the Sleman Regency. The primary attention needs to be devoted to villages with a low bioecological carrying capacity, which is 58 villages. In these villages, the direction of development needs to be emphasized in controlling land use change and increasing productivity, limiting business scale, and controlling population growth rates.

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INTRODUCTION

Each region has a certain environment and resources to support the life of the population with all its activities. An area has a certain carrying capacity in accommodating the developments that occur. But on the other hand, developments in a region will continue to occur, both due to the influence of external factors and internal factors of the region. These developments have the potential to exceed their carrying capacity, resulting in the possibility of environmental and resource degradation. Therefore, in order to avoid degradation of the environment and resources, it is necessary to direct the development of an area in accordance with its carrying capacity. An assessment of the carrying capacity of an area is an important quantitative indicator to see the extent to which development can harmonize aspects of the natural environment with the needs of its inhabitants (Zhou et al., 2021; Zhu et al., 2022).

The carrying capacity of a region is not static, definite and simple, but dynamic and complex. Many factors influence the carrying capacity of the region. Environmental conditions, resource availability, social factors, economic factors, technological factors, culture, and policies are factors that influence carrying capacity (Kumar et al., 2006). The carrying capacity of an area depends on environmental conditions and the availability of resources. However, the carrying capacity is also determined by the economic and social structure of the community which greatly determines consumption patterns and resource (Wang et al., 2021).

Development planning practices that have been carried out so far have tended to pay less attention to the carrying capacity of the region, resulting in a decrease in the environmental capacity of the area concerned. Sugandhy (1994) indicated that regional carrying capacity variations have not been widely considered in land use planning. Therefore, there is often confusion in decision-making regarding priority areas and activities. This is understandable, bearing in mind that there is still a scarcity of information on regional carrying capacity including its spatial variations.

Implementation of development in an area requires efforts to be adjusted to its carrying capacity. This is urgently required to support sustainable development (Khanna et al., 1999). Regional carrying capacity analysis will greatly help to make it easier to formulate appropriate development policies and strategies by considering the diversity of conditions from every aspects of carrying capacity in each region (Rong & Bi, 2020). Regional development planning is constrained by the carrying capacity of the region, which refers to the maximum amount of resources that can support human needs and development activities. In order to improve the quality of life and bring about economic progress, it is necessary to use available resources to facilitate development. However, the ecological impact of development activities on the environment must be considered. It is crucial to take into account the environmental capacity to support development activities in order to avoid exceeding the region's assimilative capacity. This requires careful analysis of the impact of various development activities and a focus on data-driven decision-making to ensure that the most effective and sustainable development strategies are pursued. The balance between carrying capacity and assimilative capacity is a key component in the implementation of sustainable development strategies and serves as a determinant of sustainability (Du et al., 2022). Therefore, in regional development planning, it is necessary to base plans on the region's carrying capacity (Environmental Ministry, Government of India, 2006).

The study of regional carrying capacity involves many aspects, depending on the extent of the components and the scope of the region. One important aspect of this study is related to bioecological carrying capacity. Studying bioecological carrying capacity is crucial as it directly affects aspects of land use (Bayu et al., 2021). The balance between land use needs and available land is reflected in the magnitude of bioecological carrying capacity. The description of the magnitude of bioecological carrying capacity can be used as a basis for policy-making related to land use regulation and regional spatial planning.

Sleman Regency is one of the regions in the Special Region of Yogyakarta (DIY) that has a variety of natural and cultural landscapes. These variations have implications for differences in potential and socio-economic conditions of the community, which are reflected in the diverse land use practices. Such varied land use practices will certainly have an impact on the ecological carrying capacity. Therefore, the varying ecological carrying capacity conditions between different parts of the region will strongly influence the diversity of policy directions and development strategies in Sleman Regency.

The purpose of this research is to (1) analyze the magnitude of biocapacity and ecological footprint in Sleman Regency; (2) measure and analyze the magnitude and spatial distribution of bioecological carrying capacity in global hectares; and (3) formulate the direction of development and control of development based on the classification of bioecological carrying capacity.

METHOD

The research was conducted using a quantitative approach through processing and analyzing secondary data from various sources. The secondary data analyzed was at the village level. In addition, for land use data, which is one of the basic materials in determining bioecological carrying capacity, a land use map was used which was obtained from the interpretation of remote sensing imagery.

Bioecological carrying capacity is a description of the ecological land use condition to meet the needs of the population according to their consumption level. Determination of bioecological carrying capacity is based on the calculation of ecological footprint as a manifestation of consumption level that reflects the needs of the population and biocapacity, which is a manifestation of land use aspects in providing resources. The value of bioecological carrying capacity is calculated from the comparison between biocapacity and ecological footprint calculations. The calculation of ecological footprint, biocapacity, and bioecological carrying capacity uses global hectares per capita (gh/person) units while considering equivalent factors.

Ecological Footprint

In order to be able to determine the magnitude of the ecological footprint, which reflects the level of consumption of the population in accordance with the existing lifestyle, an approach to a decent standard of living equivalent to rice is used. The calculation also considers the equivalent factor, rice productivity, and the conversion value from rice to paddy. The following formula is used to determine the size of the ecological footprint.

$$JE = \left(\left(\frac{KL_b \times 1{,}58}{P_p}\right) \times EF_p\right) \quad (1)$$

Where :

JE = Per capita ecological footprint value (gh/person).

KL_b = Adequate living needs equivalent to rice (kg/per capita/year). Sajogja, (1996) measurement was used, namely for village areas = 320 kg/capita/year and cities = 480 kg/capita/year. Use of KL_b from Sayogyo based on that the value is close to the actual condition and there is a difference between KL_b of villagers and townspeople,

1,58 = conversion value from rice to paddy,

P_p = Productivity of rice (kg/ha/year),

EF_p = Agricultural equivalent factor (WWF, ZSL, & GFN 2006).

To determine the equivalent factors, which is a conversion factor from units of agricultural land use area to global hectare units, this study used the results of previous research by WWF, ZSL, & GFN, 2006 and Wackernagel, et al., 2005).

Biocapacity

Biocapacity is a picture of the ability of ecosystems to support the provision of resources in an area in accordance with the existing potential and limitations. In this study, biocapacity is assessed from the ability to produce a product which is calculated as the equivalent area of land for each type of land use. Calculation of biocapacity is based on the type of land use considering that each type of land use has the ability to produce different resources depending on its bioproductivity. The calculation of the biocapacity of an area is formulated as follows:

$$BK = \left(\frac{\sum_{i=1}^{k} 0{,}88 \times LPL_i}{P_d}\right) \times FP_i \times EF_i \quad (2)$$

Where :

BK = per capita Biocapacity (gh/person).

LPL_i = area of land use *i* (ha).

Pd = total population (people).

0,88 = Constant (12 % is used to ensure the sustainability of biodiversity (WCED, 1987; WWF, ZSL, & GFN, 2006; Harbel, et al., 2001; Wackernagel, 1997).

FP_i = Production factor *i*, is a factor that indicates the level of productivity of a particular land use compared to global productivity (Wackernagel, et al., 2005).

EF_i = certain land use equivalent factor (WWF, ZSL, & GFN, 2006 and Wackernagel, et al., 2005).

Bioecological Carrying Capacity

The amount of carrying capacity is obtained from a comparison between the magnitude of the per capita biocapacity value and the per capita ecological footprint of an area. Thus the magnitude of the carrying capacity is formulated as follows:

$$DD = \frac{BK}{JE} \qquad (3)$$

Where :
DD = bioecological carrying capacity
BK = per capita biocapacity (hg/person)
JE = Total ecological footprint value (hg/person)

RESULTS AND DISCUSSION

Sleman Regency area has various physical environmental characteristics. This can be seen from the relatively varied physiographic conditions (Kurniawan, A., & Sadali, M.I., 2015). Starting from the top of the volcano, the slopes of the volcano, to the alluvial plains. This physiographical diversity has an impact on aspects of land capability which in turn will also have an impact on the variation of land use in Sleman Regency. Various land uses have consequences for different biocapacity between parts of the region. Biocapacity is a measure of land capability aspects as reflected in land use in providing resources in accordance with the available potential. Biocapacity calculations are measured in global hectares. Global hectares are land units in hectares according to the average condition of global bioecological productivity.

From the results of data processing, in general Sleman Regency has a biocapacity of 0.20 global hectares per capita. The resulting biocapacity value shows that the available land resources are only able to support each resident with a land area of 0.20 gh/person. The bioactivity value is calculated based on the current composition of land use. The magnitude of the capability of land resources or biocapacity, based on the analysis, in the Sleman Regency area is lower than the previous research namely *Redefining Progress*, in 2005 which reached 0.55 gh/person. The amount of biocapacity is also lower than the results of Kurniawan's research (2013) in the Special Region of Yogyakarta (DIY), which reached 0.698 gh/person. In other words, the composition of land use in the Sleman Regency area is not optimal to support the existing population, especially the area of Sleman Regency which is very limited. Thus, efforts are urgently required to rearrange the existing pattern of land use and efforts are also needed to increase land productivity. This effort is urgently required to increase the biocapacity of the Sleman Regency area.

Among the villages in the Sleman Regency area, if a classification is made, 32 villages have a relatively low biocapacity (see Figure 1). These villages which have a low biocapacity are spread over several parts of the region, especially in the suburbs of Yogyakarta City and areas along the Yogyakarta – Semarang main road corridor (see Figure 2). In these areas, land use is dominated by built-up land as a result of urban urbanization and regional transformation along the main road corridor. The dominance of built-up land causes the biocapacity of villages in the region to be classified as low. The situation is different from several villages in the northern and western parts of Sleman Regency. In these two parts of the region, land use is still dominated by forests, mixed farms, and agricultural land, so the biocapacity is still relatively high. Overall, the number of villages that have high biocapacity is 25 villages. For the eastern part of the Sleman Regency, the conditions are varied more. Some villages have moderate biocapacity, especially in villages where agricultural land is still quite large, but in some other villages their biocapacity is already classified as low due to high rate of land use conversion.

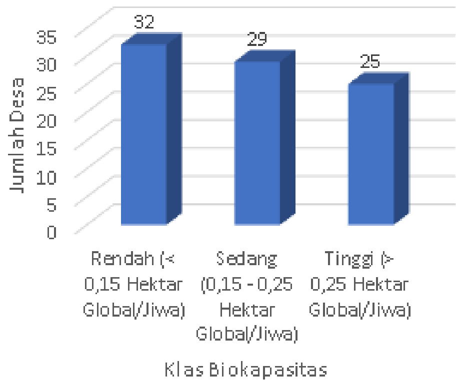

Figure 1. Graph of Biocapacity Classification in Sleman Regency

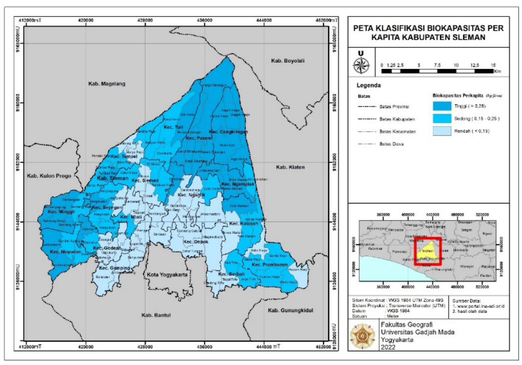

Figure 2. Per capita Biocapacity Classification Map in Sleman Regency

Furthermore, if we look at the average

biocapacity by sub-district, there are several sub-district areas that have relatively high biocapacity values compared to the average for other sub-districts. The district with the highest average biocapacity value is Cangkringan District, followed by Pakem District (see Figure 3). The two districts are the upstream or upper part of Sleman Regency. The green land cover in the upstream is still quite high and the use of the built-up land is limited because it functions as a recharge *area*. Thus, the biocapacity in Cangkringan and Pakem Districts is still quite high. On the other hand, the sub-districts of Depok, Gamping and Mlati are areas with relatively low average biocapacity. Depok District is an area directly adjacent to the City of Yogyakarta, resulting in a high conversion of land use into built-up land. This is also in line with the results of Nathaniel's research (2020) which states that the influence of urbanization has an impact on decreasing biocapacity. The high built-up area in Depok District causes the lowest biocapacity in the Sleman Regency area. Urban functions are also developing in the Mlati District area as a result of spatial urbanization in the Yogyakarta urban area so that the biocapacity is also low. Different conditions were found for the Gamping District area. In the Gamping district, the low biocapacity is more due to aspects of the physical environment which are indeed less supportive. The area of Gamping District which is dominated by karst hills causes its land capability to be classified as low so that its biocapacity is also low.

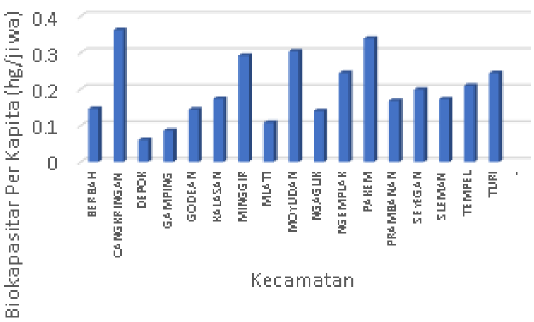

Figure 3. Graph of Per Capita Biocapacity Value by District in Sleman Regency

Additional considerations in order to be able to calculate the carrying capacity of bio-ecology is related to the value of the ecological footprint. The ecological footprint is used to calculate the need for land area to ensure the continuity of the fulfillment of human consumption which is then used as the basis for limiting and regulating the use of resources and the environment (Bicknell, et al., 1998). In connection with the conditions in the Sleman Regency area, the calculation results show the ecological footprint value of 0.279 gh/person. This figure shows that in the Sleman Regency area, the needs of every resident to be able to achieve a decent life require land with an area of 0.279 hectares globally. The amount of land needed per capita in the Sleman Regency area is adjusted to the needs of a decent life equivalent to rice according to Sajogja, (1996). The land unit as the basis for calculating the ecological footprint is adjusted to the land use needed to meet the consumption of each resident in the Sleman Regency area. The results of calculating the value of the ecological footprint in Sleman Regency, which reached 0.279 gh/person, are in accordance with the range of research results (Wackernagel, et al., 2005). On the other hand, the value of the ecological footprint of Sleman Regency is still higher than the value of the ecological footprint for fulfilling a simple life on Java Island as a result of research by Bappenas in 2005 and Rusli, et al., in 2009.

In further classification, out of the villages in the Sleman Regency area, as many as 25 villages have a high ecological footprint value (see Figure 4). The villages that have a high ecological footprint value are scattered in several parts of the Sleman Regency, especially in parts of the Gamping and Prambanan Districts (see Figure 5). The high value of the ecological footprint in the two districts is due to being able to meet the needs of the population requires relatively large land due to low land productivity due to physical environmental constraints. In addition, the high value of the ecological footprint is also caused by less-optimal land use which can be found in several villages such as in the Districts of Cangkringan, Turi, Tempel, and Sleman. On the other hand, there are quite a number of villages that have a relatively low ecological footprint, spread over many districts. The low value of the ecological footprint or per capita land area requirement in many villages is due to the relatively high land productivity in parts of Sleman Regency.

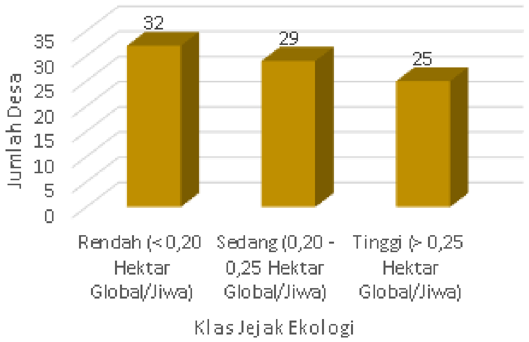

Figure 4. Graph of Ecological Footprint Classification in Sleman Regency

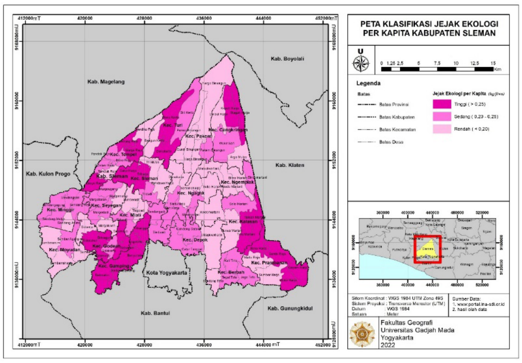

Figure 5. Ecological Footprint Classification Map in Sleman Regency

In terms of distribution by district, there are two district areas where the average ecological footprint value is relatively low. Which means, to be able to meet the needs of the population, a narrower land area is needed because the land has high productivity. Two districts that have a low average ecological footprint are Pakem and Ngemplak districts (see Figure 6). In these two areas there is still a lot of irrigated agricultural land with quite high productivity, so that the need for per capita land area to be able to live properly does not require large areas of land. It is different for the Gamping and Prambanan districts where some of the land has low productivity, so that more land area is needed to be able to live decently. For other districts, the average ecological footprint value varies between 0.21 – 0.32 gh/person.

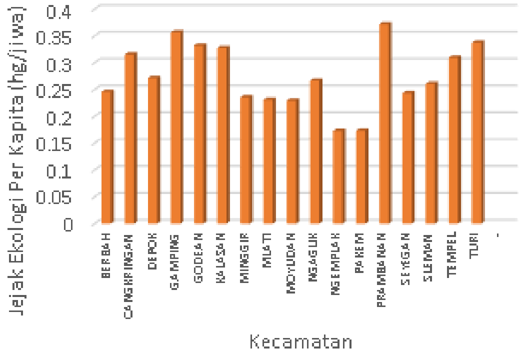

Figure 6. Graph of Per Capita Ecological Footprint Value by District in Sleman Regency

An area has the ability to produce products with limited resources to meet the needs of life without damaging the environment and maintaining ecological conditions (Catanese, J.A. and Snyder, 1989). This capability is reflected in the large carrying capacity of the region. An area has the ability to produce products with limited resources to meet the needs of life without damaging the environment and maintaining ecological conditions (Catanese, J.A. and Snyder, 1989). This capability is reflected in the large carrying capacity of the region.In this research, the calculation of the carrying capacity of the area is carried out by measuring the amount of bioecological carrying capacity. Biecological carrying capacity is an illustration of the ability of an area ecologically to be able to meet the needs of its inhabitants. The determination of the carrying capacity of biecology is based on the calculation of the ecological footprint as a manifestation of the level of consumption that reflects the needs of the population for a decent life and biocapacity which is an embodiment of the aspect of ecological capability in providing resources in accordance with the existing potential and limitations. The calculation of the carrying capacity of biecology is based on the potential and needs of land resources which are reflected in land use and are measured in global hectare units . Global hectares are land units in hectares according to the average condition of global biecological productivity. Thus, in principle the carrying capacity of biecology is also a reflection of the carrying capacity of land resources.

Based on the analysis of bioecological carrying capacity in Sleman Regency, in general it has a value of 0.87. This value is below one, meaning that the ecological footprint that reflects the magnitude of demand in Sleman Regency is higher than the available biocapacity. In other words, in the Sleman Regency area it has experienced *over population* from the current productivity and land use. This condition needs more attention so that in the future it does not cause a greater negative impact on the environment, especially due to the large population pressure. Efforts that can be made are controlling population growth and increasing land productivity as well as making efficient use of resources, especially land resources.

The low carrying capacity of bioecology in Sleman Regency is also reflected in the fact that most of the existing villages are classified as having a low carrying capacity, reaching 68% (see Figure 7). The distribution of villages that have low bioecological carrying capacity is spread mainly in the southern and eastern parts, which are areas bordering Yogyakarta City and Bantul Regency (see Figure 8). In these villages the low bioecological carrying capacity is due to the large conversion of land into built-up land and the relatively high population growth. In addition to these locations, the carrying capacity of the villages along the Yogyakarta-Semarang road corridor and along the Yogyakarta-Solo road corridor is also low. The regional transformation along the road corridor also causes a decrease in the bioecological carrying capacity. Low bioecological carrying capacity is also found in several villages in the northern and western parts of Sleman Regency. Even though the land is relatively fertile, land use in some of these villages is still not optimal so that their biocapacity is still low. However, because some villages have relatively high land capability and the population is not as large as other areas, there are still quite a number of villages that have a high bioecological carrying capacity (>1.2), especially in the northern and western parts of Sleman Regency. Spatial variations in carrying capacity in Sleman Regency are in line with the results of a study by Zhou et al., (2021) in China which showed variations by region, where in some provinces the carrying capacity was still quite good, but in some other provinces it showed poor conditions. By looking at these conditions, it is important to calculate the relative carrying capacity of an area as a basis for spatial evaluation of development. A more complete composition of the bioecological carrying capacity classes in Sleman Regency can be seen in Figure 7.

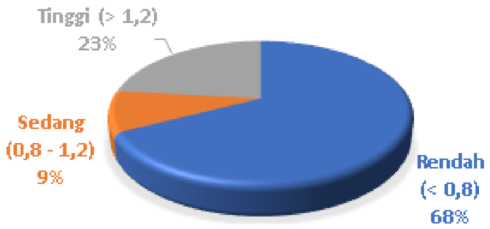

Figure 7. Graph of Bioecological Carrying Capacity Class Composition in Sleman Regency

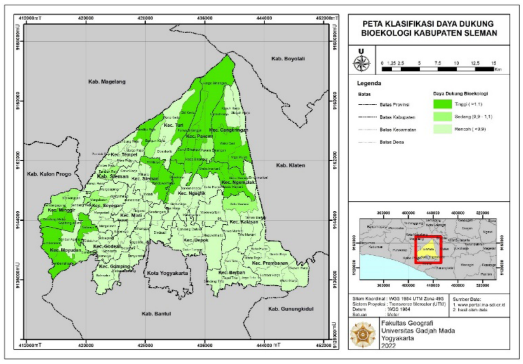

Figure 8. Classification Map of Bioecological Carrying Capacity in Sleman Regency

In a distribution comparison between the average ecological footprint and biocapacity values by sub-district, it can be seen that there is quite a large variation. Several districts such as Depok, Gamping, Godean, Kalasan, Mlati, and Prambanan have ecological footprint values that far exceed their biocapacity values (Figure 9). Thus in these districts the value of carrying capacity is low. For the Depok and Mlati districts, the low bioecological carrying capacity is caused by the location factor that is close to the Yogyakarta Urban Area, while for the Gamping and Prambanan districts it is caused by limited land capability. Unlike the case with Godean and Kalasan Districts, the low bioecological carrying capacity is caused by land use that is still less than optimal, in addition to population growth which is starting to be high.

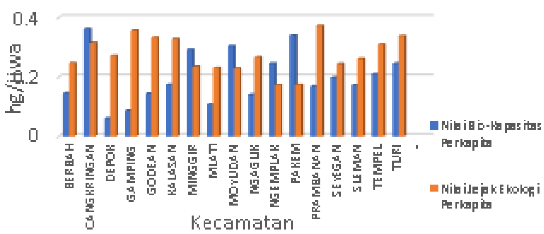

Figure 9. Graph of Biocapacity Value and Ecological Footprint by District in Sleman Regency

In the Sleman Regency area there are several districts with high average value of bioecological carrying capacity. There are five districts with high carrying capacity including Pakem, Ngemplak, Moyudan, Minggir, and Cangkringan (see Figure 10). The highest bioecological carrying capacity value was Pakem district which reached 2.19. The high carrying capacity in Pakem district is supported by a high biocapacity reaching 0.34 gh/person, while the ecological footprint is low at only 0.173 gh/person. High land productivity but not very high population density makes the bioecological carrying capacity in Pakem District one of the highest. Almost the same condition also occurred in Ngemplak District. However, for Cangkringan District, the conditions are somewhat different. Although the biocapacity is the highest, reaching 0.36 gh/person, the ecological footprint is also high, reaching 0.32 gh/person. This happened because part of the land in Cangkringan District had low productivity due to the impact of the eruption of Mount Merapi, which mostly led to the Cangkringan area.

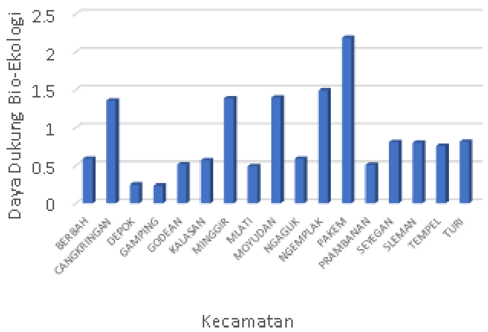

Figure 10. Graph of Bioecological Carrying Capacity Value by District in Sleman Regency

It is possible to determine whether there is a deficit or surplus in global hectares per capita based on the calculation of biocapacity and ecological footprint. In general, conditions in Sleman Regency experienced a deficit in land units of 0.079 hectares globally. This condition illustrates that the current land use is still unable to meet the needs of the entire population in Sleman Regency.

Table 1. Per Capita Deficit/Surplus in Global Hectares (gh/person) According to the District in Sleman Regency

Districts	Per Capita Biocapacity (gh/person)	Per capita ecological footprint (gh/person)	Per Capita Deficit/ surplus (gh/person)
BERBAH	0,146	0,246	-0,100
CANGKRINGAN	0,362	0,315	0,047
DEPOK	0,061	0,272	-0,211
GAMPING	0,086	0,357	-0,270
GODEAN	0,144	0,332	-0,188
KALASAN	0,174	0,327	-0,154
MINGGIR	0,292	0,236	0,056
MLATI	0,109	0,231	-0,122
MOYUDAN	0,304	0,230	0,074
NGAGLIK	0,140	0,267	-0,127
NGEMPLAK	0,245	0,173	0,072
PAKEM	0,339	0,173	0,166
PRAMBANAN	0,168	0,372	-0,204
SEYEGAN	0,198	0,243	-0,045
SLEMAN	0,173	0,261	-0,088
TEMPEL	0,209	0,310	-0,100
TURI	0,244	0,338	-0,093
Kab. Sleman	0,200	0,279	-0,079

Source: Data Analysis, 2022

The composition of land use and the level of land productivity is still not optimal to support the fulfillment of needs. However, the value of this deficit is still lower than the condition of Indonesia as a whole, which reached deficit of 0.5 hectares per capita (Global Footprint Network, 2022). If examined in the scope of the district area, there are five districts whose conditions are still surplus (see Table 1). Pakem district is the area that has the highest surplus condition, reaching 0.166 global hectares per capita. Land use in the Pakem district area which is dominated by agricultural, farm and forest uses has resulted in a high biocapacity, while the population is still not as dense as urban areas. On the other hand, the sub-districts of Gamping and Depok are the districts with the highest deficit, reaching more than 0.2 hectares per capita globally. For the Gamping District, the deficit condition is more due to the unfavorable condition of land resources so that the biocapacity is relatively low. For Depok District, the deficit condition is caused more by the high population and domination by built-up land use because it is indeed an urban area.

Assimilation with natural carrying capacity condition is required for directing the development strategy to pursue the sustainable development (Zhou et al., 2021; Du et al., 2022). To determine development directions and development control as presented in Table 2, calculation results of the bioecological carrying capacity in Sleman Regency can be used as the basis. The development strategy and control needs to refer to the results of the classification and distribution of bioecological carrying capacity locations. The main attention needs to be devoted to villages that have low bioecological carrying capacity, namely 58 villages. In these villages the development di-

Table 2. Directions for Development and Control Based on Bioecological Carrying Capacity Classes in Sleman Regency

Bioecological Carrying Capacity Class	Number of Villages	Directions for Development and Control
Low	58 Villages	1. It is necessary to rearrange land use patterns to make them more productive 2. The use of natural resources needs to be monitored very closely, because of the great population pressure. 3. Control over land conversion needs to be tightened, especially for built-up land conversion. 4. Small or limited business scale. 5. Business restrictions need to be made to prevent environmental damage and ecosystem disturbance. 6. Business diversification, especially in activities that are not only dependent on natural resources. 7. Need efforts to have land and resources rehabilitation. 8. It is necessary to limit the number of arrivals and develop an out-migration program.
Medium	8 villages	1. Utilization of land resources is directed through increased productivity. 2. Population pressure is driving the excessive use of natural resources, so it is necessary to control certain business activities. 3. The development of business activities needs to be linked to conservation and rehabilitation efforts. 4. Increasing the productivity of leading sectors. 5. Controlling the rate of population growth.
High	20 Villages	1. Business development through increased production and productivity. 2. Utilization of appropriate technology. 3. Increase in business scale (medium and large business scale). 4. Efforts of production added value. 5. It can still accommodate or support a certain number of residents.

rections need to emphasize the aspects of controlling land conversion and increasing productivity as well as limiting business scale. This includes efforts to control the rate of population growth. These efforts need to be made so that development in villages that are classified as having low carrying capacity does not cause further negative impacts. Conservation and rehabilitation efforts are very important in villages whose carrying capacity is classified as low. For villages that have moderate bioecological carrying capacity, it is also necessary to limit activities and business scale. Efforts to diversify activities need to be carried out so that environmental pressure can be reduced. This is different from villages where the bioecological carrying capacity is still relatively high. In these villages, efforts to increase production can be carried out through developing business scale and increasing productivity through the use of appropriate technology.

CONCLUSION

Based on the current conditions and composition of land use, the Sleman Regency area is only able to support each resident with a land area of 0.20 gh/person. However, there are variations in biocapacity classes by village in Sleman Regency. The villages that have low biocapacity are scattered in several parts of the area, especially in the suburbs of Yogyakarta City and areas along the main road corridors. The situation is different from several villages in the northern and western parts of Sleman Regency which have a higher biocapacity. On the other hand, the results of the calculation of the ecological footprint value in Sleman Regency reached 0.279 gh/person.

From the results of the calculation of the bioecological carrying capacity in Sleman Regency, in general it has a value of 0.87. This value is below one, meaning that the ecological footprint that reflects the magnitude of demand in Sleman Regency is higher than the available biocapacity, or experiencing a deficit of 0.07 hectares per capita globally. In other words, in the Sleman Regency area it has experienced over *population* current productivity and land use. The low carrying capacity of bioecology in Sleman Regency is also reflected in the fact that most of the existing villages are classified as having low carrying capacity, reaching 68%, which are spread mainly in the southern and eastern parts which are areas bordering Yogyakarta City and Bantul Regency.

More attention needs to be devoted to villages that have low bioecological carrying capacity, namely 58 villages. In these villages the development directions need to emphasize the aspects of controlling land conversion and increasing productivity as well as limiting business scale. This includes efforts to control the rate of population growth.

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